Mitigate+: Research for Low-Emission Food Systems

Working paper

Review of Nationally Determined Contributions (NDC) of Kenya from the Perspective of Food Systems

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Abbrebriation

ASAL	Arid and Semi-Arid Lands
AFOLU	Agriculture, Forestry and other Land Use
ATAR	Adaptation Technical Analysis Report
BAU	Business as Usual
CCUs	Climate Change Units
CO_2	Carbon dioxide
CH_4	Methane
CSA	Climate-Smart Agriculture
CIDP	County Integrated Development Plans
EVs	Electric vehicles
EWS	Early Warning Systems
GCF	Green Climate Fund
GHG	Greenhouse Gas
ICTU	Information, Clarity, Transparency and Understanding
IPCC	Intergovernmental Panel on Climate Change
JCM	Joint Crediting Mechanism
LULUCF	Land Use, Land-use Change, and Forestry
MoALF	Ministry of Agriculture Livestock and Fisheries
MRV	Monitoring, Reporting, and Verification
MTAR	Mitigation Technical Analysis Report
NDC	National Determined Contributions
NCCAP	National Climate Change Action Plans
$MtCO_2e$	Metric tons of carbon dioxide equivalent
NAMA	Nationally Appropriate Mitigation Action
NIR	National Inventory Report
NBS	Nature-Based Solutions
NEMA	National Environment Management Authority
N_2O	Nitrous oxide
REDD	Reducing Emission From Deforestation and Degradation

Summary

Context:

Agriculture is one of the fundamental pillars of the 2022–2027 Bottom-up Economic Transformation Plan of the Government of Kenya for tackling complex domestic and global challenges. Kenya's food system is crucial for climate change mitigation and adaptation. Kenya has prioritized aspects of agriculture, food, and land use as critical sectors for reducing emissions towards achieving Vision 2030's transformation to a low-carbon, climate-resilient development pathway.

Kenya's updated NDC, as well as supporting mitigation and adaptation technical analysis reports and other policy documents, has identified an ambitious set of agroecological transformative measures to promote climate-smart agriculture, regenerative approaches, and nature-positive solutions. Kenya is committed to implementing and updating its National Climate Change Action Plans (NCCAPs) to present and achieve the greenhouse gas (GHG) emission reduction targets and resilience outcomes that it has identified.

Mitigation ambitions and targets:

On December 24, 2020, the Kenyan government formally submitted its updated NDC that describes Kenya's contribution to mitigation and adaptation from 2020 to 2030 and proposes priority mitigation and adaptation actions. Kenya has made a strong commitment to reducing economy-wide emissions (including from Land Use, Land-use Change, and Forestry (LULUCF) by 2030 by 32% relative to the BAU scenario of 143 $MtCO_2$ eq, with 21% of the mitigation cost not contingent on international financial support. Kenya has committed to reducing total GHG emissions (conditionally and unconditionally) by 45.76 MtCO2e by 2030, from an estimated 85.79 $MtCO_2e$ technical GHG emission reduction potential baseline. The updated NDC does not mention sectoral contributions that have increased by 2% from 30% in the 2015 INDC to 32% in the updated NDC.

Kenya's total greenhouse gas emissions (CO_2, CH_4, N2O, and HFCs) will increase to 143 MtCO2e by 2030 from 56 $MtCO_2e$ in 2000 as the country pursues the Vision 2030 development agenda. The baseline GHG emission projections for 2030 for the seven sectors are as follows: electricity generation (29%), agriculture (27%), forestry (15%), transportation (15%), energy demand (7%), industrial processes (4%), and waste (3%).

In the agriculture, food, and land-use sectors, Kenya estimated a rise of 41% in total emissions from the baseline year 2000 to 2030 (i.e., from 23 $MtCO_2e$ to 39 $MtCO_2e$) mainly driven by i) livestock enteric fermentation (18.8 $MtCO_2e$); ii) agriculture soils (16.2 $MtCO_2e$); iii) savanna burning (2 MtCO2e); iv) livestock manure management (1.1 $MtCO_2e$); v) rice cultivation (0.4 MtCO2e) and vi) burning of crop residues (0.2 $MtCO_2e$).

The agriculture sector only contributes about 7% of the GHG emission reduction ambitions set in Kenya's NDC and about 50 % (2.27 $MtCO_2e$ out of 5.53 $MtCO_2e$) of the estimated technical emission reduction potential by 2030. The NDC establishes quantitative targets in key activities for the agriculture sector which include i) ***Agroforestry,*** with an emission reduction potential of 1.66 $MtCO_2e$; ii) ***Sustainable land management***, with an emission reduction potential of 0.55 $MtCO_2e$; iii) ***Dairy Nationally Appropriate Mitigation Action (NAMA*****),** with an emission reduction potential of 0.40 MtCO2e; and iv) ***Manure management*** (biogas technology for cooking and agro-processing), with an emission reduction potential of 2 $MtCO_2e$; The qualitative emission reduction targets considered for mitigation in the agriculture sector are i) increasing the deep/offshore fishing fleet; ii) increasing the number of farmers using low-carbon (recirculating) aquaculture systems; and iii) increasing the rice-production area using efficient production technology. In the land use and forestry sector, the NDC establishes some specific and measurable nature-based solutions for emission removal solutions for LULUCF. These are i) restoration of forests on degraded land leading to the abatement of 32.5 $MtCO_2e$ by 2030; ii) reforestation of degraded forests leading to the abatement of 6.1 $MtCO_2e$ by 2030; iii) reducing deforestation and forest degradation with an abatement of 1.6 $MtCO_2e$ by 2030.

Summary Table: Key gaps in ambitions for the food system in Kenya

Agriculture, food, and land use prioritized mitigation actions	**Emission Reduction NDC Quantified targets by 2030. ($MtCO_2eq$) (A)**	**Emission Reduction Potential by 2030 ($MtCO_2eq$) (B)**	**Emission Gaps By 2030 ($MtCO_2eq$) C = (B-A)**	**% Of Ambition Gaps D= (C/B) x 100**
Overall NDC target	45.76	143	97.24	68%
Overall agriculture sector	2.77	39	36.23	93%
Agroforestry	3.17	4.16	0.99	24%
Conservation tillage	0.77	1.09	0.32	29%
Limiting the use of fire in rangeland and cropland	N/A	0.29	N/A	N/A
Dairy NAMA to reduce livestock Enteric fermentation	0.69	18.8	18.11	96%
Overcapacity of artisanal fishing vessels	N/A	N/A	N/A	NA
Aquaculture production	N/A	N/A	N/A	NA
Rice production	N/A	N/A	N/A	NA
REDD+ Reducing emissions from deforestation and forest degradation in developing countries.initiatives - abatement	2	22.1	1.3	6%
Afforestation/reforestation and agroforestry abatement	4.8			
Restoration of degraded landscapes - abatement	13			
Private sector plantations - abatement	1			

Adaptation and Loss and Damage targets:

Kenya has emphasized adaptation as the highest priority in its updated NDC to prevent further losses and damage. The key agriculture sector adaptation activities identified in the updated NDC include i) mainstreaming climate-smart agriculture (CSA) toward increased productivity through a value-chain approach, to support the transformation of agriculture (crops, livestock, and fisheries) into an innovative, commercially oriented, competitive, and modern sector; ii) building the resilience of agriculture systems (crops, livestock, and fisheries) through the sustainable management of land, soil, water, and other natural resources, as well as insurance and other safety nets; iii) strengthening communication systems on CSA extension and agro-weather issues.

Scientific basis and data used in identifying targets:

Kenya's NDC is supported by scientific analyses and accounting methodologies, and the NCCAP 2018–2022 technical analysis reports have been cited. The NDC analysis has been updated using the Mitigation Technical Analysis Report (MTAR), the Adaptation Technical

Analysis Report (ATAR), and the Third National Inventory Report (NIR 3). The updated NDC was based on an assessment of the extent and impact of the NDC's implementation to date and an extended inventory of historical GHG emissions up to June 2020 using the best available data from various official sources and reports. Tier 1 quantification of uncertainties associated with estimates was used in the Second National Communication GHG inventory.

Adequacy of the target from the perspective of the food system

Kenya's updated NDC, submitted in December 2020, slightly increased its target for 2030. Whereas the previous NDC set a target of reducing BAU emissions by 30% by 2030 and was entirely dependent on international support, Kenya now commits to reducing BAU emissions by 32% by 2030, with a portion of this new target not contingent on financial support. While the introduction of an unconditional target is encouraging, Kenya still has a lot of room to improve its target.

The NDC target in the agriculture sector commits to reducing only 2.77 MtCO_2e, leaving a wide gap of 93% (36.23 MtCO_2e) in the mitigation ambitions for total projected emissions by 2030 and about 50% in the technical mitigation potential estimated by 2030. Similarly, forestry and land-use change information is kept within the forestry sector, and Kenya commits to reducing about 20.8 MtCO_2e (out of 22.1 MtCO_2e), leaving a narrow gap of 6% in the mitigation ambitions for total projected emissions by 2030 (Table 1).

On adaptation, the NDC targets provide specific indications of policy actions to address risk and vulnerability in the agriculture sector and food system, as well as information on policies, spatial information, and technology development, and the need to make progress against these actions and implement the NDC.

Feasibility of achieving the target

The actual mitigation potential of each of the food sectors depends on a number of factors, ranging from policy, resources, and priorities to the practicality of implementing the potential mitigation actions. A sum of about US$ 502.55 million is estimated as necessary to support implementation of climate action in the current three priority food systems — agroforestry, smart agriculture, and Dairy NAMA — including the enabling actions presented in the updated NDC.

All the food sector-related mitigation actions together have an abatement potential of 5.56 MtCO_2e by 2030, compared with the sector's target of reducing 3 MtCO_2e by 2030. The indicative proportionate emission reduction target contribution for the agriculture sector by 2030 is 2.77 MtCO_2e with a high and low range of 2.8 and 1.6 MtCO_2e, respectively. However, this does not necessarily have to be delivered by the sector since the actual sector GHG emission reduction will be based on the realistic opportunities available for emission reductions in the sector together with the sector plans and budget provisions.

Data gaps in the NDC

The available information in the overall food-system sector is viewed largely from the perspective of sensitivity to the risks, impacts, and vulnerabilities caused by climate change. Emissions from the different subsectors of the national food system, particularly from food production, consumption, storage and transportation, and food loss and waste are poorly quantified and understood in the updated NDC, suggesting that the use of data collection relating to activities should be improved in the future to analyze the sources of emissions when updating the next NDC. Adopting the Tier 2 advanced accounting method with a data-management system to prepare agriculture, food systems, and land use in the future update of the national GHG inventory is a key step to increasing coherence in GHG reporting and mitigation efforts.

Data on sectoral contributions are not specified in the updated NDC or other associated documents, posing difficulties in analyzing the sectoral contributions of about 2.85 $MtCO_2e$ by 2030. Detailed data and analysis of GHG emission trends and mitigation potential in the food production, consumption, storage and transportation, and food loss subsectors were excluded in the NDC and associated documents.

Areas for improvement

To achieve the NDC target, Kenya must implement policies, programs, and technologies that encourage reductions in emissions and drive the country to a low-carbon development pathway. Kenya has enormous potential to raise its agricultural ambitions, particularly in rice cultivation and livestock management. Similarly, other subsectors of food systems, such as consumption, transportation, and food loss and waste, have the potential to reduce GHG emissions and transition to a more resilient system. The key recommendations are as follows:

Specific Recommendations

- **Raise ambitions in the agriculture sector:** In the agriculture sector, out of 39 $MtCO_2e$ projected emissions, the current NDC targets are only set for a 2.77 $MtCO_2e$ emission reduction by 2030. This indicates a massive potential for increasing ambitions in the agriculture sector. The agroforestry, sustainable land management, and livestock climate actions proposed are projected to reduce emissions by about 5.17 $MtCO_2e$ by 2030. This aligns closely with the technical mitigation potential identified. However, efforts should be made to understand the technology and measures needed to enhance mitigation solutions in the agriculture sector, including the integration of complete food systems to raise ambitions with feasible quantifiable emission reduction targets. In addition, the NDC targets should include interventions to reduce emissions from cropland and rangeland fires, which have an identified mitigation potential, as well as emissions from rice cultivation.

- **Raise ambitions in the livestock sector:** Reducing livestock enteric methane has remained a key priority of Kenya. However, the emission reduction projection from Dairy NAMA is estimated at only 0.69 $MtCO_2e$ by 2030, suggesting a large gap in the implementation of the emission reduction program as well as in the agriculture baseline GHG emissions that are largely driven by livestock methane emissions (18.8 $MtCO_2e$ by 2030). These gaps need to be addressed by further reaching out to dairy households with interventions to reduce the intensity of emissions. Kenya should enhance its capacity for identifying methane mitigation actions that align with the Sustainable Development Goals (SDGs), and integrate methane quantification and mitigation into existing and planned livestock subsector strategies, investments, and policies.

- **Raise ambitions in agroforestry and land use:** The Agriculture, Forestry, and Other Land Use (AFOLU) sector contributes a 61.72% relative share of national GHG emissions **(FOLU,** 2022). Although there are no concrete and separate priority actions indicated for AFOLU, the NDC indicates the prioritization of nature-based solutions related to REDD+ (Reducing Emissions from Deforestation and Forest Degradation in Developing Countries), agroforestry, conservation, restoration, and reforestation of degraded land. The current ambitions for these activities have limited gaps — NDC targets of 20.8 $MtCO_2e$ of out of 22.1 $MtCO_2e$ of projected emission reduction potential. The NDC has incomplete or generic information on land-use planning. The second national communication indicated a baseline emission reduction projection of about 2.9 $MtCO_2e$ for cropland by 2030.

Therefore, the priority actions of the AFOLU sector should be set in an integrated manner for the projection and accounting of GHG emission reduction.

- **Raise ambitions in aquaculture:** Sustainable fishing and aquaculture have the potential to deliver an increased supply of ocean proteins, reducing the demand for land and supporting healthier and more diverse diets (FOLU, 2022). The NDC and associated documents have set policy priorities for sustainable aquaculture farming in Kenya mainly by increasing the number of farmers using low-carbon (recirculating) aquaculture systems and increasing deep/offshore fishing fleets. However, there is a need to make a reasonable estimate of mitigation potential at the national scale. This includes the enhancement and strengthening of the governance of community structures in participatory resource management in coastal ecosystems; conducting a blue carbon-readiness assessment for the full integration of blue carbon/ocean climate actions into NDCs; developing marine spatial planning; and outlining sustainable management approaches (Global Alliance for the Future of Food, 2022).

- **Integrate a holistic food system perspective to account for the adaptation and mitigation elements of a sustainable agriculture system:** There is emerging literature about understanding the risk and vulnerability of the food system with varied levels of information on distribution, food processing, transportation, marketing and consumption, and food loss and waste. Kenya's NDC emission reduction is targeted towards the agriculture production system; there is a critical need to account for emission reduction potential throughout the food system by integrating data and information to set quantified mitigation targets throughout the system from production to consumption. To build the resilience of the food system, further emphasis needs to be placed on improving food storage infrastructure, food transportation and distribution, and the efficiency and sustainability of food processing, to reduce post-harvest food loss and waste and to increase access for poor and marginalized communities to climate-smart agriculture production and to more control over resources, finance, infrastructure, and technology.

  Promote climate-smart agriculture practices: Kenya has taken forward CSA as a transformative tool to build a nexus between climate change and agriculture. There are opportunities to promote crop varieties, livestock, fish breeds, and tree species that are adapted to varied weather conditions and can tolerate associated emerging pests and diseases. Some crops, such as banana, cassava, sorghum, sweet potato, pearl millet, groundnut, and finger millet, are expected to experience more favorable growing conditions as a result of climate change.

- **Enhance Monitoring, Reporting and Verification (MRV) system with harmonized GHG accounting methods to integrate the food system:** Given the disparity between the Tier 1 method used in Kenya's inventory and the Tier 2 method used in the MRV of Dairy NAMA, adopting the Tier 2 method in the national GHG inventory is a key step to increasing coherence in GHG reporting and mitigation efforts. This will allow project-level initiatives to link with national MRV systems and track mitigation trends both in terms of absolute emissions and emission-intensity reductions. To realize this, support is needed to increase institutional capacity to manage the GHG inventory compilation process, as well as to create a data management system that facilitates the preparation of a livestock GHG inventory based on advanced accounting methods[i].

Chapter One: Aspects of food included in Kenya's NDC targets

1.1. Context

Agriculture is one of the fundamental pillars of the 2022-2027 Bottom-up Economic Transformation Plan of the Government of Kenya to tackle complex domestic and global challenges. Agriculture is a vital part of Kenya's economy, making up 22.4% of its GDP (KNBS, 2022) in 2021 and employing 33% of the population in 2021[ii]. Over 84% of Kenya's land area is arid and semi-arid, with poor infrastructure and other developmental challenges, leaving less than 16% of the land area to support over 80% of the population[iii].

In the last three decades, Kenya has made significant progress in modernizing and transforming its agriculture sector into an innovative, commercially oriented, and competitive sector (MoALF, 2020). However, the agriculture sector is yet to realize its full production potential to achieve positive food security, nourishment, and health outcomes in Kenya, due to climate-related shocks such as drought, floods, and pests and diseases. A recent food security and nutrition status report estimated that about 3.1 million people (20% of the population in Kenya's pastoral and Arid and Semi-Arid Lands (ASALs)) were classified as above acute food insecurity and acute malnutrition resulting from multiple shocks, including dry spells (poor seasonal rainfall), below-average crop and livestock production, and insecurity resulting from local resource-based conflicts and post COVID-19 pandemic effects that drove a price hike in staple foods[iv]. Kenya's low technological capability, inefficient production systems, inconsistent economic growth, increasing population, and climate variability is affecting food production systems and therefore the livelihoods and food security of millions of Kenyans who depend on agriculture (Lokuruka, 2020). Kenya is dealing with the double burden[v] of malnutrition, with some of the population considered overweight while others, predominantly children, suffer from undernourishment, micronutrient deficiencies, or stunted growth.

At the same time, the agriculture sector is the major emitter of greenhouse gases (GHG) and is responsible for up to 22,539 Gg CO2 eq, which is 40.9 percent of the total country's GHG emissions[vi]. While the agriculture sector has supported food production yet contributed to increasing net GHG emissions, the Intergovernmental Panel on Climate Change (IPCC) Special Report on Climate Change and Land emphasized the contribution of the food system to climate-change mitigation and recognized practices such as reducing crop and livestock emissions, sequestering carbon in soils and biomass, consuming healthy and sustainable diets and reducing food loss and waste as major opportunities for reducing GHG emissions while also improving health outcomes (IPCC, 2019).

The guidance and framework have been developed to enhance the Nationally Determined Contributions (NDCs) by integrating the food system approach to building climate resilience and diversifying context-specific mitigation solutions for food production, distribution, consumption, and waste (Global Alliance for the Future of Food[vii], 2022; WWF[viii], 2020). In this regard, the review of Kenya's NDC and associated documents was carried out to identify what aspects of food systems such as LULUC, production activities, food processing, transportation, marketing and consumption, and food loss and waste management have been included in the NDC targets. The scientific basis, data, and analytics behind the NDC targets are also reviewed to determine how realistic the targets are, identify data gaps, and provide additional mitigation options and their abatement potential for a possible update of the NDCs to consider food system integration.

1.2. Climate Change Scenarios of the country

Kenya has a tropical climate with some modifications based on the topographies and altitudes. Kenya's climate is influenced by global, regional, and localized climate conditions. Some of the variability in the country's climate is due to the El Niño Southern Oscillation that has caused periods of drought and flooding in the country over decades. These events have caused economic losses and slowed down the value-added growth of agriculture (GoK, 2016 p4). Kenya's updated NDC sets out the premise of socio-economic losses estimated at 3–5% of the GDP annually over the last decade due to the successive impacts of climate change that have impeded development efforts.

Temperature and Precipitation Trends

Future climate trends for temperature and precipitation show that Kenya's economy will continue to be affected. Global Climate Modelling (GCM) data indicate that the mean annual temperature is projected to increase by between 0.8 and 1.5°C by the 2030s, and between 1.6°C and 2.7°C by the 2060s (GoK, 2016 p5).

With regard to precipitation, GCM data indicate that there will be a possible increase in average rainfall by the 2060s, especially from October to December. In addition, the data suggest with greater confidence that the proportion of annual rainfall that occurs in heavy events will increase. The range of increase varies from 2 to 11 percent by the 2060s and from 2 to 12 percent by the end of the century (GoK, 2016 p5).

Climate Change and Food System Scenarios

Agricultural production in Kenya is largely rainfed and dominated by smallholder farmers whose land holding is between 0.2 and 3.0 hectares, accounting for about 75% of total agricultural output and 70% of marketed agricultural produce (c.f. MoALF, 2020). Kenya's economy is highly dependent on horticulture and floriculture exports to the European Union. More than 95% of the fresh fruits and vegetables consumed in Kenya are grown domestically, mainly by smallholder farmers, and are supplied to rural and urban markets by small and medium-sized enterprises through informal supply chains.

The sustainability of current arable, pastoral, and fishing production is expected to be negatively affected by changes in rainfall patterns, increases in temperature, and the occurrence of extreme weather events. Future projections of annual rainfall are uncertain and range from a 6% decrease to a 26% increase from the 1970–1999 average by 2060. The amount and timing of rainfall throughout the year are also projected to change, with increased inter-annual variability. Kenya has experienced extreme events of droughts, floods, and storms that have increased in frequency and extent in recent decades, impacting areas that were unaffected historically in both the arid and semi-arid lands and the key agricultural zones.

Rising temperatures will probably alter the mix and distribution of agriculture and livestock pests, while the increased incidence of droughts, coupled with reduced rainfall projections for the arid and semi-arid regions, is expected to reduce yields in the key crops — maize, wheat, rice — and production in livestock and fisheries. Key cash crops such as coffee and tea are also likely to be severely affected due to temperature increases and the increased presence of pests and diseases (NEMA 2015). Fisheries are expected to be affected by physical and biological changes associated with climate change such as increase in water salinity, low primary production, and ocean acidification (Mohammed and Uraguchi, 2013). Additionally, indirect impacts, such as increased rates of runoff and soil erosion, and increased crop losses from wildlife migrations, rising and novel infestations from insects, diseases, and weeds, could significantly magnify production losses (NEMA, 2015, c.f WorldBank, 2021)

1.3. Mitigation Priorities and actions for the agriculture, food, and LULUCF sectors

1.3.1. GHG trends and scenarios

Kenya has committed to ambitious policies and measures to pursue a low-carbon, climate-resilient development pathway to realizing Vision 2030, despite the country's negligible contribution to global greenhouse gas (GHG) emissions (less than 0.1% in 2018). Kenya's total baseline greenhouse gas emissions were estimated to increase from 44 $MtC0_2e$ in 1995 to 55 $MtCO_2e$ in 2020 and are projected to increase to 143 $MtCO_2e$ by 2030. Kenya's updated NDC (2020) describes Kenya's mitigation and adaptation contributions for the period 2020 to 2030 and proposes priority mitigation and adaptation actions. Kenya has made a strong commitment to economy-wide emission reduction, with an absolute target of 32% by 2030 relative to the BAU scenario of 143 $MtCO_2e$, and a 2% increase in ambitions from the INDC submitted in 2015 (Table 1).

Kenya has now committed to reducing 45.76 $MtCO_2e$ of GHG emissions in total by 2030 out of the 85.79 $MtCO_2e$ technical baseline GHG emission reduction potential estimated (21% of the mitigation cost not conditional on international financial support). However, with the increase in the ambitions raised, the updated NDC does not explicitly state the sectoral contributions to the total increased ambitions.

Table 1 Kenya's emission reduction potential and the NDC targets by sector (MtCO2e per year) — Source: GoK, 2015 (SNC) and GoK, 2018 (MTAR, 2018–2022)

Sector	Baseline emission projections ($MtCO_2e$)			Emission reductions relative to baseline $MtCO_2e$		
				Projected Technical Potential	INDC Targets 2015 (30 % reduction)	Updated NDC Targets 2020 (32 % reduction)
	1995	2000	2030	2030	2030	2030
Agriculture	**24**	**23**	**39**	**5.53**	**2.77**	**NA**
Electricity generation	0	1	41	18.63	9.32	NA
Transportation	4	4	21	6.92	3.46	NA
Industrial processes	1	1	6	1.56	0.78	NA
Energy demand	4	4	10	12.17	6.09	NA
Waste	1	1	4	0.78	0.39	NA
Forestry (LULUCF)	**10**	**21**	**22**	**40.2**	**20.1**	**NA**
Total	**44**	**55**	**143**	**85.79**	**42.91**	**45.76**

In 2020, the leading source of emissions was agriculture at 42% of total national emissions, mostly due to livestock enteric fermentation, manure left on pasture and agricultural soils, and fertilizer application. This was closely followed by LULUCF at 38% because of deforestation and energy demand (7%), including transport at 7%. The balance from industrial processes and product use (IPPU) was at 2% and waste management at 2%. Between 2000 and 2030, electricity generation and agriculture sources are projected to contribute to overall national emissions through increased consumption of fossil fuels in generating electricity, meeting domestic, commercial, and industrial heating demands, and for transportation.

In 2000, Kenya's total GHG emissions were 54,955 Gg CO_2 equivalent (approximately 55 million tons of CO_2 eq.) coming from all the sectors (Table 2). About 41% of total national emissions in 2000 were from the agriculture sector alone through enteric methane emissions from the livestock sector and emissions associated with the management of soils on agricultural lands, such as cultivation and tillage. The agriculture sector also contributes emissions by conventional tilling, the burning of savannah and crop residues, and rice cultivation. The LULUCF sector was a net emitter, contributing approximately 20,000 Gg CO_2 equivalent (or approximately 20 million tons of CO_2 equivalent) or 37.55 percent of total emissions.

The agriculture sector (crops, livestock, fisheries, and agroforestry) together with land-use change contributes 78% of greenhouse gas (GHG) emissions (NEMA, 2015). Within the agriculture sector, the major sources of GHG emissions are livestock enteric fermentation, manure left on the pasture, manure applied in soils, manure management, burning crop residues, rice cultivation, and burning savanna (NEMA, 2015).

Table 2 Emission patterns by sectors and GHG type (NEMA, 2015 page 2)

Sector	**2000 Emissions (CO_2e-Gg)**				**Total**	**Total as %**
	CO2	**CH4**	**N2O**	**HFCs**		
Energy sector	7227	1932	601		9760	17.76
Industrial processes sector	694			118	812	1.48
Agriculture sector		**13041**	**9498**		**22,539**	**41.01**
Land use, land use change, and forestry	20571	57	9		20637	37.55
Waste	7	687	502		1205	2.19
Total	28,499	15,526	10,611	118	54,955	100

1.3.2. Mitigation targets for agriculture, food, and LULUCF sectors in the NDCs

The INDC target contribution for the agriculture sector for indicative proportionate emission reduction by 2030 is 2.77 $MtCO_2e$, with a high and low range of 2.8 and 1.6 MtCO2e, respectively. Kenya committed only to an emission reduction target of about 7% in its INDC 2015 compared to the baseline emission projection for 2030. The updated NDC does not elaborate on sectoral contributions to the 2% overall rise in ambitions (including the quantitative and qualitative targets in Table 3).

Table 3 Quantitative and qualitative mitigation targets in food, agriculture, and land use

GHG emission reduction, quantifiable targets	**Emission reduction targets ($MtCO_2e$)**	
	Action up to 2022	**Action up to 2030**
Increase **agroforestry** area by 200,000 acres by 2022	1.66	3.71
Increase farm area under **sustainable land management** by 250,000 acres by 2022	0.55	0.77
Implement **Kenya's Dairy NAMA**-267 HH by 2030	0.40	0.69
Limit the use of fire in rangeland and cropland with emission reduction potential	N/A	0.29
Manure management (biogas technology for cooking and agro-processing) with emission reduction potential	N/A	2
Reduce deforestation and forest degradation by the rehabilitation and protection of an additional 100,000 ha of natural forests (including mangroves) by 2022	2	2

Afforestation/reforestation/agroforestry of an additional 100,000 ha of land by 2022	2	4.8
Restoration of 200,000 ha of forest on degraded landscapes (ASALs, rangelands) by 2022	5.4	13
Increase area under private sector-based commercial and industrial **plantations** from 71,000 ha to at least 121,000 ha	1	1
• Increase deep/offshore **fishing fleet** from 9 to 68 by 2022. • Increase the number of farmers using low-carbon (recirculating) **aquaculture systems** from 20 to 180 by 2022. • Put 50% of 30,000 hectares under **rice production** into efficient production technologies by 2022. • Increase the area under rain-fed **rice production** from 400 hectares to 600 hectares by 2022	Qualitative	Qualitative

With regard to the agriculture, food, and land-use change sectors, the NDC policy targets are implemented through the National Climate Change Action Plan (2018–2022) and its annex, the Mitigation Technical Analysis Report, where the key sector NDC-related targets are set. The following are the key salient mitigation actions proposed under the agriculture, food, and LULUCF sectors.

- **Focus on Sustainable Agriculture:** The NDCs place significant emphasis on promoting sustainable agriculture practices such as conservation agriculture, agroforestry, and limiting the use of fire in rangelands and cropland management, thus helping to improve food security, reduce GHG emissions, improve soil health, and reduce the impact of climate change on food systems.
- **Sustainable Land Management: The** NDCs recognize the importance of increasing farm area under sustainable land management through conservation tillage for food security, and outline measures to improve the resilience of Kenya's food systems.
- **Sustainable Rice Production:** The use of efficient production technology to increase rice production and expand areas of rain-fed rice production to lower GHG emissions.
- **Sustainable Livestock Management:** Implement Kenya's Dairy NAMA project program, leading to the reduction of GHG emissions from livestock enteric fermentation.
- **Use of Renewable Energy:** Manage manure using biogas technology for cooking and agro-processing (abattoirs), providing an alternative to burning biomass.
- **Protecting and Restoring Degraded Land:** Promote reforestation and afforestation that mitigate climate change by increasing carbon sequestration and improving soil health.
- **Sustainable Aquaculture Farming:** Increase the number of farmers using low-carbon (recirculating) aquaculture systems and increase the deep/offshore fishing fleet.
- **Support for Small-scale Farmers:** Enable access for small-scale farmers to finance, training, and extension services in agriculture, livestock, and aquaculture farming for adopting sustainable practices and reducing GHG emissions.
-

1.4. Adaptation Targets or ambitions reflected in the NDC.

The updated NDC aims to ensure a climate-resilient society by mainstreaming climate-change adaptation actions through the Medium-Term Plans (MTPs) and County Integrated

Development Plans (CIDPs). The updated NDC emphasizes that Kenya's priority is to ensure food security in the context of climate change to safeguard basic rights to food. Kenya considers adaptation the highest priority to prevent further loss and damage, continue infrastructure and economic development, and at the same time safeguard lives and livelihoods. The adaptation actions prioritized are in line with Kenya Vision 2030, MTP III (2018-2022), the NCCAP 11 (2018-2022), and the National Adaptation Plan (NAP) (2015-2030). The following are the key salient adaptation actions, (which will also catalyze mitigation co-benefits) proposed under the agriculture, food, and LULUCF sectors.

- **Enhance the resilience of the agriculture value chain:** Adopt sustainable climate-smart agriculture to build the resilience of small-scale subsistence farmers through the production of food crops, industrial crops, and horticultural products.
- **Enhance the resilience of the livestock value chain:** Enhance the resilience of pastoralists' livelihoods in the ASAL areas to promote climate-smart livestock and dairy production.
- **Reduce disaster risk:** Enhance drought risk management through drought early-warning preparedness and response.
- **Mainstream climate-smart agriculture:** Increase productivity through a value chain approach to support the transformation of agriculture (crops, livestock, and fisheries) into an innovative, commercially oriented, competitive, and modern sector.
- **Promote nature-based solutions:** Promote agroforestry in farmlands and plantations in degraded forest lands, maintain watershed health and expand opportunities for nature-based enterprises including seaweed farming and mangrove ecotourism.
- **Provide access to safety net programs:** Increase climate-related resilience through access to subsidies for agriculture inputs, crop insurance, and livestock insurance**.**
- **Promote sustainable land management:** Strengthen resilience through the conservation of water catchments, integrated soil nutrient management, conservation agriculture, agroforestry, sustainable pastoralism, integrated rangeland rehabilitation, development of pastoral product value chains, and climate-smart cage fish farming.
- **Increase farm water resource management:** Promote water harvesting, water storage, soil moisture conservation, climate-smart irrigation infrastructure, and efficient water use.
- **Promote the adoption of diversified adaptive enterprises/value chains:** Promote commodity enterprises/value chains, upscale climate-resilient strategies/technologies in fisheries, develop climate-resilient fish species, and develop traditional, climate-resilient crop value chains including drought-tolerant pulses/legumes.
- **Reduce agricultural losses along the production and supply chains:** Reduce climate-induced agricultural (pre and post) harvest losses (from 40% to 15%) by adopting climate-smart, post-harvest technologies, inclusive warehouses, cold-storage facilities, canning, and the establishment of abattoirs.

1.5. Policy measures on mitigation and adaptation reflected in the NDC

1.5.1 Mitigation Policy Measures

Kenya aims to achieve Vision 2030 through a low-carbon, climate-resilient development pathway. The key mitigation policy measures and strategic measures highlighted in Kenya's Climate Smart Agriculture Strategy (2017–2027) include the promotion and implementation of the following priorities.

- Promote energy-efficient technologies and innovations to enhance energy and resource efficiency.
- Make progress towards achieving a tree cover of at least 10% of the land area of Kenya.
- Make efforts towards achieving land degradation neutrality.
- Scale up Nature Based Solutions (NBS) for mitigation.
- Enhance REDD+ activities
- Adopt clean, efficient, and sustainable energy technologies to reduce over-reliance on fossil- and non-sustainable biomass fuels.
- Adopt climate-smart agriculture (CSA) in line with the Kenya CSA Strategy, with an emphasis on efficient livestock management systems.
- Reduce the rate of emissions from livestock (manure and enteric fermentation) and rice production systems.
- Mainstream sustainable natural resource management to reduce emissions in agricultural production systems.
- Develop Measurement, Reporting, and Verification (MRV) Systems in the agriculture sector, including capacity building of sector stakeholders.

1.5.2 Adaptation Policy Measures

Kenya intends to implement various priority adaptation actions to attain the Triple Adaptation Dividend, namely, avoidance of losses, gain of economic benefits, and gain of social and environmental benefits (including mitigation co-benefits). The key adaptation policy measures and strategic measures highlighted in Kenya's Climate Smart Agriculture Strategy (2017–2027) include the promotion and implementation of the following priorities.

- Enhance adaptive capacity and climate resilience across all sectors of the economy.
- Explore innovative livelihood strategies for enhancing the climate resilience of local communities through the financing of locally-led, climate-change actions.
- Enhance a risk-based approach to climate-change adaptation through the development and application of comprehensive climate risk management tools that would help in addressing and adaptively managing climate risks in crops, livestock, and fisheries value chains.
- Develop and implement strategies for early warning and response and ensure preparedness for extreme weather events.
- Develop and use index-based agricultural insurance to reduce vulnerabilities due to extreme weather events.
- Promote crop varieties, livestock, fish breeds, and tree species that are adapted to varied weather conditions and tolerant to associated emerging pests and diseases.
- Develop, disseminate, and adopt technology along the crops, livestock, fisheries, and forestry value chains to withstand changes in temperature regimes and precipitation patterns.
- Address residual climate-change impacts, loss, and damage, especially in the productive sectors of the economy.
- Enhance the generation, packaging, and widespread uptake and use of climate information in decision-making and planning across sectors and counties with robust early warning systems (EWS).
- Enhance the uptake of adaptation technology, especially by women, youth, and other vulnerable groups, incorporating scientific and indigenous knowledge.
- Promote the diversification of enterprises and alternative livelihoods to enhance the productivity and profitability of agriculture enterprises.
- Manage vulnerability due to unsustainable natural resource management by protecting existing natural resources.

- Promote water harvesting and storage, irrigation infrastructure development, and efficient water use.
- Promote and support the conservation and propagation of the germplasm of species with adaptive capacity.

Chapter Two: Scientific basis, data, and analytics behind the NDC targets

2.1. The Process adopted.

Kenya's updated Nationally Determined Contribution (NDC) is in accordance with paragraphs 22–35 of Decision 1/CP.21 and Decision 4/CMA.1 and its annex. Compared to the first NDC, the updated NDC established a strong coordination mechanism led by the Ministry of Environment, Climate Change and Forestry, while the coordination was carried out by the Climate Change Directorate under the Ministry. Kenya has adopted the just transition principle as part of an aspiration to update the NDC that includes an extensive consultation process for social protection and an institutionalized review by stakeholders, to ensure that the interests of all stakeholders are considered in all the climate actions.

According to the updated NDC, the process has been informed by a more detailed and robust assessment of mitigation and adaptation measures, in-depth analysis, improved information and data, and an extensive stakeholder consultation process that has included national and county government sectors, civil society, academia, and the private sector. The process was structured to support the enhancement of mitigation, adaptation, and transparent communication, together with alignment of the NDC with the Sustainable Development Goals (SDGs). The enhancements have not only targeted the mitigation ambitions of the NDC, but also the strengthening of the NDC's implementation.

The process entailed the review of relevant national plans, policies, and legislation (Figure 1). The contributions described in the updated NDC submission build upon Kenya's initial NDC, the National Adaptation Plan (NAP) 2015–2030, new policies and national plans, and reflect subsequent work as captured in Kenya's Second National Climate Change Action Plan (NCCAP 2018–2022) and the Third National Inventory Report (NIR 3).

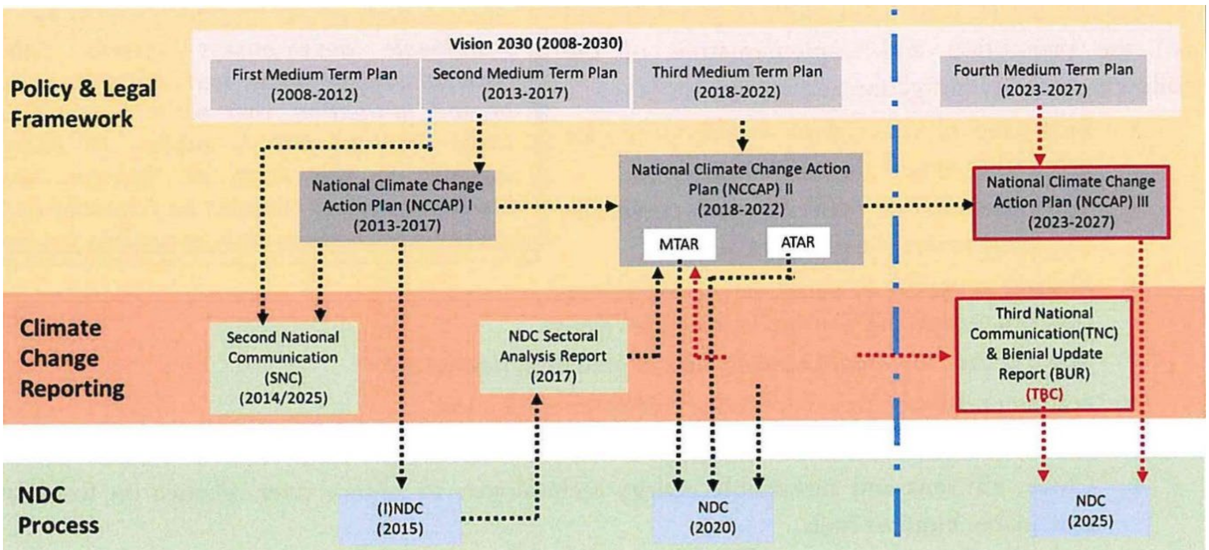

Figure 1 Documents reviewed to update Kenya's NDC (Second NDC, GoK, 2020)

2.2. Scientific basis and data used.

Kenya followed UNFCCC guidelines on information to facilitate clarity, transparency, and understanding (iCTU) to prepare its updated NDC. Kenya's preparation for the NDC has been informed by the best available science and its assessment is central to the IPCC's special report on 1.5 degrees C. Kenya's current GHG inventory follows Decision 24/ CP.19 and hence the Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2019, the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000), and the Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC, 2003). The concepts contained in the Good Practice Guidance are being implemented in stages, according to sector priorities and national circumstances.

The CO_2 equivalent calculation was based on IPCC 2006 guidelines, global warming potentials (GWP) for a 100-year time horizon from the IPCC's Fifth Assessment Report. The Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC, 2003) was used to account for land use change under LULUCF as per Removals from. The land sector was accounted for based on specific accounting rules for the different land categories as per the Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC, 2003)

Kenya's NDC is supported by scientific analyses and accounting methodologies, and reference has been made to the technical analysis reports of the NCCAP 2018–2022. The Mitigation Technical Analysis Report (MTAR), the Adaptation Technical Analysis Report (ATAR), and the NIR 3 have been used to update the NDC analysis. The updated NDC was based on an assessment of the extent and impact of the implementation of the NDC to date and an extended inventory of historical GHG emissions up to June 2020, applying the best available data from various official sources and reports. The Second National Communication GHG inventory has used Tier 1 quantification of uncertainties associated with the estimates.

According to the updated NDC, the priority mitigation and adaptation actions will be implemented through the NCCAPs as set out in the Climate Change Act, 2016, thus creating the opportunity to enhance the ambitions every five years with the revision of the NCCAPs. Kenya has developed an Integrated MRV system, including an Integrated MRV tool, for monitoring and reporting both mitigation and adaptation actions, together with their results. This Integrated MRV system is linked with already existing monitoring and reporting systems including the National Integrated Monitoring System (NIMES) and County Integrated Monitoring System (CIMES). The integrated MRV system will track the implementation status of the NCCAP, the NAP, and the NDC in the annual reports and will be input for both national and international reporting obligations.

2.3. Analytics behind NDC targets

2.3.1. Adequacy of the Mitigation targets

2.3.1.1 Overall National Mitigation targets

Kenya has made a clear commitment to implement and periodically update the National Climate Change Action Plans (NCCAPs) to achieve the NDC targets. While the previous NDC target was entirely conditional on international support, Kenya now commits to bear 21% of the mitigation costs, i.e. US$ 3.7bn, to reduce 32% of the BAU emissions projected by 2030. The updated NDC is not clear on specific sectoral contributions to GHG reduction as compared to the overall commitment to reducing the BAU emissions of 143 $MtCO_2e$ by 32%, (48.76 $MtCO_2e$) by 2030. It is expected that in the NCCAP (2023–2027), there will be elaboration on how the 2% increase in ambitions is progressing; an emission reduction of about 2.85 $MtCO_2e$ is proposed in addition to sectoral disaggregated mitigation contributions. Therefore, at present, only national-level economy-wide emission reduction targets are known without a sectoral breakdown of raised ambitions for emission reduction relative to BAU (Table 4).

Table 4 Analysis of the NDC in terms of NDC submissions (INDC and updated NDC)

Sector	**Baseline Total Emissions ($MtCO_2e$)**			**Emission Reductions relative to baseline $MtCO_2e$**				
				INDC Targets2015 (30 %)	**Mitigation Gaps based on the 2015 INDC target**	**INDC ambitions against projected baseline emissions**	**Updated NDC Targets 2020* (32 %)**	**Mitigation Gaps based on the 2020 NDC targets**
	1995	**2000**	**2030**	**2030**	**2030**	**2030**	**2030**	**2030**
Agriculture	**24**	**23**	**39**	**2.77**	**36.23**	**7%**	**N/A**	**N/A**
Electricity generation	0	1	41	9.32	31.68	23%	N/A	N/A
Transportation	4	4	21	3.46	17.54	16%	N/A	N/A
Industrial processes	1	1	6	0.78	5.22	13%	N/A	N/A
Energy demand	4	4	10	6.09	3.91	61%	N/A	N/A
Waste	1	1	4	0.39	3.61	10%	N/A	N/A
Forestry	10	21	22	20.1	1.9	**91%**	N/A	N/A
Total National GHG Emissions	**44**	**55**	**143**	**42.91**	**100.09**	Avg = 32%	**45.76**	**97.24**

*Detailed breakdown of sectoral contributions is expected in Kenya's NCCAP (2023–2027) — not accessible during the study period.

2.3.1.2 Mitigation targets in food systems

The NDC promotes transformational agriculture for crops, livestock, and fisheries to contribute toward meeting the ambitious climate-change mitigation targets. The NDC target for the agriculture sector commits to reducing only 2.77 $MtCO_2e$, leaving a wide gap of 93% (36.23 $MtCO_2e$) in mitigation ambitions for total projected emissions by 2030. For the agriculture sector, the indicative proportionate emission reduction target contribution by 2030 is 2.77 $MtCO_2e$ with a high and low range of 2.8 and 1.6 Mt CO_2e, respectively.

Agriculture is the largest source of GHG emissions in Kenya and these are likely to increase from 30 $MtCO_2e$ in 2010 to 39 $MtCO_2e$ in 2030, largely driven by livestock methane emissions (18.8 $MtCO_2e$ by 2030) and agricultural soils (16.2 $MtCO_2e$ by 2030). The sector also contributes carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emissions through activities such as conventional tillage, burning of the savannah and crop residues, and rice cultivation (GoK, 2015).

Table 5 Agriculture Baseline GHG Emissions for Kenya ($MtCO_2e$) — MTAR, 2018–2022

Agriculture source	Agriculture Baseline GHG emission ($MtCO_2e$)						
	2000	2005	2010	2015	2020	2025	2030
Livestock enteric fermentation	10.8	12.7	14.5	15.5	16.5	17.7	18.8
Agriculture soils	9.0	10.6	11.9	12.8	13.9	15.0	16.2
Savanna burning	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Livestock manure management	0.6	0.7	0.8	0.8	0.9	1.0	1.1
Rice cultivation	0.2	0.2	0.3	0.3	0.3	0.4	0.4
Burning crop residues	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Total	**22.6**	**26.3**	**29.6**	**31.4**	**33.6**	**35.9**	**38.5**

The Land-Use, Land Use Change, and Forestry (LULUCF) sector includes estimates of emissions and removals of greenhouse gases associated with increases or decreases of carbon in living biomass as land-use changes occur over time. Such land-use changes include the conversion of a forest area to cropland when establishing new forest lands through reforestation or afforestation/agroforestry. Kenya's forest cover has been substantially reduced over the last 50 years, signaling an overall downward trend in carbon biomass stocks over the period. However, recent reports indicate that the forests have started to recover because of various Government initiatives, and it is currently estimated that the country's forest cover is 8.33%[ix]. Table 6 shows the total LULUCF baseline emissions between the year 2000 and the year 2030 with the baseline projected GHG net emissions from cropland. However, emission estimates of the carbon stocks of forests (that is forest land remaining forest land in the LULUCF sector) have the highest degree of uncertainty because of lack of knowledge of the actual extent of total forest cover, activity data, and emission factors.

Table 6 Cropland baseline GHG net emissions ($MtCO_2e$) — MTAR, 2018–2022

LULUCF Sector	LULUCF Baseline GHG Net Emissions ($MtCO_2e$)						
	2000	2005	2010	2015	2020	2025	2030
Cropland	**4.6**	**3.4**	**4.6**	**6.0**	**4.5**	**4.4**	**2.9**
Total – Forestry	19.1	17.8	24.4	26.0	24.9	22.6	22.1

The overall impact of the actions of the three agriculture sources depicts the low range of potential targets for emission reductions and opportunities to enhance NDC targets with practical strategy. The NDC target for agriculture is only set at 2.77 $MtCO_2e$, which is a 50% gap in the estimated technical mitigation potential (5.53 $MtCO_2e$) by 2030. Table 7 provides an overview of mitigation actions within the agriculture sector and the projection of agriculture's emission reduction potential by 2030.

Table 7 Projection of emission reduction potential through the priority actions of the agriculture sector ($MtCO_2e$) – MTAR, 2018-2022

Agriculture Source	Agriculture Emission Reduction Potential 2015 to 2030 (Mt CO_2e)			
	2015	2020	2025	2030
Conservation tillage	0.11	0.65	1.09	1.09
Agroforestry	0.28	1.66	3.05	4.16
Limiting the use of fire in rangeland and cropland management	0.24	0.26	0.27	0.29
Total	**0.63**	**2.57**	**4.41**	**5.54**

The analysis of the adequacy of the food system target, based on the target set as per the NCCAP 2018–2022 mitigation technical analysis report, suggests that agroecological measures and nature-positive mitigation solutions are promoted in the NDC. The most significant reduction can be achieved through agroforestry, which has an abatement potential of 4.16 $MtCO_2e$ per year in 2030. The overall target sets guide to the responsible ministries and agencies in terms of what they should objectively plan and prepare for should the sector require additional emission reductions.

Similarly, forestry and land-use change information is kept within the forestry sector, and Kenya commits to reducing about 20.8 $MtCO_2e$ (out of 22.1 $MtCO_2e$), leaving a narrow gap of 6% in the mitigation ambitions for total projected emissions by 2030. For forestry, including the LULUCF sector, the indicative proportionate emission reduction target contribution by 2030 is 20.1 $MtCO_2e$ with a high and low range of 20.1 and 11.3 MtCO2e, respectively. However, there remain areas where the NDC can be enhanced in terms of quantitative targets for agriculture and food sources for which the potential emission reduction projection has been carried out. (Table 8).

Table 8 Analysis of the NDC in terms of adequacy of the target for food systems

Agriculture, Food, and Land Use Prioritized Mitigation Actions	Emission Reduction NDC Quantified targets by 2030. ($MtCO_2eq$)	Emission Reduction Potential by 2030 ($MtCO_2eq$)	Emission Gaps By 2030 ($MtCO_2eq$)	% Of Ambition Gaps
Overall NDC target	45.76	143	97.24	68 %
Overall agriculture sector	2.77	39	36.23	93 %
Agroforestry	3.17	4.16	0.99	24 %
Conservation tillage	0.77	1.09	0.32	29%
Limiting the use of fire in rangeland and cropland	N/A	0.29	N/A	N/A
Dairy NAMA to reduce livestock enteric fermentation	0.69	18.8	18.11	96 %
Overcapacity of artisanal fishing vessels	N/A	N/A	N/A	NA
Aquaculture production	N/A	N/A	N/A	NA
Rice production	N/A	N/A	N/A	NA
REDD+ initiatives - abatement	2	22.1	1.3	6 %
Afforestation/reforestation and agroforestry - abatement	4.8			
Restoration of degraded landscapes - abatement	13			
Private-sector plantations - abatement	1			

Overall, the NDC scores from low to high in many categories of the food system-focused emission reduction targets for the quantitative and qualitative targets presented in the NDC as well as in Kenya's national climate-change action plans. In terms of content, agroecology, regenerative approaches, and nature-positive solutions are found to be promoted. The MTAR provides key enabling technologies associated with the priority mitigation options related to food systems for monitoring, reporting, and verification (MRV) and capacity building, including data collection and inventory development.

Table 9 Qualitative assessment of the food systems inclusion in the NDC for emission reduction (also based on MTAR, 2018–2022)

Systems	What is included	Adequacy of the NDC (High, Medium Low)
Production activities	A focus on sustainable agriculture management, land management, efficient livestock management, rice production management, manure management through the use of renewable energy technology, protecting and restoring degraded farmland, sustainable aquaculture farming and production, and rice production. Supporting small-scale farmers to reduce GHG emissions.	● The NDC lists essential actions, including specific commitments, strategies, or funding, related to the critical transition **Overall Rating: High**
Food processing, transportation	Adoption of biogas technology for agro-processing (abattoirs).	The NDC lists essential actions, including specific commitments, strategies, or funding, related to the critical transition. **Overall Rating: Low**
LULUCF	Scaling up Nature-Based Solutions (NBS): enhancement of REDD+ activities, by rehabilitation and protection of natural forests (including mangroves); Afforestation/ reforestation/ agroforestry of land; Restoration of forest on degraded landscapes (ASALs, rangelands); Increase in area under private sector-based commercial and industrial plantations and dryland forests efficiently utilized in all counties. Nature-based enterprises including seaweed farming and mangrove ecotourism.	The NDC lists essential actions, including specific commitments, strategies, or funding, related to the critical transition. **Overall Rating: High**
Marketing and consumption	No specific information on marketing and consumption.	The NDC does not mention any specific information on policy interventions for the critical transition. **Overall Rating: Low**
Reducing food loss and waste management	Reducing climate-induced agricultural (pre & post) harvest losses (from 40% to 15% by 2022) by adopting climate-smart post-harvest technologies, inclusive warehouses, cold storage facilities, canning, and establishment of abattoirs.	The NDC lists some specific policy measures and actions for the critical transition. **Overall Rating: Medium**

2.3.2. Adequacy of adaptation targets

Overall, the NDC rates high to very high across many categories as it provides specific indications of actions to address risk and vulnerability in the agriculture sector and food systems, as well as information on policies, spatial information, and technology development; it needs to make progress against these actions and implement the NDC. Kenya has a sufficient commitment to adaptation through enhancing the resilience of the value chains by promoting climate-smart agriculture, livestock development, and aquaculture. The NDC includes measures to improve climate services to build climate resilience through sustainable land-use management, the provision of safety nets and extension services, as well as access to finance specifically targeted at marginalized communities.

Table 10 Adaptation targets and gaps.

Category	Overall Rating
A. Future climate risk and vulnerability in the agriculture sector (2030)	**Overall Rating: Very high (5)** Kenya's GDP relies on climate-sensitive sectors. Kenya's agriculture is 98% rainfed and therefore highly vulnerable to extreme events, climatic shocks, climatic changes, and variability. Drought, floods, rising sea levels, and pests and diseases are the key climate-related threats to agriculture food production. The NDCs have set a very strong policy target to enhance a risk-based approach to climate change adaptation through the development and application of comprehensive climate-risk management tools that could help in addressing and adaptively managing climate risks. Kenya has a well-developed strategy and action plan to address current and future climate risks and vulnerabilities with near- to long-term adaptation actions to address changes in temperature regimes, precipitation patterns, and extreme weather events.
B. Adaptation target ambitions for 2030	**Overall Efforts rating: High (4)** The adaptation target aims adopt climate-smart agriculture, including through national policy and strategic measures in the agriculture sectors, to enhance the adaptive capacity and resilience of farmers, pastoralists, and fisherfolk to the adverse impacts of climate change by reducing vulnerabilities.
Differences in the degree of risk and level of adaptation efforts = Gap	**Overall Gap rating: Low (2)** There are minimal gaps in terms of information and scientific basis to take forward adaptation action in Kenya.

Rating: Very high (5), high (4), moderate (3), low (2), very low (1)

2.3.3. Feasibility of achieving the NDC food system targets

The actual mitigation potential of each of the food sectors depends on a number of factors ranging from policy, resources, and priorities to the implementation practicality of the potential mitigation actions. An estimated sum of about US$ 502.55 million is needed to support the climate action implementation of the current three priority food systems, including enabling the actions presented in the updated NDC. Kenya has estimated about i) US$ 279.70 million for agroforestry and sustainable land management as part of the smart agriculture program; ii) US$ 222.6 million (US$ 149.73 million as private sector co-financing) for Kenya's Dairy NAMA project, of which US$ 56.06 million is requested from the Green Climate Fund (GCF), and iii) US$ 0.25 million for enabling actions, about a quarter of which is included in the Capacity-Building Initiative for Transparency (CBIT) project.

All the food sector-related mitigation actions together have an abatement potential of 5.56 MtCO2e by 2030, compared with the sector's target of reducing emissions by 3 MtCO_2e by 2030. The indicative proportionate emission reduction target contribution for the agriculture sector by 2030 is 2.77 MtCO_2e, with a high and low range of 2.8 and 1.6 MtCO_2e, respectively. This does not necessarily have to be delivered by the sector though, since the actual GHG emissions reduction by the sector will be based on the realistic opportunities available for emission reductions in the sector, together with the sector plans and budget provisions. The agriculture sector should strive to meet the low range of emission reductions (1.6 $MtCO_2e$ by 2030), requiring that other sectors implement actions to achieve the high range of emission reductions.

The implementation of climate-smart agriculture practices has had mixed results[x] as indicted in the implementation status report of Fiscal Year 2019/20 of the NCCAP 2018–2022. As of June 2020, 52,075 ha of degraded land has been reclaimed through sustainable land management practices, meeting 87% of the NCCAP's 2022 target. Only 10,286 ha of agricultural land, or 4% of the 2022 target, has been put under soil nutrient management, while conservation agriculture practices are implemented in 20,050 ha of land, or 8% of the 2022 target. According to the NDC baseline, absolute emissions from the agriculture sector are projected to grow from 34 MtCO2e in 2015 to 41.6 MtCO2e in 2030, while the contribution of agricultural emissions (excl. LULUCF) to total national emissions is expected to decrease from 59% in 2015 to 32% in 2030. With the implementation of the CSA strategy, absolute emissions would reach 31.6 $MtCO_2e$ in 2030. If the sector successfully implements the measures from the NCCAP 2018–2022 and the sector's CSA strategy, it is likely that the sectoral target can be met. In order to achieve the minimum 1.6 $MtCO_2e$ recommended NDC target for emission reduction by 2030 for the agriculture sector, focusing on food security mainly during the NCCAP 2018–2022 period, the sector priority actions can comfortably deliver the low range of emission reductions (1.6 $MtCO_2e$) by 2022 and the high range of emission reductions (2.8 $MtCO_2e$) by 2030.

Kenya has identified the key technologies required as part of the enabling actions for monitoring, reporting, and verification (MRV) associated with the three priority mitigation options. These are i) Agroforestry: nurseries, improved market access for small farms, extension service support, capacity building and pilot projects: ii) Sustainable land management: agriculture extension services, low-cost tillage systems and equipment; extension services to educate pastoralists and farmers on the risks associated with using burning to manage rangelands and croplands and the benefits of using alternative practices; iii) Kenya Dairy NAMA: formulation of improved feeds and feed additives to reduce enteric fermentation; development of breeding schemes and improved herd health and iv) enabling actions: MRV capacity building, including data collection and inventory development.

Chapter Three: Missing data gaps

Kenya's NDC is found to be focused more on emission reduction from nature-positive food production activities to meet the country's demand for food as the sector is dominated by smallholder rain-fed production. With climate change, there is an increasing problem of food insecurity and malnutrition, and tackling the decline in production is the major priority. Therefore, the immediate priority is on reducing emissions from distribution, processing, transportation, and marketing, and consumption and reducing food waste are not included. This may be partly due to a lack of data and information for activities related to the overall food system and potential contributions to emission reductions.

The available information concerning the overall food system is viewed primarily from the perspective of sensitiveness to climate-change risks, impacts, and vulnerabilities. For example, Kenya has two distinct national distribution systems for agri-food products[xi]: one based on small-scale production and informal networks, and the other based on contract farming and supermarkets. Each distribution chain has different requirements regarding infrastructure (e.g., roads, markets, airports, or ports) and degree of organization. Kenya receives major foreign investments in agriculture, such as for large export-oriented horticulture and floriculture; the food system is transitioning from a traditional food system to a modern one, shown by export-oriented production, distribution concentration, and overnutrition for an increasing number of citizens, especially in the middle- and upper-classes. With the projected trends of increased precipitation and temperatures, there is a likelihood of an increase in flooding, washouts, scour, erosion, siltation/debris, and soil erosion,[xii] which ultimately disrupt road transportation networks or corridors essential for distributing food from production sites to markets, resulting in increased food prices and decreased access to food. Most farmers are small-scale, with mostly rainfed produce, and have limited transport, storage, and processing facilities, hence cash-strapped farmers sell their surplus around the peak of seasonal production at the lowest prices; this infrastructural inefficiency will limit access to food by marginalized groups.

Consumption volumes are generally kept low in Kenya partly due to the relatively higher prices of indigenous vegetables (fresh produce in low supply) compared with staples like maize (and kale) that are easier to store and transport and enjoy more established and effective distribution networks. The reliance on rain, lack of storage facilities, and low level of food processing, coupled with other market failures and lack of water in the dry season (particularly challenging in the arid and semi-arid lands), cause peaks in food insecurity in a large part of Kenya for about eight months of the year. During the rainy season, there are often cases of overproduction leading to falling prices and/or food waste.

Food consumption patterns are altered by the availability and affordability of certain foods impacted by production and distribution. Climate change can increase food loss due to supply-chain disruptions and spoilage during transportation and storage, as well as post-harvest crop losses. Kenya estimates that about 20% of cereals are lost even before they reach the market[xiii]. The problem of post-harvest loss in horticultural crops is found to be acute in Kenya[xiv]. This loss not only contributes to environmental degradation but also exacerbates acute food and nutrition insecurity and malnutrition[xv] by reducing the availability of food.

Soethoudt, and Castelein, 2021 analyzed intervention scenarios for smallholder potato value chains in Kenya that improved yields, reduced losses, minimized greenhouse gas (GHG) emissions, and increased economic performance and food security.

The GHG inventory of the agriculture sector consists of disaggregated baseline emissions from livestock enteric fermentation, agriculture soils, savanna burning, livestock manure management, rice cultivation, and burning crop residues. The situation analysis of the agriculture sector report shows mitigation potential in the crop, livestock, and fisheries/aquaculture subsectors; landscapes and forestry; and productive resources (land, soil, and water), broadly categorizing mitigation strategies in three ways: carbon sequestration in soils; on-farm emission reduction; and emission displacement from the transportation sector through biofuels (MoALF, 2020). However, in the national food system, emissions, particularly from food production, consumption, storage and transportation, and food loss and waste, are poorly quantified and understood, suggesting that the collection of activity data should be improved in the future to analyze the sources of emissions (Table 11).

The review of the Biennial Update Report (BUR) submission from non-annex 1 parties to the UNFCCC secretariat[xvi] shows that Kenya has not yet submitted its BUR. Kenya has stated during a submission[xvii] made to the UNFCCC secretariat that the country has no experience with BURs and hence no experience with reporting on support needed or received.

Table 11 Analysis of the food system data and information reflected in the NDC.

Data and information management	**Focus of NDC**
Availability of information to estimate resulting emission level of target	The NDC gives sufficient information to estimate the targeted GHG emission levels. The NDC includes the targeted absolute GHG emissions level. Regarding the food system, the NDC aligns with existing food system practices, considering agroecology and regenerative approaches and the conservation and regeneration of forest ecosystems. However, it does not account for overall food system emissions, a shift to healthy and sustainable diets, and the reduction of food loss and waste.
Followed the guidance in information to facilitate clarity, transparency, and understanding of NDCs in Decision 4/CMA.1	Kenya followed the Decision 4/CMA.1 guidance on transparency to a large extent and followed iCTU guidance to prepare the updated NDC
Accounting modalities	The NDC describes most of the accounting modalities following IPCC guidance. The GHG inventory has used Tier 1 quantification of uncertainties associated with the estimates; however, this can be improved in subsequent GHG inventories using Tier 2. Scientific analyses and accounting methodologies in food system elements only consider production-related emissions information.
Digital revolution	The NDC lists essential actions, including specific commitments, strategies, or funding, related to the critical transition. It states that by 2030 the country will have an improved integrated MRV system. Kenya aims to promote sustainable digital agriculture solutions to improve productivity with support from development partners. Digital literacy among the population is a major barrier to the large-scale adoption of digital solutions. However, there is potential to adopt the digital revolution in the food system and agriculture[xviii] for inputs, production, distribution, and consumption using machine learning, weather stations, databases, mobile applications, and blockchains (FAO, and World Bank, 2021).

Chapter Four: Additional mitigation options and their abatement potential for the possible update of Kenya's NDC

4.1. General recommendations

- **Raising ambitions in the overall agriculture and the food system:** Kenya's projected level of emissions in the sector by 2030 and the current level of climate-action ambitions have significant gaps of 93%. Although Kenya is not a significant GHG contributor globally, domestically, in line with Vision 2030 and as a part of low carbon climate-resilient development committed to under the Paris Agreement, it can further elevate its contribution to the reduction of emissions from agriculture and the food sector. There are 14 key opportunities[1] to expand the current level of targets and accelerate food system translation based on the Global Alliance of Future of Food (2022) in three NDC components: i) the NDC planning and construction process; 2) NDC targets and measures; and 3) NDC implementation and monitoring aspects during the next NDC update process in 2025. Kenya should implement its land use-related emission abatement program more effectively and efficiently to achieve the desired results and impacts.

- **Preparing its long-term strategy for climate action:** Kenya is waiting for the endorsement of its 2050 Long-Term Greenhouse Gas Strategy and Carbon Resilience Development Pathway under the Paris Agreement. Its long-term vision for 2030 has been presented, and it is not clear if Kenya would be able to achieve net zero status by 2050. There are opportunities to set targets for agriculture, food, and land use.

- **Improve coordination mechanisms set up within and across levels of government to develop the NDC and the policy development/implementation process:** The National Climate Change Council is responsible for overseeing and coordinating the implementation of the NDC. However, there is a need to continue strengthening the coordination capacity of the Climate Change Units (CCUs) at the national and county levels to ensure better complementarity and cooperation between national, regional, and global transparency-related activities in Kenya. This also includes improving institutional capacity to manage the compilation process for the GHG inventory and establish a sustainable system for producing regular national GHG inventories.

- **Stronger alignment needed on global commitments:** At the 26th meeting of the Conference of Parties in Glasgow, four sectoral initiatives were launched to accelerate climate action: methane; the coal exit; 100% electric vehicles (EVs); and forests/land use. Methane makes up around half of Kenya's total emissions. Kenya has not signed the methane pledge — becoming a signatory could have significant emission reduction implications for the country. Kenya has not signed the coal pledge — while Kenya has not yet deployed coal power generation, the long-term energy supply plan outlines coal as 12% of the country's power supply by 2040. Kenya adopted the electric vehicle pledge at COP26. While it did not commit to the 2040 target, Kenya signed the forestry pledge at COP26. This is significant, given Kenya's high share of emissions from LULUCF, which on average made up one-third of Kenya's total emissions over the last 20 years. Kenya can accelerate the shift toward sustainable food systems, in particular through measures that further promote regenerative agricultural practices, restore degraded land, and protect natural ecosystems.

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[1] assessment-of-food-systems-in-ndcs.pdf (futureoffood.org)

4.2. Recommendation for adopting additional mitigation options.

- **Raising ambitions in the agriculture sectors:** In the agriculture sector, out of 39 MtCO2e projected emissions, the current NDC targets are only set for 2.77 $MtCO_2e$ emission reduction by 2030. This indicates the massive potential for increasing ambitions in the agriculture sector. The agroforestry, sustainable land management, and livestock climate actions proposed are projected to reduce emissions by about 5.17 $MtCO_2e$ by 2030. This closely aligns with the technical mitigation potential identified. However, there are efforts required to understand the technology and measures needed to enhance the mitigation solutions in the agriculture sectors, including the integration of full food systems approach to raise ambitions with feasible quantifiable emission reduction targets. In addition, the NDC targets should include interventions to reduce emissions from cropland and rangeland fires, the mitigation potential of which has been identified, as well as reducing emissions from rice cultivation.

- **Raising ambitions in the livestock sectors:** Reducing livestock enteric methane has remained one of Kenya's key priorities. However, the emission reduction projection from the Dairy NAMA is estimated at only 0.69 $MtCO_2e$ by 2030, suggesting a large gap in the implementation emission reduction program as well as in the agriculture baseline GHG emissions that are largely driven by livestock methane emissions (18.8 $MtCO_2e$ by 2030). These gaps need to be addressed by further reaching out to households in the emission reduction program. Kenya should enhance its capacity for identifying methane mitigation actions that align with the SDGs and integrate methane quantification and mitigation into existing and planned livestock subsector strategies, investments, and policies.

- **Raising ambitions in agroforestry and land use:** The AFOLU sector contributes a 61.72% relative share of national GHG emissions (FOLU, 2022). Although there are no concrete and separate priority actions indicated for AFOLU, the NDC indicates the prioritization of nature-based solutions related to REDD+, agroforestry, conservation, restoration, and reforestation of degraded land. The current ambitions in terms of these activities have limited gaps: 20.8 $MtCO_2e$ of NDC targets out of 22.1 $MtCO_2e$ of projected emission reduction potential. The NDC has incomplete or generic information on land use planning. The second national communication has indicated about a 2.9 $MtCO_2e$ emission reduction baseline projection for cropland by 2030. Therefore, the AFOLU sector priority actions should be set in an integrated manner for the projection and accounting of GHG emission reductions.

- **Raising ambitions in aquaculture:** Sustainable fishing and aquaculture have the potential to deliver an increased supply of ocean proteins, reducing the demand for land and supporting healthier and more diverse diets (FOLU, 2022). The NDC and associated documents have set policy priorities for sustainable aquaculture farming in Kenya, mainly by increasing the number of farmers using low-carbon (recirculating) aquaculture systems and increasing deep/offshore fishing fleets. However, there is a need to make a reasonable estimate for the mitigation potential at the national scale. These include the enhancement and strengthening of governance of community structures in participatory resource management in coastal ecosystems, conducting a blue carbon-readiness assessment for the full integration of blue carbon/ocean climate actions into NDCs, developing marine spatial planning, and outlining sustainable management approaches (Global Alliance for the Future of Food, 2022).

- **Integrating a holistic food system perspective to account for the adaptation and mitigation elements of a sustainable agriculture system:** There is emerging literature about understanding the risk and vulnerability of the food system, with varied levels of information around distribution, food processing, transportation, marketing and consumption, and food loss and waste. Kenya's NDC emission reduction program is targeted at the agriculture production system, there is a critical need to account for emission reduction potential throughout the food system by integrating data and information to set the quantified mitigation targets from production to consumption. To build the resilience of the food system, further emphasis needs to be placed on improving food-storage infrastructure, food transportation and distribution, and the efficiency and sustainability of food processing, to reduce post-harvest food loss and waste; and on supporting access to climate-smart agriculture production and control over resources, finance, infrastructure, and technology for poor and marginalized communities.

- **Promoting climate-smart agriculture practices:** Kenya has taken forward CSA as a transformative tool to build a nexus between climate change and agriculture. There are opportunities to promote crop varieties, livestock, fish breeds, and tree species that are adapted to varied weather conditions and can tolerate associated emerging pests and diseases. Some crops, such as banana, cassava, sorghum, sweet potato, pearl millet, groundnut, and finger millet are expected to experience more favorable growing conditions as a result of climate change.

- **Enhancing the MRV system with harmonized GHG accounting methods to integrate the food system:** Given the disparity between the Tier 1 method used in Kenya's inventory and the Tier 2 method used in the MRV of the Dairy NAMA, adopting the Tier 2 method in the national GHG inventory is a key step to increasing coherence in GHG reporting and mitigation. This will allow project-level initiatives to link with national MRV systems and track mitigation trends both in terms of absolute emissions and reductions in emission intensity. To realize this, support is needed to increase institutional capacity to manage the compilation process of the GHG inventory, as well as to create a data management system that facilitates the preparation of the livestock GHG inventory based on advanced accounting methods[2].

- **Providing clear financial allocations for sustainable food systems:** Although the amount available to fund the implementation of the food system initiatives is not explicitly stated in the NDC, given the need to integrate all food system components in the NDC, greater resources would be needed to ensure that the activities being undertaken adhere to climate-smart as well as agroecological principles. There is scope to raise the conditional targets set within the NDCs by raising domestic financing as well as by ensuring that international finance is pledged and received to meet both the quantified and the policy measures communicated. Furthermore, it is important to enhance Kenya's capacity to secure climate finance for transformative action. Kenya is already part of the Joint Crediting Mechanism (JCM[3]) to facilitate the diffusion of leading decarbonizing technologies, products, systems, services, and infrastructure.

- **Including measures to build cross-ministerial collaboration as well as frameworks for stakeholder dialogue, exchange of best practices, and building of institutional capacity:** The NDC refers to cross-sectoral problems that are a result of the impacts of climate change leading to food insecurity. Hence, greater coordination and cooperation between the relevant sector ministries must be demonstrated tangibly in the NDC to ensure improved and sustained access to nutritious food and contribute to a sustainable food system.

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