Climate change mitigation in the East and Southern Africa region:

an economic case for the agriculture sector

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Abstract

The Sustainable Development Goals (SDGs) and the Nationally Determined Contributions (NDCs) carry a potential for synergies and complementarities. The achievement of the zero-hunger goal by 2030 can be facilitated through green growth investments in agriculture, forestry and land use (AFOLU) sector but significant levels of finance are needed. We quantify the mitigation potential of the East and Southern Africa (ESA) region with focus on the AFOLU sector and introduce cost-effectiveness criteria to exploit such potential, in view of attracting private financing. We argue that mitigation investments can be prioritized to enhance the efficiency of available financing (economy of scope), maximize the mitigation results (economy of scale), and create synergies with the economic development needs. We find that AFOLU is a profitable option to invest in climate change mitigation in the ESA region, being more competitive than energy and other sectors in attracting mitigation finance. also given the low prices recorded in the regional carbon market. Potential revenues may provide the necessary resources to partially fill the funding gap and drive the transition of the AFOLU sector in ESA towards the SDGs and its restructuring in a more sustainable way, enhancing its competitiveness.

Acronyms and abbreviations

AFOLU	Agriculture, Forestry and Land Use
BAU	Business as usual
CO_2e	Carbon dioxide equivalent
COP	Conference of the Parties
COSOP	Country Strategy and Opportunities Programmes
GDP	Gross Domestic Product
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate change
LULUCF	Land Use, Land Use Change and Forestry
MACC	Marginal abatement cost curve
NDC	Nationally Determined Contributions
SECAP	Social, Environment and Climate Assessment Procedures
tCO_2e	Tons of carbon dioxide equivalent
UNFCCC	United nations framework convention on climate change

1. Introduction

In December 2015, at the 21st Conference of the Parties (COP 21) in Paris, Parties of the United Nations Framework Convention on Climate Change (UNFCCC) adopted the Paris Agreement to address climate change. Countries have made commitments through their (Intended) Nationally Determined Contributions (NDCs) by which Parties communicate their climate commitments to the international community and report on the progress made[1].

Globally, the NDCs submitted to the UNFCCC represent 98.6% of global greenhouse gas (GHG) emissions. Their implementation is estimated to result in aggregate global emissions levels of 57 GtCO_2e in 2030. Accounting for NDC commitments, global GHG emissions levels will decrease by 4 GtCO_2e in 2030 compared to pre-NDC trajectories to emissions levels (UNFCCC 2015). These emissions represent a decrease in the rate of growth of emissions by a third from 2010 to 2030 when compared to the rate of growth of emissions from 1990 to 2010. Aggregate global emission levels resulting from the implementation of NDCs will remain 15 Gt CO_2eq higher in 2030 than the least-cost 2˚C scenario (ICF, 2016).

The agriculture, forestry and land use change sector (AFOLU) plays an important role. Mitigation actions in agricultural and land-use sectors sector are included in 84% of the Parties' NDCs (Richards et al. 2015). Globally there is a strong economic case to invest in agriculture for future food security and rural livelihoods under climate change (IFAD, 2016b) and international organizations working in the field of agriculture and rural development are committed to it. Here we look at the example of international financing from the International fund for agriculture Development (IFAD), which works with governments and communities to reduce the vulnerability to climate variability and longer-term climate change and is committed to scaling up investments in mainstreaming environment and climate change (IFAD 2016a, 2018a,b). IFAD also works at integrating climate and environment into its programme of work in the countries, starting from the very early stage of country strategies through country strategic opportunities programme (COSOP) design (IFAD 2020).

Reducing GHG emissions while ensuring food security will be a challenge in Eastern and Southern Africa, as agriculture drives the rural economy (FAO 2017). There could be trade-offs between mitigation and economic development goals unless low-carbon options that are best cost-effective are promoted (Colenbrander et al. 2016). Green growth could be a solution. The international development community has generally converged on a definition of green growth consisting of job creation or economic growth that is either compatible with or driven by reduced emissions, improved efficiencies in the use of natural resources, and protection of ecosystems (e.g. OECD 2011, World Bank 2012, UNEP 2011). In Africa, green growth will mean pursuing inclusive economic growth through policies, programs and projects that invest in sustainable infrastructure, better manage natural resources, build resilience to natural disasters, and enhance food security (Sperling et al. 2012). Public and private investment in low emissions agriculture must rapidly scale up to meet climate change mitigation targets. There is the need to develop economic analyses and business cases for achieving climate

[1] Most NDCs began life as Intended NDCs (INDCs), which countries submitted before the Paris Agreement. At the start of COP 21 in Paris – also known as the 21st session of the Conference of the Parties to the UN Framework Convention on Climate Change (UNFCCC) - some 190 countries had submitted their INDCs. Upon formal acceptance of the Paris Agreement, which entered into force on 4 November 2016, most countries converted their INDCs into NDCs. Under the terms of the Agreement, countries also agreed to communicate and update their NDCs by 2020 and every five years thereafter. For the sake of simplicity, in this report we adopt only the term NDC.

change mitigation in agriculture. For example, CCAFS has prepared such cases with a focus on opportunities in production[2].

In this context, we present here an economic case for investing in climate change mitigation and support low-carbon development path in Eastern and Southern Africa (ESA) region. We aim to quantify the mitigation potential of the area with specific reference to the AFOLU sector and to discuss possible socio-economic criteria in orienting the investments to exploit such mitigation potential and to shift from business as usual to greener agriculture. Results will provide elements to shape policies and strategies for potential subsequent investments in climate change mitigation.

2. Data and methods

2.1 Data

The analysis is developed with reference to the 22 countries included in the IFAD ESA Region. It also considers the following sub-regions: (i) Southern Africa (10 countries); (ii) East Africa and Indian Ocean (9 countries); (iii) Horn of Africa (3 countries). The complete list of countries, by sub-region, is reported in Table 1.

Table 1. List of countries and sub-regions considered in the analysis

Eastern Africa and Indian Ocean		Southern Africa		Horn of Africa	
1	Burundi	1	Angola	1	Eritrea
2	Comoros	2	Botswana	2	Ethiopia
3	Kenya	3	Eswatini (Swaziland)	3	South Sudan
4	Madagascar	4	Lesotho		
5	Mauritius	5	Malawi		
6	Rwanda	6	Mozambique		
7	Seychelles	7	Namibia		
8	Tanzania	8	South Africa		
9	Uganda	9	Zambia		
		10	Zimbabwe		

Source: own elaboration

Data sources include country documents and global datasets. Specifically:

(i) UNFCCC GHG Data Interface which includes data from the National Communications (NCs), 1990-2015;
(ii) FAOSTAT dataset on GHG emissions from agriculture[3];
(iii) Country (Intended) Nationally Determined Contributions (NDCs), available on the online NDC registry[4], which includes baseline from various years (2005-2020) and target reductions to 2030;
(iv) World Bank national accounts data, and OECD National Accounts data files, various years, 2016-2019;

[2] See https://ccafs.cgiar.org/invest-climate-change-mitigation-and-agriculture

[3] The FAOSTAT domain 'Agriculture Total' contains estimates of the greenhouse gas (GHG) emissions from agricultural activities. These emissions consist of non-CO2 gases, namely methane (CH4) and nitrous oxide (N2O) from crop and livestock productions and associated management activities within the farm gate. Data are computed using Tier 1 default factors of the IPCC Guidelines for National greenhouse gas (GHG) Inventories. An useful note about the use of the FAOSTAT data can be found in Tubiello et al. (2013).

[4] See: https://www4.unfccc.int/sites/ndcstaging/Pages/Home.aspx

(v) International Monetary Fund, International Financial Statistics and data files, various years, 2005-2019;
(vi) IFAD Country Strategy and Opportunities Programmes (COSOP) prepared under various IFAD's Performance-based Allocation System (PBAS) allocation cycles and the related Social, Environment and Climate Assessment Procedures (SECAP) document. When they are not available, the Country Strategy note (CSN) is used instead; and
(vii) country level green growth strategies and/or national investment plans for agriculture and rural sectors (NAIPs) (when available).

Different timeframes apply for the NDCs. While the same projected year is used (2030 for all the NDCs considered), different baseline year is used depending on the country. Similarly, the COSOPs cover different time periods and PBA cycles. Therefore, data are standardised for meaningful data comparisons among the countries. For example, the abatement costs are computed as annual averages.

Financial budgets associated to the mitigation targets included in the NDCs are derived from the NDC documents. They are already expressed in US dollars (US$) and no issues related to the use of local currencies arise. However, since financial figures refer to different time periods, they have been adjusted to account for the inflation rate. They are expressed in constant 2010 US$: the year 2010 is chosen as reference year for the analysis. We adjust financial data using the US consumer price index (CPI) as inflation measure[5] through the following formula:

$$Adjusted\ cost\ (2010\ prices) = Cost\ (year\ i\ prices) \times \frac{CPI\ year\ 2010}{CPI\ year\ i}$$

2.2 Methodology

With reference to the countries listed in **Table 1** and to the timeframe indicated above, the analysis presented in this report is conducted according to the methodology described in what follows.

First, we quantify the mitigation potential of the area with specific reference to the AFOLU sector. We analyse the national communications and data from the national inventories to assess the current GHG emissions profile at regional and national level. Next, we review the Nationally Determined Contributions (NDC) submissions to quantify the mitigation targets and analyse the proposed actions and targeted sectors[6]. We examine all sectors included in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter 2006 IPCC Guidelines), namely: These sectors include: ‘Energy’, ‘Industrial Process and Product Use

[5] US inflation rates more accurately reflect the price changes of tradable resources (which are often globally purchased and priced) compared with local inflation rates. However, it may not be reflective of the price changes for local non-tradable resources. As US inflation rates are typically lower than local inflation rates, we may underestimate the adjusted costs related to the non-tradable resources. In the AFOLU sector there is high use of tradable resources (inputs and energy) and the main local resource is labour whose market is often imperfect. Also, here we are interested at the comparison among the different values rather than at the absolute values. Therefore, eventual costs underestimation would only limitedly affects our findings.

[6] A “target” represents an intention to achieve a specific result within a given timeframe, for example to reduce GHG emissions to a specific level (GHG target, i.e. –20% by 2030) or increase energy efficiency to a specific level (non-GHG target, i.e. achieve an energy matrix with 50 MW of electricity from renewable sources by 2030). An “action”, on the contrary, represents an intention to implement specific means of achieving GHG reductions, such as policies (i.e. revision of Building Code to improve energy performance through thermal building and renovation standards and a certification process), or projects (i.e. completion of the USD 165 million Kénié hydropower project between 2015 and 2020, Swaziland).

(IPPU)', 'Agriculture', Land use, land-use change and Forestry (LULUCF)' and 'Waste'. We specifically look at the agriculture and LULUCF sectors (which are often aggregated as AFOLU). We look at the net GHG emissions, which are computed as the difference between the direct emissions and the removals (through Carbon sinks). We consider only the mitigation commitments (adaptation is excluded from the analysis).

Second, we explore the possible socio-economic criteria in orienting the investments to exploit such mitigation potential. We compare carbon-effectiveness with cost-effectiveness: the former is defined as the quantity of GHG emissions potentially mitigated by the national commitments (measured in tCO_2e) and refer to the overall mitigation goal; the latter refers to reaching such goal in a cost-effective way and is proxied by the marginal abatement cost, i.e. the unitary cost of reducing GHG emissions (measured in \$/ tCO_2e). By introducing cost effectiveness into the analysis, we expect to gain social efficiency and optimize the use of climate finance.

We use as proxy of the abatement cost the mitigation budget indicated in each NDC (under the conditional scenario). We proceed as follows: since the different sectors are characterised by different Carbon intensity and economic performance, the abatement cost may vary depending on the sector. Therefore, we cannot simply divide the total budget by the total emissions indicated as mitigation target in the NDCs. To account for the different costs to reduce emissions in the different sectors, we use the value added by sector (in constant 2010 US\$[7]) to weight the budget required to reduce emissions in the corresponding sector. We use the value added for manufacturing, industry, and services to weight the emission reduction costs for the 'energy, IPPU and waste' sectors; and the value added for agriculture, forestry and fishing as weight for the AFOLU sectors. We compute the economy-wide abatement cost as a weighted average. We also estimate the sectoral abatement cost as the ratio between the sectoral budgets (AFOLU versus 'energy, IPPU and waste'), obtained from the weighting procedure, and the sectoral emissions.

$$MAC\ sector\ i, country\ j = \frac{(mitigation\ budget\ i, j * \%\ VA\ i, j)}{mitigation\ target\ i, j}$$

Third, we combine the two criteria (carbon- and cost-effectiveness) by building marginal abatement costs curves (MACCs) to estimate the cost-effectiveness of the NDCs in generating mitigation benefits. We build both economy-wide and AFOLU-related MACCs: the former consider all 2006 IPCC Guidelines, while the latter considers only AFOLU (sum of Agriculture and LULUCF). With reference to earlier research about marginal abatement cost curves (Jiang et al., 2020) we apply MACCs to quantify emission abatement costs of each country starting from the information in the NDCs. We compute the unitary mitigation potential in terms of constant 2010 US\$ per ton of carbon dioxide equivalents (CO_2e) abated compared with the business as usual scenario (counterfactual).

We use here the 'bottom-up' approach to deal with the heterogeneity of countries' economies (Branca et al., 2015; 2020). For each country, we link the budget foreseen under the conditional scenario (which is used as proxy of the expected costs) with the mitigation potential resulting from the corresponding mitigation targets. The economy-wide and AFOLU-related MACCs are built by plotting the abatement costs of various countries (per unit of CO_2e mitigated) on the vertical axis, and the volume of emissions saved (total units of CO_2e mitigated by the 2030 target year) on the horizontal axis. Positive gross margins indicate negative abatement costs (and vice versa). The curve is upward sloping. The list of countries is ordered by increasing

[7] Data source: World Bank national accounts data, and OECD National Accounts data files. Various years, 2016-2019.

abatement costs and volumes of CO_2e abated. The results are also compared with reference to the GDP per capita which is selected as proxy of the countries' economy level.

Unfortunately, countries do not use a common metric in estimating the emissions and financing pledges which are assessed in the national communications and determined contributions. Mechanisms to compare domestic efforts to mitigate global climate change are key elements for the ex-ante comparisons of proposed pledges (and ex-post assessments of subsequent actions delivering on those pledges) in the international climate policy architecture emerging from the Paris agreement (Aldy et al., 2016). Specifically, while for the emissions levels public domain data exist making the estimated levels universal, measurable, and replicable, the assessment of emissions abatement and related costs is challenging (Aldy and Pizer, 2015). Our methodology represents an objective method which looks at the comparison among countries more than at the absolute values. More in depth analysis would require modelling tools and subjective choices to determine counterfactual and to model costs (e.g. see Markandya and Boyd, 1999; Böttcher et al., 2011) which are out of the scope of this report.

3. Results and discussion

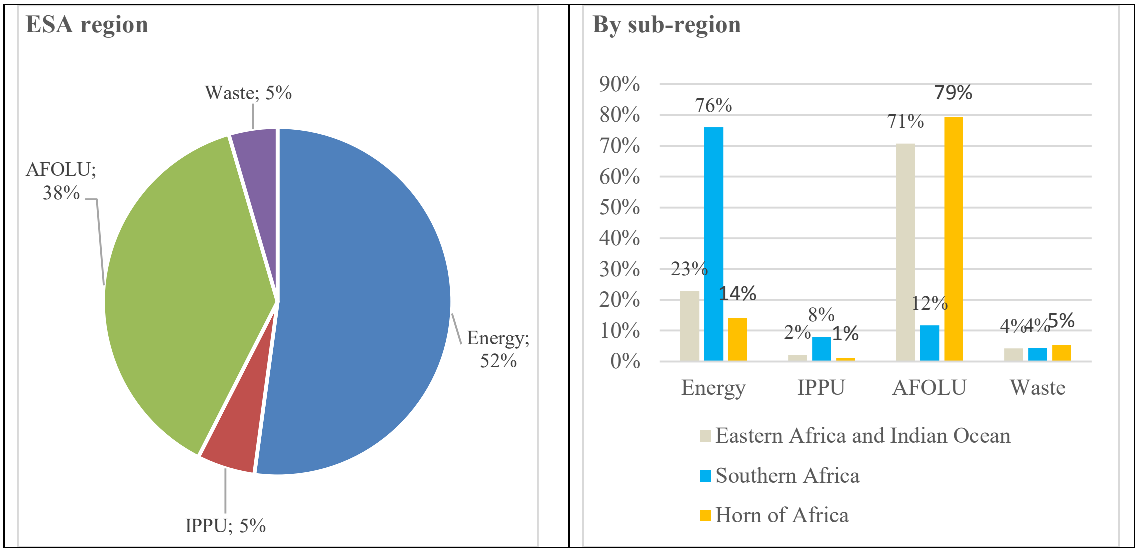
In this section, we report and discuss the analytical results obtained by applying the methodology described above, with reference to the ESA region. First, we summarize the results from the analysis of the NCs (Inventories) (and FAOSTAT data) describing the GHG emissions profile at regional and country level. Second, we report the quantitative results of the analysis of the regional and national mitigation potential which emerges from the NDCs and the relative budget within the conditional scenario[8]. We refer to the conditional scenario since we are interested at the investment needs and at the possible contribution from international financing. Third, we present the planned measures and the country strategies, also with the reference to the IFAD program of work in the region.

3.1 The GHG emissions profile

Based on the latest figures reported in the GHG inventories available from the National Communications, the economy-wide level of GHG net emissions amount to about 819 $MtCO_2e$ for the reference period 1990-2015. Looking at the contribution from the different sectors (Figure 1), the Energy sector represents the most significant share of net emission in the region (52%), followed by the Agriculture, Forestry and Other Land Use (AFOLU) sector (which also includes land use change) (38%), Waste and Industrial Processes and Product Use (IPPU) sectors (5%, respectively).

[8] An unconditional contribution represents a commitment to achieve a certain goal (i.e. a target or action) that a country declares to undertake irrespective of any conditions. On the contrary, a conditional contribution represents a commitment to achieve a certain goal (i.e. a target or action) given that certain conditions are met, such as the provision of finance, capacity building and technology transfer, and they usually represent a progression from the unconditional contribution.

Figure 1. GHG net emissions per sector, by region and sub-region



Source: own elaborations from UNFCCC GHG Data Interface (1990-2015)

While the agriculture sector constitutes a source of annual net emissions (0.29 Gt CO_2e), the Land Use, Land Use Change and Forestry (LULUCF) sector is almost neutral with a level of annual net emissions amounting to 0.02 Gt CO_2e. Within the AFOLU sector, the GHG sources from agriculture and LULUCF sectors have a similar weight (36% and 32% each, respectively), as can be derived by examining the detailed contributions to GHG emissions reported in Table 2. Largest sources of emissions in the region are forest degradation, grassland biomass burning, enteric fermentation and non-CO_2 emissions from managed soils, cropland biomass and manure management. Negative values indicate removals, constituted by enhanced forest management and afforestation within the LULUCF category (FAO 2017).

Table 2. GHG net emissions per sector from ESA countries' national inventories ($MtCO_2e$)

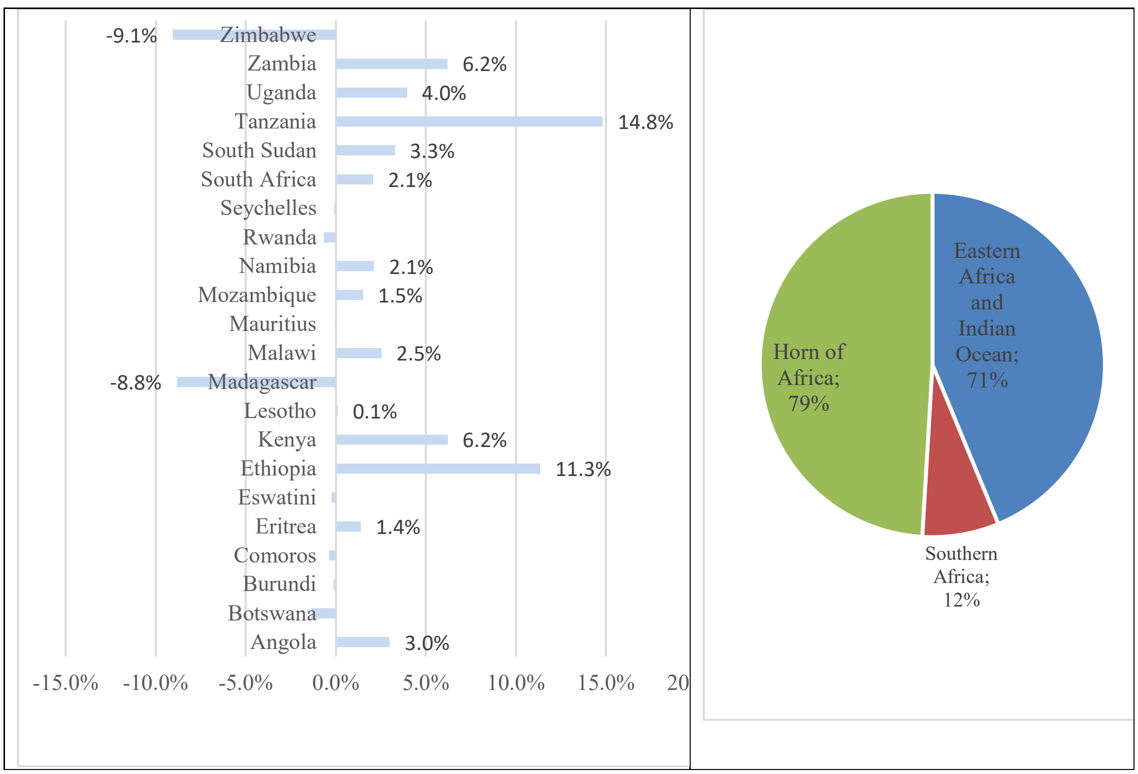
Country	Energy	IPPU	Agriculture	LULUCF	Waste	Total
Angola	37.7	0.4	22.6	1.9	1.0	63.5
Botswana	6.9	0.5	16.4	-27.5	0.1	-3.5
Burundi	1.1	0.0	0.4	-1.3	0.2	0.4
Comoros	0.1	0.0	0.2	-3.2	0.0	-2.9
Eritrea	0.8	0.0	3.1	8.3	0.0	12.2
Eswatini	1.1	4.9	1.2	-3.3	0.3	4.3
Ethiopia	20.0	1.8	67.2	25.5	6.1	120.5
Kenya	16.3	2.2	29.6	21.2	1.9	71.1
Lesotho	1.1	0.0	2.2	-1.4	0.2	2.1
Madagascar	3.0	0.2	24.1	-96.2	0.5	-68.4
Malawi	3.7	0.1	3.2	17.5	0.1	24.6
Mauritius	4.9	0.8	0.0	-0.4	1.5	6.9
Mozambique	1.9	0.1	4.6	7.7	1.7	16.0
Namibia	2.2	0.0	6.7	10.6	0.2	19.7

Rwanda	1.7	0.1	2.9	-8.5	0.6	-3.8
Seychelles	0.3	0.0	0.0	-0.8	0.1	-0.5
South Africa	297.6	30.4	35.5	-18.6	16.4	361.2
South Sudan	2.7	0.0	0.0	26.8	2.8	32.3
Tanzania	6.9	0.4	29.7	91.4	2.2	130.6
Uganda	4.9	0.2	21.8	10.5	0.7	38.1
Zambia	2.6	1.0	10.4	40.3	0.4	54.7
Zimbabwe	10.6	0.9	9.0	-83.0	0.6	-61.8
Total ESA	427.8	43.8	290.9	17.5	37.2	817.2

Source: own elaborations using data from UNFCCC GHG Data Interface (1990-2015)

Countries' contributions to the AFOLU-related (38%) GHG net emissions are shown in Figure 2. While for total emissions the sum of all countries' contribution is equal to 100%, for the AFOLU emissions the sum of countries' emissions and removals amounts to 38% (which is the total weight of the AFOLU sector to regional emissions).

Figure 2. Contribution to regional GHG net emissions from AFOLU sector, by country and sub-region (%)



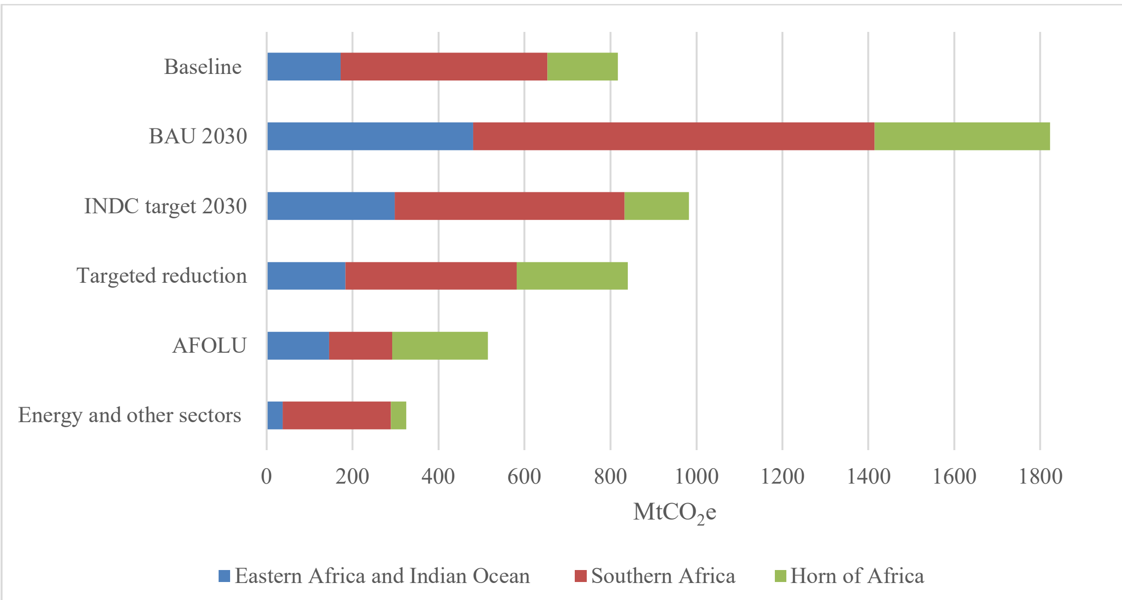
Source: own elaborations using data from UNFCCC GHG Data Interface (1990-2015)

3.2 The NDC mitigation targets: an economic perspective

In this section we look at the mitigation potential of the ESA region (by region and country) which emerges from the analysis of the countries' NDCs, with specific attention to the economic implications. We also make both economy-wide and sectoral level considerations, with the goal to compare the AFOLU aggregate with the 'energy, IPPU and waste' one.

A picture of the baseline GHG emissions, the 2030 business as usual (BAU) projected scenario, the overall mitigation targets computed as sum of the national mitigation targets derived from the NDCs, and the target GHG reduction are shown in Figure 3. The figure also reports information by regional hub (Eastern Africa and Indian Ocean, Southern Africa, and Horn of Africa), and by sector (AFOLU, energy and other sectors).

Figure 3. GHG emissions and mitigation targets, by region and sub-region



Source: own elaborations using data from UNFCCC GHG Data Interface (1990-2015)

Out of the 22 countries of the ESA region, 21 communicated their ambitions towards reducing GHG net emissions in their mitigation contributions through the NDCs (Table 3 and Table 4). Only the South Sudan's NDC is not available. The baseline year indicated in the NDCs ranges between 2005 and 2020. At the aggregate level, economy-wide net emissions in the ESA region reported in the NDCs are expected to increase by 123% between the baseline (2005-2020) and 2030 (from 818 to 1,823 $MtCO_2e$). Full implementation of both conditional and unconditional mitigation targets set forth in the NDCs would limit the increase of regional net emissions to about 20% above the baseline – equivalent to a cumulated net emission reduction of about 840 Mt CO_2e in 2030[9]. Ethiopia and South Africa have indicated the biggest share of expected reduction in the net emissions at regional level (Figure 4).

[9] It must be specified that not all NDC include economy-wide GHG baseline and mitigation targets. In such cases, we have used information available from the NCs instead.

Table 3. Unconditional and conditional targets

Country	Unconditional target	Conditional target
Angola	35% below BAU	Additional 15% is conditional
Botswana	15% below 2010 levels	
Burundi	3% below BAU	Additional 17% is conditional
Comoros	84% below BAU	
Eritrea	39.2% unconditionally below BAU	Additional 41.6% is conditional
Eswatini (Swaziland)		NDC sets out a number of sectoral measures
Ethiopia		64% below BAU
Kenya		30% below BAU
Lesotho	10% below BAU	Additional 25% is conditional
Madagascar		14% below BAU
Malawi	NDC sets out a number of sectoral measures	NDC sets out a number of sectoral measures
Mauritius		30% below BAU
Mozambique		Reduction of 67.5 $MTCO_2e$
Namibia	79% below BAU	Additional 10% is conditional
Rwanda		NDC sets out a number of sectoral measures
Seychelles		29% below BAU
South Africa	SA's commitment takes the form of a peak (between 2020 and 2025), plateau for approximately a decade and decline in absolute terms thereafter.	
South Sudan		
Tanzania		10-20% below BAU
Uganda		22% below BAU
Zambia	25% below BAU	Additional 22% is conditional
Zimbabwe		33% below BAU

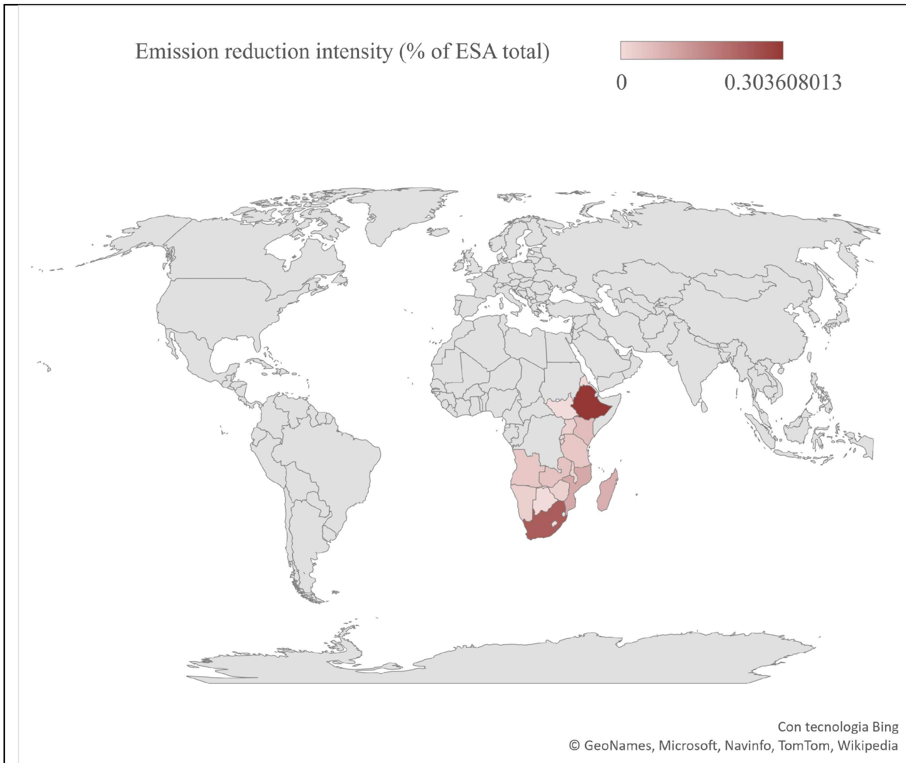
Source: countries' NDCs

Table 4. Economy-wide GHG net emissions: baseline, BAU 2030 and mitigation targets, by country, region and sub-region

Country	Base year	Baseline	BAU 2030	INDC target 2030	Targeted reduction	Targeted yearly reduction	Energy and other sectors	AFOLU
		$MtCO_2e$				$MtCO_2e$/year	$MtCO_2e$	
Angola	2005	64	193	161	32	1.27	20	12
Botswana	2010	-4	8	7	1	0.06	0	1
Burundi	2005	0	75	60	15	0.60	11	3
Comoros	2015	-3	1	0	0	0.03	0	0
Eritrea	2010	12	8	5	3	0.16	0	3
Eswatini (Swaziland)	2010	4	5	4	1	0.05	1	0
Ethiopia	2010	121	400	145	255	12.75	35	220
Kenya	2010	71	143	97	46	2.29	13	33
Lesotho	2015	2	6	4	2	0.13	1	1
Madagascar	2010	-68	22	-45	68	1.81	4	64
Malawi	2015	25	42	27	15	1.00	3	12
Mauritius	2015	7	7	5	2	0.14	2	0
Mozambique	2020	16	19	-57	77	7.65	17	59
Namibia	2010	20	23	3	20	1.13	2	19
Rwanda	2015	-3	4	-1	5	0.31	2	2
Seychelles	2020	0	0	0	0	0.02	0	0
South Africa	2020	361	614	418	196	21.60	196	0
South Sudan		32						
Tanzania	2015	131	153	122	31	2.04	2	28
Uganda	2015	38	77	60	17	1.13	3	14
Zambia	2010	55	80	42	38	1.90	3	35
Zimbabwe	2020	-62	-57	-74	17	1.73	10	7
Total ESA		818	1823	983	840	56	325	515
Eastern Africa and Indian Ocean		172	481	298	183	8.36	38	145
Southern Africa		481	933	535	399	36.53	252	147
Horn of Africa		165	408	150	258	12.91	35	223

Source: own elaborations using data from countries' NDCs

Figure 4. ESA region, contribution to the NDCs 2030 mitigation targets (%)



Ethiopia	30.7%
South Africa	26.0%
Mozambique	9.2%
Kenya	5.5%
Zambia	4.6%
Madagascar	4.3%
Angola	3.8%
Tanzania	3.7%
Namibia	2.7%
Zimbabwe	2.1%
Uganda	2.0%
Malawi	1.8%
Burundi	1.8%
Rwanda	0.6%
Eritrea	0.4%
Mauritius	0.3%
Lesotho	0.2%
Botswana	0.1%
Eswatini	0.1%
Comoros	0.1%
Seychelles	0.0%
South Sudan	0.0%

Source: own elaborations from countries' NDCs

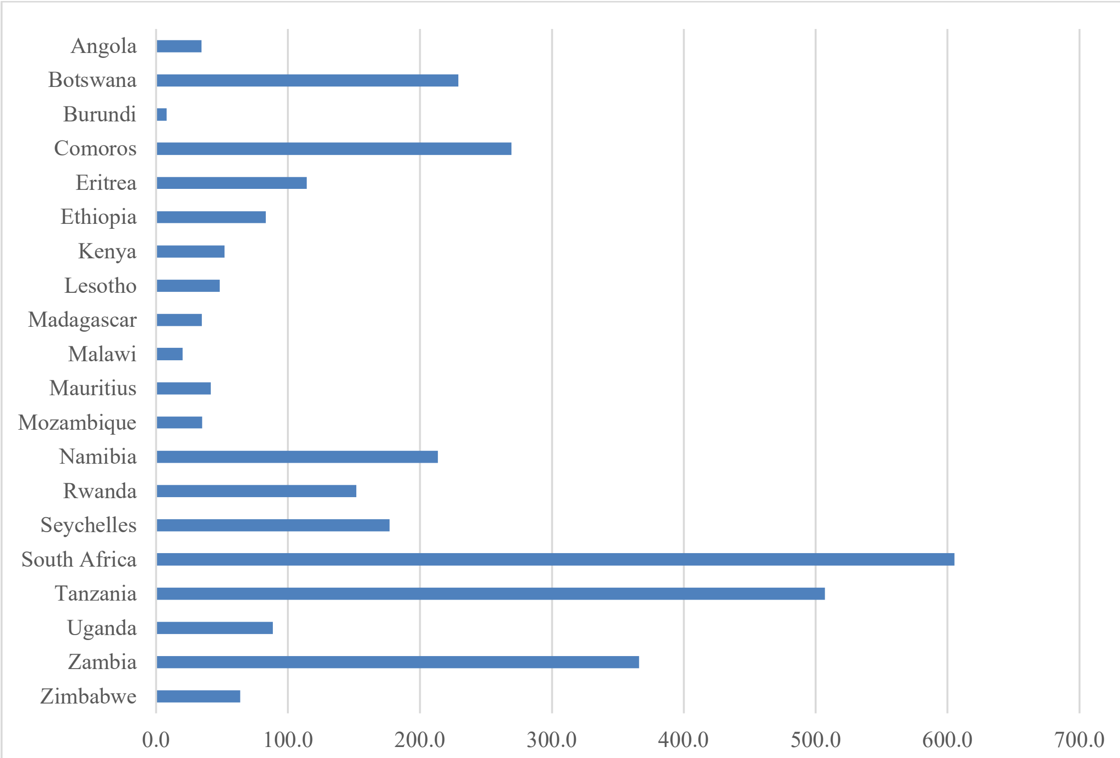
In the NDCs, countries also indicate the sectors potentially contributing to the mitigation targets reported, either by reducing the emissions' sources or by increasing the carbon sinks. We observe that: (i) all countries explicitly indicate the energy sector as a major mitigation source and indicate a wide range of measures, from hydropower to renewable energy, efficient energy technologies and electric engines; (ii) 71% of countries have indicated an ample spectrum of measures both for agriculture and LULUCF sectors (e.g., improved and climate-smart crop and livestock management, agroforestry, reduction in biomass burning and wildfires, soil and water conservation, afforestation/reforestation/improved forest management, improved wetland management; (iii) 67% of countries have committed to invest in mitigation measures from the waste sector (e.g., solid waste disposal, composting, domestic/industrial wastewater treatments); and (iv) 43% of countries have listed mitigation measures within the IPPU sector (e.g., more sustainable cement production, improved building techniques). A summary of such measures by country can be found in Table 5 (see section 3.3).

In preparing a regional strategy to exploit the regional and national mitigation potential emerging from the NDCs, the first option is to guide the investments using a carbon-effectiveness criterion, i.e. prioritizing the results in terms of total mitigation targets. However, since we are looking here at the conditional targets, which would require the financing contribution from the international community, there is the need to introduce a value-for-money criterion. We therefore also look at the cost-effectiveness of the proposed mitigation contributions. Thus, we have estimated the GHG abatement cost by country. As summarised in the methodology, we looked at the proposed budget reported in the NDCs[10] and computed the unit cost of abatement using a weighting procedure. The economy-wide national abatement

[10] The total budget is available for 20 countries.

costs resulting from such procedure are shown in Figure 5. They are reported here by country in alphabetical order.

Figure 5. Economy-wide GHG abatement costs, by country (constant 2010 US$/$tCO_2e$)[11]



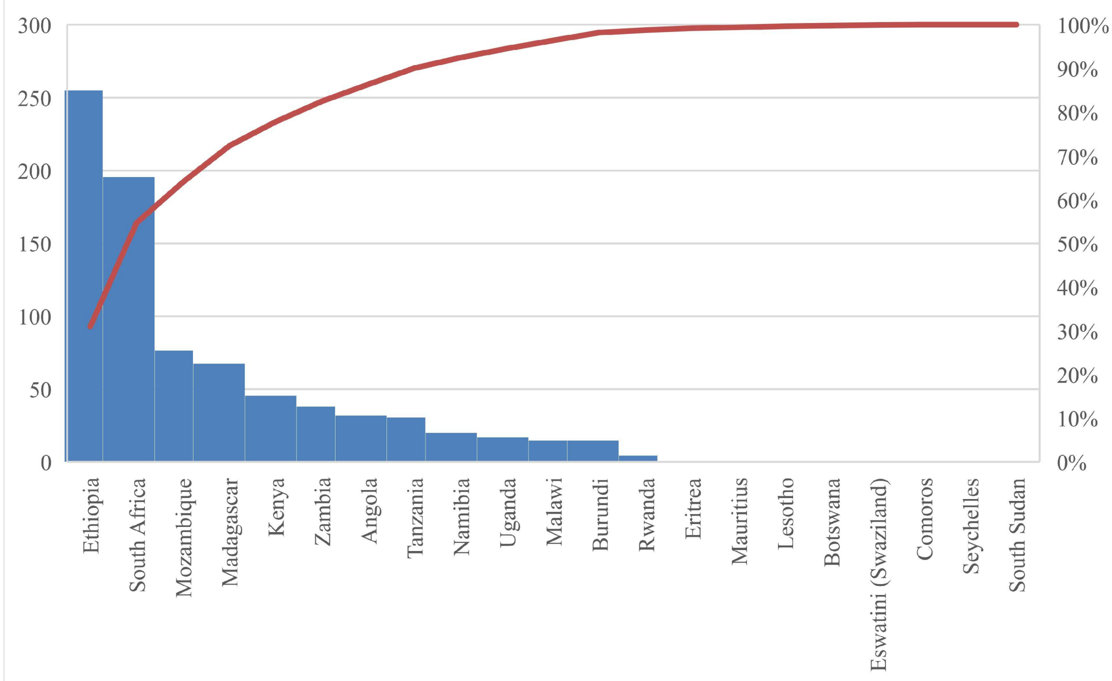
Source: own elaborations

Orienting the investments according to the two different decision criteria, carbon-effectiveness or cost effectiveness, would result in different outcomes, as shown in Figure 6. By adopting the carbon-effectiveness criterion, it may be more effective to prioritize countries with the highest intended mitigation programs (e.g. Ethiopia, South Africa). On the contrary, by choosing the cost-effectiveness one, it may be more effective to prioritize countries where the marginal abatement cost is relatively lower (e.g., Malawi, Angola, Madagascar). Figure 7 shows a cross-comparison of the results from the implementation of the two different criteria. The figure relates the annual mitigation potential (carbon-effectiveness) to the unitary abatement costs (cost-effectiveness). The annual abatement potential controls for the different timeframes of the NDCs. The size of the bubbles reflects the total Carbon savings.

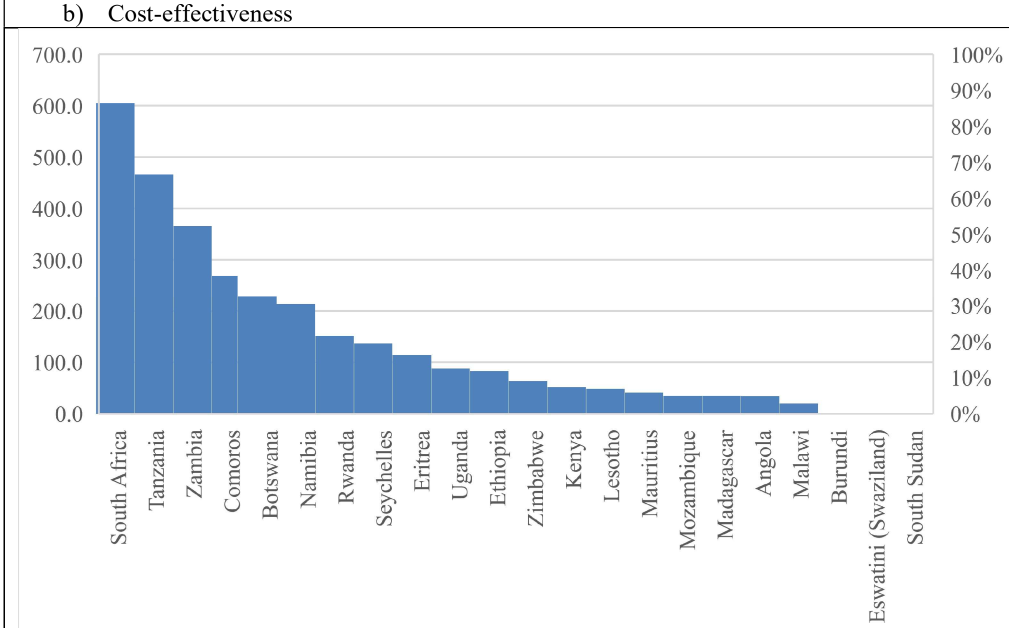
[11] The data for Eswatini and South Sudan are not available

Figure 6. Economy-wide carbon effectiveness and cost-effectiveness, by country

a) Carbon effectiveness



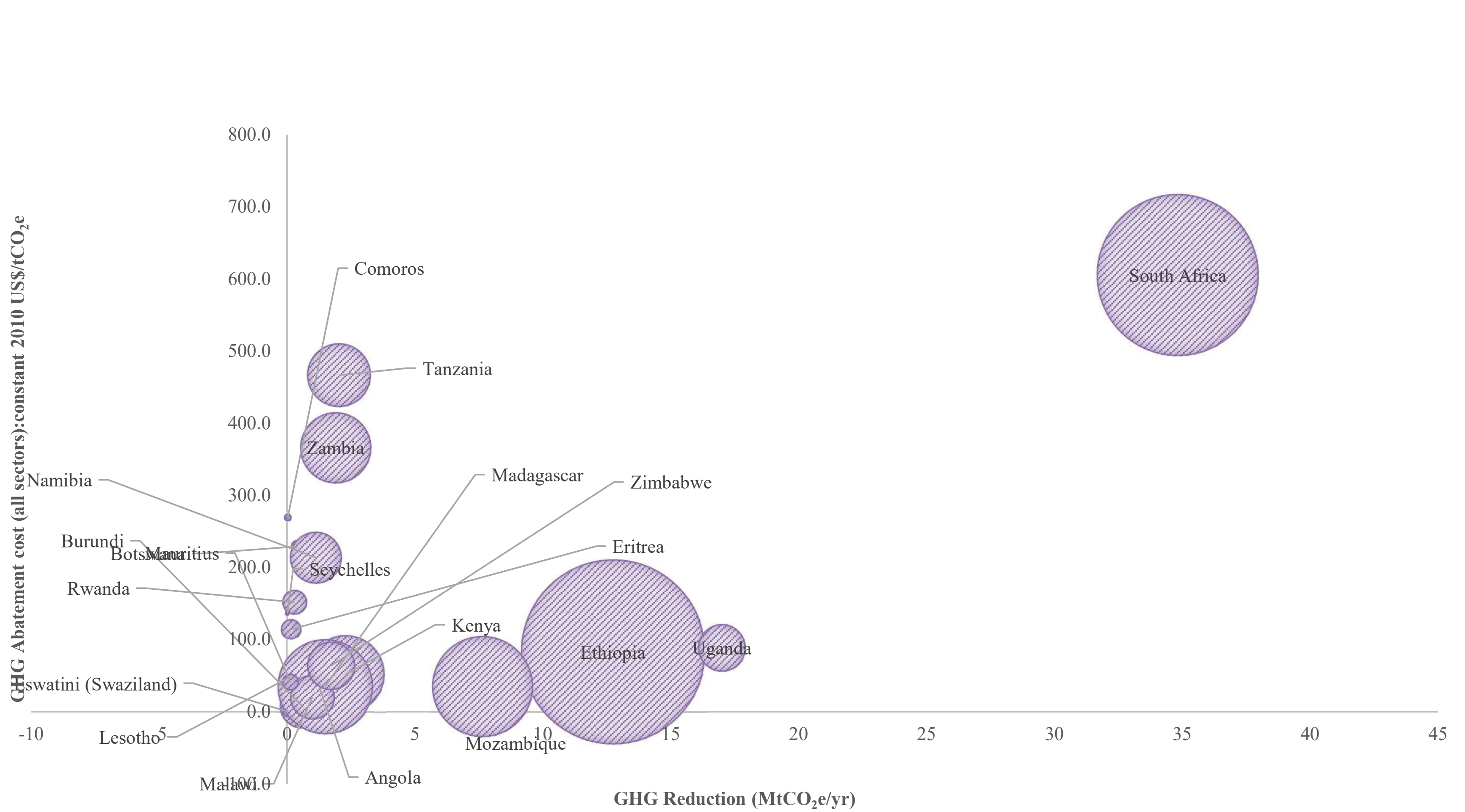
b) Cost-effectiveness



Source: own elaborations

Figure 7. Distribution of countries' mitigation opportunities according to cost- and carbon effectiveness.

The size of the 'bubble' reflects the total Carbon savings

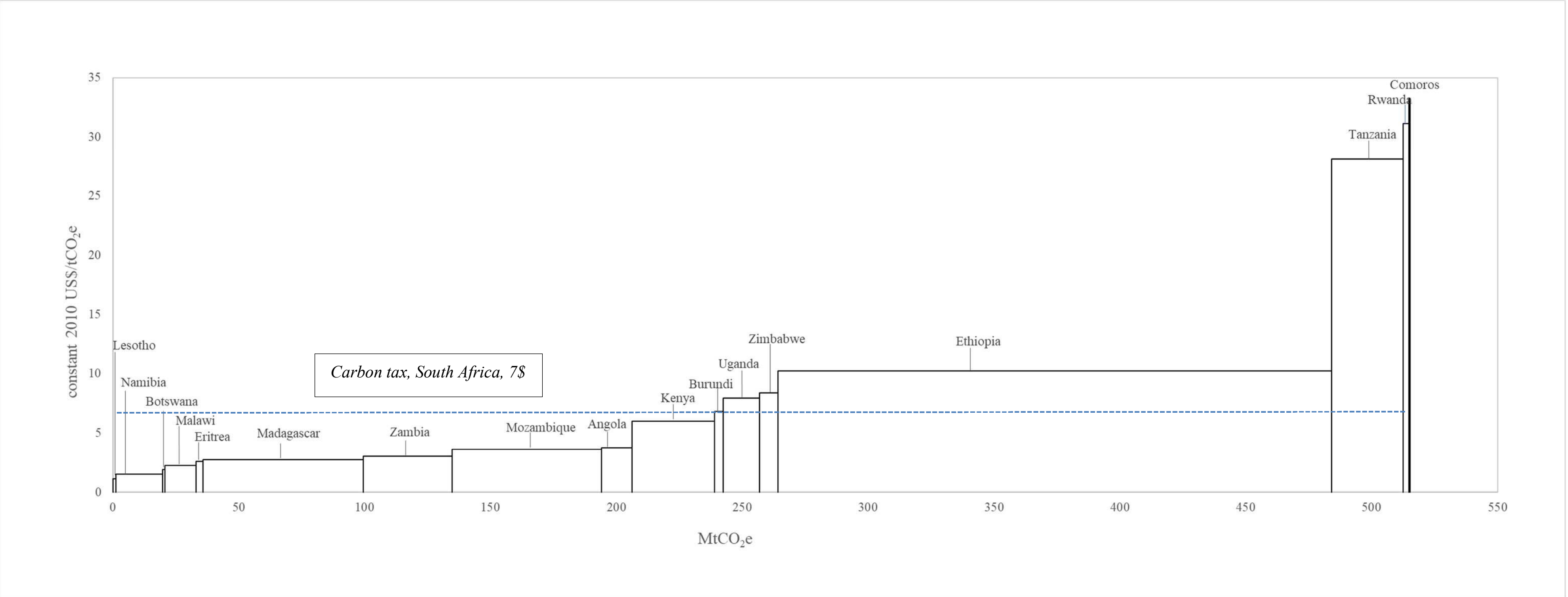


There are trade-offs in adopting one criterion or another. The marginal abatement cost curves (MACCs) are a useful way to visualize this trade-off. Each bar corresponds to a specific country (and to its mitigation commitments as indicated in the NDC). The height displays the on-country unit mitigation cost: it is measured on the y axis and is expressed in constant 2010 US$ per ton of CO_2e. The width indicates the mitigation potential: it is measured on the y axis and is expressed in ton of CO_2e. The area displays the on-country total abatement cost (in constant 2010 US$). Since countries are ordered by increasing marginal abatement costs and volumes of CO_2e abated, moving along the curve from left to right worsens the mitigation profitability of mitigation plans, as each ton of CO_2e mitigated becomes more costly. This indicates the country plan mitigation option that should progressively be implemented to seek cost-effective climate change mitigation.

Given that we are interested at the investments' opportunities in the agriculture and LULUCF sectors, we have specifically analysed the mitigation potential of the AFOLU aggregate which figures prominently in the region's commitments to a low-emissions and sustainable development pathway. Its mitigation potential is about 60% (the remaining 40% is from energy, IPPU and waste sectors). However, such figures should be considered as an approximation: we have estimated such mitigation potential starting from the NDCs' targets. Unfortunately, only a few countries (Comoros, Ethiopia, Namibia and Rwanda) report the reduction targets by sector; for the other countries, we have assumed that the expected AFOLU contribution to the economy-wide mitigation is proportional to the % contribution of the various sectors to the national level of net emissions, as reported in the GHG emissions inventory. We have used such % contributions as weights to estimate both the mitigation targets and the associated financial budget required under the conditional scenario. We are aware that this procedure assumes that the overall structure of the economy will remain unchanged with respect to the baseline, in the timeframe of the current analysis. Also, some measures such as the use of renewable energy or ethanol production are often included in the energy sector-related options even if they are clearly linked to the agriculture sector. The AFOLU mitigation potential reported here is therefore under-estimated. The mitigation potential for the two aggregates (AFOLU and 'Energy, IPPU and waste'), both at regional and national levels, is shown in Table 4.

We compare the abatement costs of the two aggregates finding that the costs are very different. In particular, the overall consideration is that the abatement costs in the AFOLU sectors are lower than those in the 'energy, IPPU and waste' sectors. This is due to the type of investments foreseen under the different sectoral plans described in the NDCs, since most infrastructures would be built to reduce emissions related to energy (see the Table 5 in section 3.3). This may have important implications in terms of mitigation strategies. From the pure standpoint of the economic efficiency (without any consideration of the implementation, policy, socio-economic and risk issues) it would be more cost-effective to first exploit the mitigation potential of AFOLU sectors (about 515 Mt corresponding to about 60% of the regional mitigation potential) and then financing the (more costly) mitigation options in the remaining sectors of the economy. This would enhance the efficiency of the overall mitigation program. The resulting inputs to the strategic orientation of the potential mitigation investment plan are summarised by the MACC developed with only reference to the AFOLU sector and reported in **Figure 8**.

Figure 8. ESA region, marginal abatement cost curve for the for the AFOLU sector



Source: own elaborations

By comparing the marginal abatement cost with the carbon price on the existing markets, it is possible to assess the profitability of investing in mitigation opportunities. It is estimated that carbon prices of at least US$50–100/$tCO_2e$ by 2030 are required to cost-effectively reduce emissions in line with the temperature goals of the Paris Agreement (CPLC, 2017). However, the global average carbon price is only US$2/$tCO_2e$ (IMF, 2019). Also, in the ESA region, only South Africa applies a price on carbon through a 7 US$/ tCO2e tax since 2019 (World Bank, 2020) which is chosen as proxy of the carbon market in the region. AFOLU abatement costs fall below such price in many countries, indicating the financial gain in investing in mitigation from AFILU sector in such countries.

It is also possible to categorize countries based on the different abatement costs using the concepts of 'economy of scope', which focuses on the average abatement cost, and 'economy of scale', which focuses on the cost advantage that arises when there is a higher level of mitigation potential. For example, countries to be prioritized according to the 'economy of scope' approach in the AFOLU sector would include e.g. Lesotho, Namibia, Botswana, Malawi, Eritrea, given the relatively low abatement cost level. Under such approach, prioritized interventions could be aimed to enhance country readiness. Following the 'economy of scale' approach in the AFOLU sector would prioritize e.g. Madagascar, Mozambique, Kenya, Ethiopia, given the relatively high mitigation potential.

Mitigation options within the AFOLU sectors may vary, including sustainable soil and improved cropland management, improving livestock and grazing management, agroforestry conversion and expansion, avoided deforestation/forest conservation, afforestation, sustainable forest management, rewetting of organic soils. Due to data constraints we cannot compute the abatement costs at this level of detail. Some information may be available in the literature at global (e.g., see McKinsey & Company, 2020), regional (e.g. see FAO, 2017 for Eastern Africa) or national (e.g. see Branca et al., 2020 for Malawi and Zambia). There is evidence that many mitigation options also deliver food security and income benefits (synergies between mitigation and economic development).

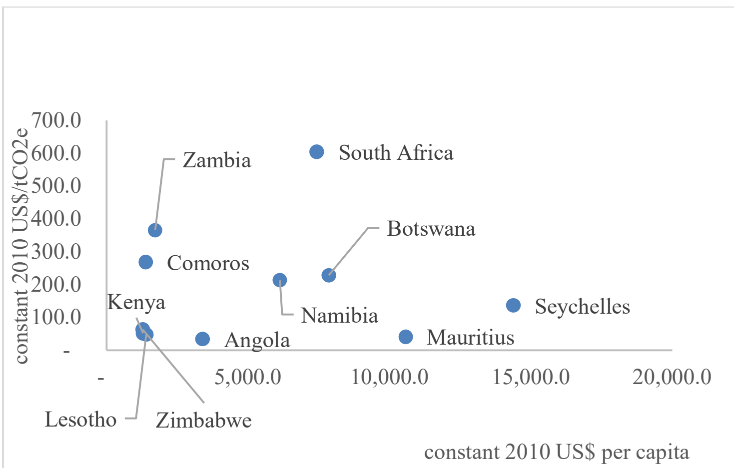
In estimating the cost-effectiveness of the mitigation options, the abatement costs are computed in constant 2010 US$ and the comparison is therefore meaningful. However, the countries in the region have different economy levels. We have therefore reported the GHG abatement costs by GDP level group (we have divided the countries in two groups below/above 1,000 constant 2010 US$/per capita and year), as shown in Figure 9 and Figure 10. By comparing countries with a similar GDP level, it is possible to say, for example, that the economy-wide abatement costs in Malawi, Mozambique and Madagascar are similar, and lower than those in Tanzania; or that the costs in Rwanda and Zambia are lower than those in Uganda.

Including GDP levels into the analysis provides additional insights to the problem of trade-off between carbon- and cost-effectiveness, extending it to the broader trade-off between mitigation and economic development. In international climate policy (e.g. the Kyoto Protocol) and theory (e.g. the hypothesized Kuznets curve, see Azomahou et al., 2006), is often evident the assumption that climate change mitigation can only be afforded at a certain level of income. This suggests that, under business as usual conditions, low and middle-income countries will need to reach a tipping point when low-carbon investment becomes affordable.

This is confirmed by looking at the Figure 11, in which the GHG emissions per capita are plotted against GDP per capita (the size of the bubbles indicates total abatement costs as share of GDP, indicating the economic burden of the planned mitigation measures on the national economy). Countries with relatively low GDP per capita have in general much lower emissions level and relatively higher abatement costs, indicating the importance of international finance (in the conditional NDC scenario) to afford the costs for mitigation. Indeed, countries with high emissions and low GDP per capita, show large differences with the conditional NDC scenario. Countries with high GDP show relatively small differences between the Conditional NDC scenario and the unconditional one (see also Hof et al. 2017).

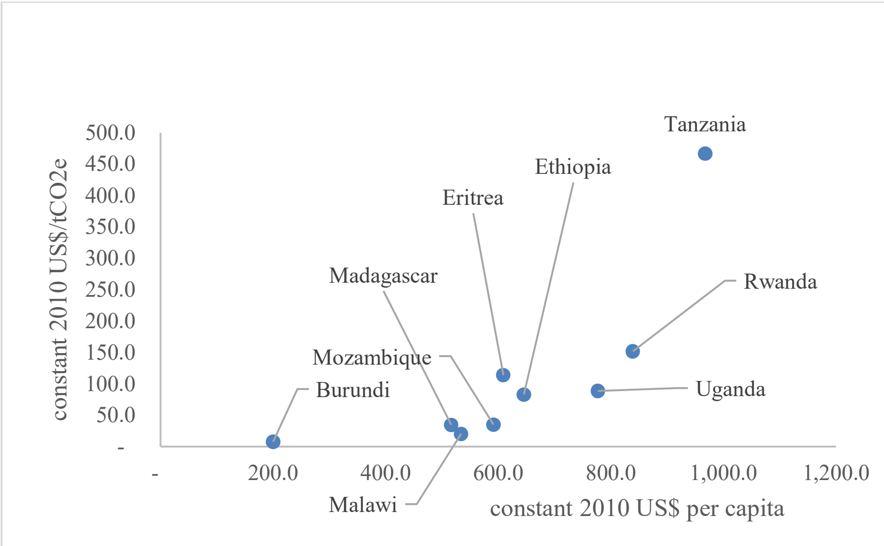
Supporting the mitigation plan of low-income countries could be a priority to solve the trade-off between mitigation and economic development, decoupling economic output from carbon emissions also in the frame of fighting against poverty and food insecurity. In this context, there would be the need to identify a wide range of opportunities that are cost-effective in their own, also in low- and middle-income countries. Assuming that these can be deployed in a socially and environmentally responsible way, public authorities could reasonably be expected to invest in these measures purely on economic grounds and this would coincidentally deliver real reductions in per capita emissions. Green strategies would represent an important opportunity to this extent, as discussed in the following section.

Figure 9. Economy-wide abatement cost, country group 1: medium-high income (>1,000 constant 2010 US$ per capita/year)



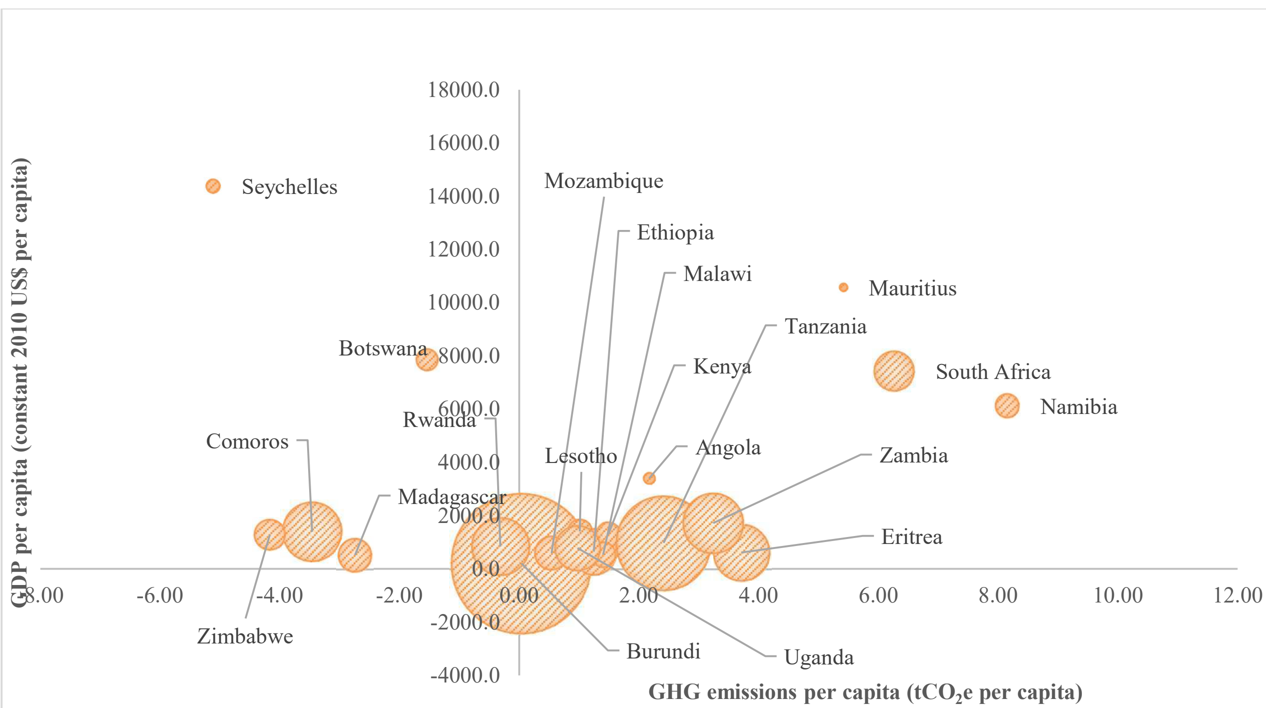
Source: own elaborations

Figure 10. Economy-wide abatement cost, country group 2: low-medium income (<1,000 constant 2010 US$ per capita/year)



Source: own elaborations

Figure 11. GHG net emissions per capita plotted against GDP per capita. *The size of the bubbles indicates abatement costs as share of GDP*



Source: own elaborations

3.3 Mitigation investment strategies

In this section we report the results of the analysis of the mitigation actions in the ESA countries' NDCs. We also compare such actions with the IFAD strategies as they emerge from the COSOPs and, when available, with the national green growth strategies.

The NDCs are rooted in a variety of existing or in progress plans, policies, or programs, including national development plans, climate change response policies, low-carbon development strategies, NAPs, NAPAs, National Climate Change Action Plans, and NAMAs. Mitigation efforts focus mainly on the AFOLU and energy sectors.

The list of priority mitigation actions indicated in the analysed NDCs is summarised in Table 5. We consider only the priority measures, i.e. those contributing to the 'conditional' mitigation NDC target and for which a budget is estimated. We exclude those indicated as measures with 'additional' mitigation potential. We report them by sectoral aggregate (AFOLU and 'Energy, IPPU and waste'), in line with the economic analysis conducted above. We specifically look at the eight priority areas most relevant to IFAD, namely: agriculture; biodiversity, ecosystem conservation and restoration; renewable energy; fisheries; food security and resilience; LULUCF; social inclusion; water and irrigation.

We find that most relevant intervention areas, in terms of number of proposed measures, relate to (i) energy, (ii) LULUCF, and (iii) agriculture.

(i) Energy-related measures have mainly to do with the enhancement of hydro-electric power and other renewable sources, energy efficiency, reduced emissions from transport. As access to reliable electricity is a development priority for many countries, the energy sector is often predicted to be the sector with the greatest increase in emissions. Thus, expanded use of renewable energy is a common mitigation action.

(ii) Given the widespread deforestation, and reliance on fuelwood in ESA countries, the land use change and forestry sectors are often the largest emitters. LULUCF mitigation options have a relevant mitigation potential. They include all forest-related mitigation activities with a special focus on policies and actions under REDD+[12], mainly reduced forest degradation and deforestation on the emission's side, and improved forest management and afforestation/reforestation on the sink's side. However, the realization of such potential is often constrained by economic and land-use factors (UNEP 2015). Also, in order for the developing countries to access results-based finance for REDD+, they need to have in place a national strategy or action plan, a national forest monitoring system, a safeguards information system and a summary of information on how the REDD+ safeguards have been addressed and respected, a forest reference emissions level, fully measured, reported and verified results, in terms of emission reductions/enhanced removals (UNEP 2015)[13]. Needs include capacity building, technology transfer, and assistance in inventory development (see also ICF, 2016).

[12] The REDD+ program includes reducing greenhouse gas emissions from deforestation and forest degradation, conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks.

[13] These requirements place some constraints on the potential for REDD+ implementation in the short term, for example the speed at which policies can be put in place and governance improvements can be implemented. The availability of finance, whether domestic or international, to cover the upfront costs of REDD+ measures will also be a determining factor. Results-based finance, by its nature, will be released only after success has been achieved. Many developing countries have expressed their interest in largescale forest-related actions, both in their NDCs and a range of other statements (UNEP, 2015).

(iii) GHG hotspots for emission' reduction in the agriculture sector are grassland biomass burning, enteric fermentation and poorly managed agriculture soils. Several countries refer to improved crop management to reduce their GHG emissions, mainly in addressing soil management on cropland, fertilizer use, and rice cultivation. For instance, Ethiopia commits to improve crop production practices for greater food security and higher farmer incomes, while reducing agricultural emissions. Many countries also foresee policies and measures aiming to increase energy production from agricultural biomass, with potential mitigation co-benefits.

We also screen the country COSOPs to analyse how IFAD's interventions can contribute to the country's NDC mitigation commitments[14]. We find that a wide range of measures with mitigation potential fall within the IFAD strategies, e.g. climate-smart agriculture, agroforestry, energy efficiency and renewable energy. Within the agriculture sector, measures include both improved crop management and livestock breeding, together with manure management.

In the NDCs, AFOLU-related measures are often not included within the mitigation priorities but are listed among the adaptation options. While adaptation is not directly considered in the present report, it is evident that synergies between mitigation and adaptation exist. Adaptation measures may generate important climate mitigation externalities and vice-versa.

The synergies between mitigation, adaptation and development are often reflected in the national green growth strategies, environmental policies and agriculture and rural development plans[15] which provide the opportunity to integrate the scaling up of practices that potentially benefit development, food security and climate change adaptation and mitigation into an existing continental and country owned sustainable agriculture development framework (Branca et al., 2012). In general, they aim to promote sustainable infrastructures, (e.g. access to renewable/low carbon energy and energy efficiency, sustainable transport, sustainable cities), efficient/sustainable management of natural assets (agriculture, forests, and other land-uses, water, minerals), and building resilience of livelihoods (physical/climate, economic, social). The convergence of the proposed actions is reflected by the existing funding mechanisms , e.g. the Adaptation for Smallholder Agriculture Programme (ASAP)[16], the Adaptation Fund, the Africa Fertiliser Financing Mechanism (AFFM), the African Water Facility (AWF), the Climate Investment Funds (CIF), ClimDev-Africa Special Fund (CDSF), the Sustainable Energy Fund for Africa (SEFA) (see AFDB, 2012).

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[14] However, only the most recent COSOPs (those referring to the PBAS 11 and beyond) explicitly refer to the mitigation targets in view of their anticipated contribution to the NDCs. Such information can mainly be found in the 'Social, environmental and climate assessment procedures' (SECAP) note. Indeed, with the aim to set IFAD on a path to better supporting its client countries in meeting their climate commitments, as well as aligning IFAD country strategies to countries' NDC priorities, the new COSOPs use an analysis of priorities articulated in the NDCs for strategy development.

[15] For example, National Agriculture and Food Security Investment Plans (NAFSIPs) are being prepared by several African countries within the CAADP – which is owned and led by African governments – with the goal to reach and sustain higher economic growth through agriculture-led development that reduces hunger and poverty and enables food and nutrition security. To achieve these goals, more strategic and integrated planning and increased investment in the sector is advocated.

[16] Launched in 2012, the Adaptation for Smallholder Agriculture Programme (ASAP) channels climate and environmental finance to enable smallholder farmers who participate in IFAD projects to increase their resilience to climate change.

Table 5. Priority mitigation actions indicated in the ESA countries' NDCs

Country	AFOLU	Other sectors
Angola	Agriculture: stabilization of emissions (animal production and wildfires). LULUCF: forestry conversion; use of biomass; phase-out of harvested land.	Energy: promotion of renewable energy (power generation from renewable sources); production of ethanol as an alternative to fossil fuels. Industrial processes.
Botswana	Agriculture: livestock sector (reduce emissions from enteric fermentation)	Energy (mobile and stationary sources) and transport sector infrastructural developments; waste
Burundi	Forestry:(i) reforestation of 8,000 ha/year for 15 years, beginning in 2016; (ii) replacement of 100% of traditional charcoal kilns and traditional home ovens by 2030. Agriculture: gradual replacement of 100% of mineral fertilizers with organic fertilizer by 2030.	Energy: building hydroelectric power plants
Comoros	Agriculture & agroforestry; Forestry: reforestation, afforestation, forest conservation	Energy; waste
Eritrea	Agriculture and agroforestry. E.g., biogas at big farms; reforestation with agroforestry/silvopasture; biogas at rural farms; efficient wood stoves	Energy, industry, transport, waste: waste heat recovery at steel plant; waste heat recovery at cement plant; efficient domestic lighting with LEDs; geothermal power; wind turbines, on-shore; solar PVs, large grid; wind turbines, off-shore; composting of Municipal Solid Waste; biodiesel from MSW; charcoal production; efficient wood stoves; LPG stoves replacing wood stoves; clinker replacement; Bus Rapid Transit (BRT);
Eswatini (Swaziland)		Renewable energy; transport (ethanol blend in petrol); phase out and substitute ozone depleting substances
Ethiopia	Agriculture, forestry	Industry; transport; buildings.
Kenya	Agriculture (climate smart agriculture); forestry (afforestation and reforestation 10% tree cover)	Energy and IPPU: renewable energy (geothermal, solar, wind, biogas etc.) and energy efficiency; low carbon and efficient transport systems; wildlife & tourism. Waste: sustainable waste management
Lesotho	Agriculture: Improving crop and livestock production practices for food security while reducing emissions. LULUCF: Protecting and re-establishing forests for their economic and ecosystem services, while sequestering CO2	Energy: expanding electric power generation from renewable energy; Improving access to modern and energy efficient technologies in transport. IPPU: industry and building sectors. Waste.
Madagascar	Agriculture: large scale dissemination of intensive/improved rice farming techniques (SRI/SRA); large scale implementation of conservation agriculture and climate-smart agriculture; dissemination of arboriculture (from 2018: 5,000 ha per year). LULUCF: large scale reforestation for sustainable timber production and indigenous species for conservation; reduction of forest timber extraction; promotion of REDD-plus; large scale adoption of agroforestry; forest and grassland forests enhanced monitoring	Energy, waste

Malawi	Agriculture: support development of market based policies and legal instruments to shift decisions from financial to environmental decisions; develop appropriate extension and training materials for climate resilient agronomic practices; upscale the dissemination of climate resilient agronomic practices to above 10% of current cropland; build capacity to implement and monitor the agriculture NAMA. LULUCF: afforestation, reforestation and forest conservation and protection of catchments.	Energy supply & utilization; IPPU; waste
Mauritius	Agriculture: climate-smart agriculture (including smart use of marine resources); sustainable consumption and production in all sectors of the economy; climate smart agriculture including bio-farming; sustained tree planting programme within the context of the cleaner, greener and safer initiative	Electricity; cleaner technologies; transport. Specific measures: expansion in solar, wind and biomass energy production and other renewable energy sources; gradual shift towards the use of cleaner energy technologies, such as LNG, among others; modernisation of the national electricity grid through the use of smart technologies, which is a prerequisite to accelerate the uptake of renewable energy; efficient transportation system; sustainable and integrated waste management, including waste to energy; leapfrog to low global warming potential refrigerants.
Mozambique	LULUCF: REDD+	Energy: electricity production, transports and other – residential, commercial and institutional. Waste: solid waste disposal and treatment.
Namibia	LULUCF: reduce deforestation rate by 75 %; reforest 20,000 ha per year; restore 15 Mha of grassland; reduce removal of wood by 50%; afforest 5,000 ha per year; plant 5,000 ha of arboriculture per year. Agriculture: fatten 100,000 cattle heads in feedlots; soil carbon.	Energy: increase share renewables in electricity production from 33% to 70%; increase energy efficiency and Demand Side Management; mass transport in Windhoek, car and freight pooling. IPPU: replace 20% clinker in cement production. Waste: transform 50% Municipal Solid Waste to electricity and compost
Rwanda	Agriculture: crop rotation, improved fertilization, terracing, multi-cropping, conservation tillage; improved livestock and manure management.	Energy, IPPU, waste
Seychelles	No agriculture. Opportunities for emission reductions in LULUCF are limited	Energy, waste, land transport
South Africa		Energy: expand the Renewable Energy Independent Power Producer Procurement Programme (REI4P); Decarbonised electricity, Carbon capture and storage, hybrid and electric vehicles
South Sudan	-	-
Tanzania	Forest sector: a) Enhancing and up-scaling implementation of participatory forest management programmes. b) Facilitating effective and coordinated implementation of actions that will enhance contribution of the entire forest sector including Forest policies, National Forest Programmes and REDD+ related activities. c) Strengthening national wide tree planting programmes and initiatives. d) Strengthening protection and conservation of natural forests to maintain ecological integrity and continued benefiting from service provisions of the sector. e) Enhancement and conservation of forest carbon stock	Energy (and transport): energy diversification, clean technologies for power generation, use of natural gas, energy efficient technologies, rural electrification, low emissions transport system. Waste management: Application of modern and practical way of managing waste including the enhanced use of engineered/sanitary landfills. b) Promotion of waste to energy programmes. c) Promoting co-generation activities

Uganda	Agriculture: Climate-smart agriculture for cropping, livestock breeding and manure management practices. LULUCF: forestry management; wetland (improved).	Energy (power supply); energy for buildings etc. & transport
Zambia	Agriculture: sustainable agriculture (enteric fermentation and manure management, rice methane, agriculture soils, burning of savanna and agriculture waste, agriculture farrow and plantations). LULUCF: sources (i.e. deforestation and forest degradation through land clearing for agriculture, uncontrolled fires, infrastructure, timber harvesting, and charcoal production); sinks (regeneration from abandoned land from disturbed forests (firewood collection, charcoal production and timber harvesting), afforestation and reforestation	Renewable energy and energy efficiency: manufacturing, commercial, residential, agriculture, transport, mining and electricity; waste (i.e. solid waste disposal, solid waste open burning, domestic wastewater handling, industrial wastewater handling and human sewage
Zimbabwe		Energy: ethanol blending, solar water heaters, energy efficiency improvement, increasing hydro in the energy mix, electrification of the rail system.

Source: own elaborations from NDCs

4. Conclusions

The adoption of the 2030 Agenda for Sustainable Development and the Paris Agreement in 2015 represents a significant achievement. The Sustainable Development Goals (SDGs) and the NDCs carry a potential for synergies and complementarities. Countries can use NDC updates to align their climate activities more closely with their SDG priorities. To this end, the achievement of the zero-hunger goal by 2030 can be facilitated through green growth investments such as sustainable infrastructure, natural asset management and response to climatic and economic shocks (AFDB, 2012). This constitutes a strong justification to promote more mitigation-related investments in the AFOLU sector which would include: development of low-carbon and energy-efficient farming systems; production and access to renewable energy; efficient and sustainable management of land (agriculture, forests, and other land-uses) and water; building physical, economic, social resilience of smallholders' livelihoods.

Significant levels of finance are needed to support countries to implement such strategies and to fulfil their commitments in the NDCs. Climate financing and investment for agriculture are far from sufficient to enable the transition to low-carbon development (IFAD, 2020). Indeed, mitigation commitments in the NDCs are conditional to accessing finance, capacity and technology transfer. Given the current low level and unpredictability of public finance, private finance remains a key source of supporting such mitigation actions. However, attracting climate finance is still a challenge due to barriers such as weak governance systems, high-risk profile, lack of incentives, weak project bankability. Governments should create the environment necessary for the finance to flow at a scale needed (AMCEN, 2019).

The work presented in this report quantifies the mitigation potential of the East and Southern Africa region with focus on the AFOLU sector and introduces cost-effectiveness criteria to exploit such potential, in view of attracting additional financing. Results show that most emissions in the region come from the energy sector (52%), followed by AFOLU (38% due to poor agricultural practices, widespread deforestation, and fuelwood use), Waste and IPPU sectors (5% each). Full implementation of both conditional and unconditional mitigation targets set forth in the NDCs would limit the increase of regional net emissions to about 20% above the baseline, equivalent to a cumulated net emission reduction of about 840 Mt CO_2e in 2030.

Including cost-effective low-carbon options into green growth strategies can minimize the trade-offs and enhance the synergies between mitigation and economic development, therefore supporting socio-economic growth, and efficiently using the available climate mitigation financing. The economic case indicates that mitigation investments can be prioritized to enhance the efficiency of available financing (economy of scope) and maximize the mitigation results (economy of scale), showing how to create synergies with the economic development needs (prioritizing low income level countries).

The economic case also shows that, on average, AFOLU is a profitable option to invest in climate change mitigation in the ESA region, being more competitive than energy and other sectors in attracting mitigation finance (21.3 versus 226.2 constant 2010 US$/t$CO_2e$). Investing in mitigation from AFOLU in ESA is certainly more feasible given the low prices recorded in the regional carbon market. We find that in many ESA countries the average abatement cost falls below 7 US$/ t$CO_2e$ which is the carbon tax level applied in South Africa (the only country in the ESA region applying a price on carbon) and chosen as proxy of average price on the carbon market in the region.

Investing in mitigation from AFOLU may represent an interesting solution for private financiers and investors as a 'transition path' in view of the expected carbon prices future increases in Africa. Revenues from the carbon market may provide the necessary resources to (at least partially) fill the funding gap and drive the transition of the AFOLU sector in ESA towards the SDGs and its restructuring in a more sustainable and 'green' way, enhancing its competitiveness with respect to other sectors of the economy. Given the relatively low price and the relatively high start-up costs system (e.g. for the monitoring protocol and data management) to put in place a carbon trading system, this option would probably be feasible for the private sector only in countries with large mitigation capacity (economy of scale approach). For low-income countries with limited mitigation potential (economy of scope) finance support from the public sector would probably be required.

More robust economic assessment will help to release greater finance for climate action in agriculture, and to ensure higher likelihood of positive outcomes for food security and emissions reductions. For example, estimating the cost-effectiveness of the different mitigation measures (see Branca et al., 2015; 2020) would help moving from the long list to the short list of options, providing a better articulated range of options within the agriculture, forestry and land use sector.

African policymakers need to improve the enabling environment to access to climate-related finances and carbon market by increasing investments in agricultural public goods and developing innovative financing instruments, e.g. through public-private partnerships (Braimoh, 2020). Current usage of climate finance across ESA indicates that all countries can access far more of available funds, especially in the context of NDCs. Of the three sources of climate finance available, the Global Environmental Facility (GEF), the GCF and the Adaptation Fund (AF), many countries have not exhausted their resource allocation, and many do not yet qualify for funding due to lack of readiness (IFAD, 2019a).

There are several data limitations and uncertainties in our calculations which may affect the results. They are related to: differences in data availability and metrics adopted in the pledges indicated in the national communications and determined contributions; absence of specific budgets and mitigation targets for the different sectors; heterogeneous methodologies used to estimate the emissions and the sinks in the various GHG inventories and databases, the current and projected level of emissions and the resulting mitigation potential, and baseline assumptions.

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