Initiative for Climate Action Transparency - ICAT -

Description of the implementation of the ICAT Guidance on Sustainable Development, and recommendations on how to improve monitoring and reporting for the related sectors

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Description of the implementation of the ICAT Guidance on Sustainable Development, and recommendations on how to improve monitoring and reporting for the related sectors, and how lessons learned can be transferred to other sectors

Deliverable #3

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Date of the deliverable: November, 2019

PUBLISHED BY

Ministry of Lands, Environment and Rural Development (MITADER), Mozambique

PREPARED UNDER

Initiative for Climate Action Transparency (ICAT) project supported by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the Children's Investment Fund Foundation (CIFF), the Italian Ministry of Ecological Transition (IMET) and ClimateWorks.

The ICAT project is managed by the United Nations Office for Project Services (UNOPS)

ACKNOWLEDGEMENT

We would like to acknowledge and express gratitude to the fieldwork team Osorio Nhuaiane and Felicio Guelume, and especially to DINAB technicians: Dra Telma Manjate and Eng. Paula Panguene, for insightful discussions and their continued support of this report.

ABSTRACT

The assessment of sustainable development impacts on the Nationally Appropriate Mitigation Action (NAMA) Promoting a Sustainable Charcoal Value Chain in Mozambique (Charcoal NAMA)" using the ICAT Sustainable Development guidance has enabled the quantitative and qualitative assessment of potential impacts of the NAMA's implementation. Being an action within the country's policies included in the Nationally Determined Contribution (NDC), the identification and assessment of impacts of the policy ex-ante will facilitate further tracking of the implementation and achievement of the NDC, and provides a tool for informed and effective policy planning and implementation. An initial matrix presents the qualitative impact assessment developed including the identified specific impacts within each impact dimension environmental, social and economic. The identified impacts were validated by key stakeholders in a consultation workshop in Maputo, in April, 2019.

The analysis also provided a quantification of specific impacts where the data and available methods could allow such and assessment. Results of the assessment show that the NAMA has the potential to contribute to emissions reductions amounting to 314 521 ± 45 138 t CO_2-eq by 2025, equivalent to a 1 to 1.5% of the NDC emission reduction target of 31,19 Mt CO_2-eq. Other analysed impacts are related to:

- The reduction of 12 ton of accumulated residual biomass that may cause natural fires it not utilized for charcoal or other sustainable energy carrier (briquettes, pellets);
- An increase in the number of charcoal producers using efficient technologies and good forest management principles from 1143 to 1855;
- increase in the number of consumers using sustainable charcoal by 15%;
- An increase in the number of enrolled children at school by 20% as result of increased investments in education at local level from charcoal income, allowing that more children can be enrolled in schools;
- Increased employment by 22.5% in the charcoal sector; and
- Increased forestry sector revenue of 10%.

Factors identified that may limit effective MRV either for GHG emissions reductions, MRV of non-GHG impacts, and MRV of support included:

- Limited technical capacity and limited availability of resources or means for implementation, such as
    - Limited financial resources and availability of technology,
    - Unclear institutional responsibilities for reporting, monitoring and verification, and weak coordination between institutions,

- Lack of consistent data and data collection standard protocols, and lack of mechanisms for data collection, processing, repository and sharing.

Effecting Monitoring, reporting, and verification (MRV) system is key to track the NAMA progress, as well as for GHG inventory, NDCs, National Communications (NCs), Biennial Update Report (BURs) or Biennial Transparency Reports (BTRs).

Contents

LIST OF ACRONYMS

BAU	Business as usual
BECSUS	Biomass Energy Conservation and Sustainable Use Strategy
CSO	Civil Society Organization
DINAF	National Directorate of Forests
DMC	Department of Adaptation and Mitigation to Climate Change
DNPO	National Directorate of Planning of Budgeting
ENAMMC	National Strategy for Adaptation and Mitigation of Climate Change
FNDS	National Fund for Sustainable Development
FUNAE	National Energy Fund
GDP	Gross domestic product
GHG	Greenhouse Gases
GHGi	Greenhouse Gases inventory
ICAT	Initiative for Climate Action Transparency
INE	National Statistics Bureaux
JICA	Japanese International Cooperation Agency
MEF	Ministry of Economy and Finance
MIREME	Ministry of Energy and Mineral Resources
MITADER	Ministry for Land, Environment and Rural Development
Moz FIP	Mozambique Forest Investment Programme
MRV	Monitoring, Reporting and Verification
NAMA	Nationally Appropriate Mitigation Action
NDC	Nationally Determined Contribution
PNDS	National Plan for Sustainable Development
REDD^{+}	Reduced Emissions from forest degradation and deforestation
REFIT	Renewable Energy on the renewable energy feed-in-tariff
SDAE	District Services of Economic Activities
SDGs	Sustainable Development Goals
SFM	Sustainable Forest Management
SLCP	Short-Lived Climate Pollutants
SPDI	District Services of Planning and Infrastructure
UEM	Eduardo Mondlane University
UNFCCC	United Nations Framework Convention on Climate Change

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I. INTRODUCTION

With the adoption of the Paris Agreement in 2015, the United Nations Framework Convention on Climate Change (UNFCCC), and the Parties to the Convention have agreed on a common framework to reach the objective to limit the increase in global average temperature at well below 2 °C, relative to pre-industrial levels, and pursue efforts to limit warming to 1.5 °C. The vehicle to achieve these objectives are countries' Nationally Determined Contributions (NDCs), defining the countries' priorities in domestic mitigation and adaptation actions, to achieve national emission reduction contributions, and enhance resilience and adapt to the impacts of climate change.

Transparency of national emissions, national circumstances and mitigation and adaptation efforts is paramount in order to monitor the implementation of the Paris Agreement, enhance confidence and trust amongst countries, and promote an effective implementation of the Paris Agreement. To this end, Article 13 of the Paris Agreement established an Enhanced Transparency Framework (ETF), designed with built-in flexibility, which takes into account Parties' different capacities, and builds upon the collective experience of transparency under the Convention (UNFCCC).

The Initiative for Climate Action Transparency (ICAT) arises in this context, aiming to operationalize the request formulated to strengthen national institutions to meet the standards on transparency of the Paris Agreement. ICAT provides a methodological framework to assess the impacts of climate policies and actions, and strengthens national capacities for Monitoring, Reporting and Verification (MRV). Therefore, ICAT enables and provides tools to facilitate effective decision-making and formulation of effective climate policies. Mozambique is one of the countries implementing the Initiative for Climate Action Transparency (ICAT). ICAT project activities are coordinated by the Department of Adaptation and Mitigation to Climate Change (DMC) of the Ministry for Land, Environment and Rural Development (MITADER), where the ICAT focal point is located.

The Government of Mozambique has after its first NDC submission made efforts to update and improve its NDC, resulting in a second NDC, including an operational plan, which was approved by the government in December 2018. The NDC is currently being translated before submission to the UNFCCC. The NDC operational plan includes amongst other the Nationally Appropriate Mitigation Action (NAMA) Promoting Sustainability of the Charcoal Value Chain in Mozambique (Charcoal NAMA). Although identified as a priority action, the Charcoal NAMA could benefit from an in-depth assessment of potential GHG and sustainable development impacts, in order to support decision making.

The present report includes both an assessment of potential GHG impacts, but also a wide range of other selected sustainable development indicators. By proving a framework to assess the impacts of the Charcoal NAMA, ICAT is contributing to the enhancement of Mozambique's transparency on climate policies and actions and NDC planning and implementation. The assessment of potential impacts of policies and actions, is also considered a key step towards developing effective sustainable development strategies, and will therefore also contribute to the assessment and improvement of the NDC.

Assessment before implementation has multiple gains (ICAT, 2018) as it allows:

(i) to improve policy selection, design and implementation by comparing policy options based on their expected future impacts across multiple impact categories, and understanding the impacts of different design and implementation choices;
(ii) inform goal setting by assessing the potential contribution of policy options to national or subnational goals, such as Sustainable Development Goals (SDGs) and NDCs, and understand whether planned policies are sufficient to meet goals;
(iii) report on the multiple expected future impacts of policies and actions, domestically or internationally;
(iv) access financing for policies and actions under consideration by demonstrating net benefits across multiple impact categories; and
(v) development of an appropriate MRV system to track progress toward national goals such as NDCs and SDGs, and understand the contribution of policies and actions toward achieving them.

Specific outputs and activities of this assignment are as follows:

i. **Description of charcoal NAMA and applicability of the ICAT Guidance on Sustainable Development through:**

   (i) Review of the ICAT Guidance on Sustainable Development, and its applicability on the Charcoal NAMA

   (ii) Piloting of ICAT's Sustainable Development Guidance on the NAMA Promoting a Sustainable Charcoal Value Chain in Mozambique (Charcoal NAMA)

   (iii) Examination of charcoal production process in Mozambique and identify the GHG emission sources and removals

   (iv) Identification of possible potential technology of emission reduction of charcoal production process.

ii. **Description of the GHG emission sources and removals of the charcoal production process in Mozambique, and possible ways of reducing GHG emissions and increasing GHG removals in the charcoal production process through:**

(i) Identification other impact categories of the NAMA Charcoal and establish how to minimize the negative impacts and potentiate the positive ones

(ii) Conduction ex-ante assessment of policy Charcoal NAMA, including development of a baseline, policy scenarios, and estimation of sustainable development impacts

(iii) Identification of barriers and gaps in monitoring and reporting of indicators and parameters for the policy NAMA Charcoal, and identify ways to overcome these barriers

iii. **Description of the implementation of the ICAT Guidance on Sustainable Development, and recommendations on how to improve monitoring and reporting for the related sectors, and how lessons learned can be transferred to other sectors.**

The output i and ii has been already been achieved through deliverable #1 and #2. A validation seminar for these outputs took place in September 2019. The present report covers deliverable #3, related to objective iii. These objective includes as well:

i. **Description of how the preliminary findings were presented at the stakeholder meeting #3, including feedback and central topics and aspects discussed by the participating stakeholders.**

ii. **Description of how lessons learned can be transferred to other sectors (What were the lessons learned? What was good, and what would you do differently now?)**

Scope and targets

The Government of Mozambique approved the National Strategy for Adaptation and Mitigation of Climate Change (ENAMMC) in 2012. ENAMMC establishes guidelines for action to create resilience in communities and in the national economy, while promoting the development of a low carbon and green economy through the integration of climate change into the sectoral and local planning process. With regard to mitigation, it is the country's objective to identify opportunities and implement actions or measures to reduce GHG emissions that contribute to the sustainable use of natural resources and reduction of pollution and degradation of the environment, dependant on the access to affordable financial and technological resources.

The Mozambique Biomass Strategy, Biomass Energy Conservation and Sustainable Use Strategy (BECSUS) was approved in 2012, with an ultimate goal to promote the production and sustainable use of biomass energy, and the adoption of alternative sources of energy. BECSUS establishes objectives the following objectives:

(i) the introduction and expansion of energy alternatives to replace wood and charcoal;
(ii) reduce the use of woody fuels as a primary energy source; and
(iii) Strengthening institutions in controlling the value chain of wood fuels.

To contribute to the achievement of BECSUS's objectives, the Ministry of Energy, through the National Energy Fund (FUNAE), and with the collaboration of development partners, formulated the Charcoal NAMA. The NAMA is not under implementation, but application for support has been formulated. In the NDC of Mozambique, approved in December 2018, the Charcoal NAMA actions and measures are also included. The charcoal NAMA was designed in 2014, and proposed to have an implementation timeframe up to 2020. However, the implementation of the NAMA, being conditional on external funding, has not started yet, the timeframe for implementation is scaled up to 2030 in this study.

The Charcoal NAMA states and highlights the following envisioned impacts through its implementation:

(i) Reduction of the deforestation rate as a result of improved and more efficient ovens, sustainable forest management practices and use of improved stoves;
(ii) Reduction of forest degradation as a result of adoption of sustainable forest management practices;
(iii) Maintained and secured biodiversity conservation in forest areas under sustainable forest management practices;
(iv) Improved income of charcoal producers engaged in the NAMA implementation project and not limited to the Charcoal NAMA project targets; and ultimately;
(v) Reduction of GHG emissions associated with the use of improved and efficient kilns and efficient stove technologies.

To achieve the defined NAMA goals and objectives, various actions are considered such as:

(i) Introduction of new technologies in the charcoal production (improved kilns, sustainable forest management practices, training of producers and technicians);
(ii) Identification and introduction of a viable model of improved and efficiently produced charcoal;
(iii) Formalization of the charcoal sector or biomass energy sector and definition of a new charcoal business model;
(iv) Identification of appropriate mechanisms for distribution or sale of improved stoves, and training in the use of new technologies;

(v) Training of government technicians involved in control and management of biomass resources, institutional capacity building, and education and awareness campaigns.

Three main technologies/approaches have been identified by the NAMA, and used in respect to GHG and sustainable development impact assessment.

(1) Briquetting charcoal residues: The current process of producing charcoal leaves a significant volume of small pieces and charcoal dust in the field. A rough estimate would suggest a loss of 200 kg material per kiln production, which can be used for briquetting.
(2) Modern kilns and sustainable forest management: Efficient and modern kilns allow for more efficient charcoal production: a brick kiln has a 3:1 (wood / charcoal) ratio instead of 7:1 by the current earth kilns. Producers experience forest degradation as a limitation to their production and the introduction of efficient kilns should therefore be combined with Sustainable Forest Management (SFM).
(3) Torrefaction by the private sector: torrefaction can be a commercial viable option in regions with (a) high level of charcoal production with producers that already produce the maximum amount allowed by their licenses, and (b) lower levels of organization capacity and thus less opportunities for the above-mentioned projects.

1.1 Identification of impact categories of the NAMA Charcoal

The impact assessment for the Charcoal NAMA was done following the ICAT Sustainable Development Guidance, allowing for both a qualitative and quantitative impact assessment. The identification, prioritisation and categorization of impacts was made through available literature and policy review, and consultation with stakeholders who have been working actively in the energy sector, including stakeholders directly involved in the Charcoal sector. Stakeholders at the national level were consulted through semi-structured interviews and group meetings. Consultation workshops at district (Chicualacuala, Mabalane, Massingir and Guijá) and cities levels (Maputo and Matola) were conducted to collect stakeholders' perceptions and validate relevant impacts from different stages of the charcoal value chain namely; production, transportation, marketing and consumption.

The relevance of each selected impact was assessed through the respondents' perceptions, priorities and objectives, and by assessing the impacts alignment with priorities in national and local policies and strategies, such as BECSUS, ENAMMC, the Reduced Emissions from forest degradation and deforestation ($REDD^{+}$) Strategy, the National Plan for Sustainable Development (PNDS), and Nationally Determined Contribution (NDC). Following the identification of the relevant impact categories, verification was made of the categories that will be significantly affected by the NAMA implementation and location of its occurrence (if

the impact occurs within or outside the NAMA implementation area). The impacts assessed cover the three dimensions: environmental, economic and social. Potential negative impacts were also considered.

1.1.1 Description and Identification of specific impacts within each impact category

An initial matrix was developed including the identified specific impacts within each impact category, based on literature review and the ICAT Guidance. The identified impacts were validated by key stakeholders in a consultation workshop in Maputo, in April, 2019. Each specific impact was characterized in relation to its baseline or business-as-usual scenario (what will happen if the NAMA is not implemented) to inform the change scenario (impacts from NAMA implementation).The qualitative impact assessment was done at national scale. However, some impacts were validated using a questionnaire in the pilot area (the five districts namely: Chicualacuala, Massingir, Mabalane and Guijá). The detailed methods of sampling strategy and interviewing are presented in the next section.

Each NAMA technology, improved kilns and sustainable forest management, briquetting of charcoal waste material, and torrefaction from forest plantation, were assessed in the three dimensions, environmental, economic and social, and impact categories (air, soil, land, forest and biodiversity, jobs, energy, health etc.) were identified and assessed within each dimension. The results of the assessment provide the following information which can be found in the following sections.

(i) Impact categories included in the assessment,
(ii) specific impacts identified,
(iii) in-or out-of-jurisdiction,
(iv) magnitude,
(v) significance,
(vi) summary of qualitative and quantitative assessment results for each impact category,
(vii) methods or source used,
(viii) feasibility to quantify,
(ix) included to quantitative assessment boundary,
(x) Justification of exclusion or other comments.

As indicated above, some impacts were possible to quantify, while others were not, so the assessment is both qualitative and quantitative. It is worth mentioning that the qualitative assessment covers all impact categories that were identified as potential impacts, but the quantitative assessment only includes quantifiable impact categories where relative sufficient data was available. The periods of impact assessment considered in this study are short-term (up to 5 years), medium-term (5 to 15 years) and long-term (greater than 15 years), where

according to the stakeholders each impact has a specific effect, and its magnitude and significance can change with time and space.

Table 1: Choice of impact categories and specific impacts for assessing the Charcoal NAMA

Impact Category	specific impacts	Brief Description (relevance and significance)
ENVIRONMENTAL DIMENSION		
Climate Change Mitigation	Reduction of GHG emission from the introduction of new technologies and practices	The use of more efficient furnaces and the use of charcoal waste and other biomass material will reduce the consumption of wood per unit of charcoal produced and reduced forest clearing for energy production, and consequently, the reduction of GHG and Short-Lived Climate Pollutants (SLCP) emissions per unit of charcoal produced.
	Increased emissions from increased need for transport	The NAMA is expected to lead to an increase in charcoal produced, increasing the need of charcoal transportation from the production sites to the consumers.
Fire prevention	Reduction in the amount of accumulated residual biomass that may cause natural fires	The utilization of charcoal waste and other biomass material, as opposed to being left on the production sites will contribute to reduced accumulated biomass that may cause natural fires
Water availability	Increased water available	The NAMA by reducing deforestation will also reduce the silting effects on rivers, and improved ecosystem services important for water quality and availability.
Water Quality	Increased amount of available water of adequate quality for domestic use, and irrigation	
Biodiversity of terrestrial ecosystems	Increased land areas managed in a sustainable way and reduction of disturbance of ecosystems	The expected reduction of extracted wood will result in reduced levels of environmental disturbance, with reduced habitat loss and positive effects on species and biodiversity, and terrestrial ecosystems, including their crucial functions.
Soil	Reduction of eroded areas	With the preservation of vegetation cover, significant gains in soil quality are expected.
	Increased soil fertility	
Energy produced in sustainable manner	Increased access to charcoal and other energy carriers (briquettes, torrefied material) produced in a sustainable way	The NAMA is expected to significantly affect this category by increasing the availability of sustainably produced charcoal
		SOCIAL DIMENSION

Impact Category	specific impacts	Brief Description (relevance and significance)
Air quality and health impacts due to air pollution	Reduction of air pollution	The use of efficient ovens and stoves promoted by NAMA will significantly reduce the concentration of atmospheric pollutants and aerosols, resulting in disease reactions (broncho-pulmonary, carcinogenic etc.) and deaths.
	Reduction of occupational diseases in the charcoal production sector	
Hunger, nutrition and food security	Improved access to food in quantity, quality and diversity	As far as farmers are concerned, they find themselves in drought risk-prone areas, so establishing an alternative source of livelihood through sustainable forest management and charcoal production will reduce the risk of outbreaks of hunger.
		Charcoal production can finance agricultural mechanization / mini-irrigation and consequent reduction of rainfall dependence, and relative stability of agricultural production.
		Soil improvements and efficient ecosystems can provide goods and services that benefit the communities in both food (animals, fruits, etc.) and services (pollination).
Education	Improved access to education for local children	It is expected that the NAMA will build capacity in the use of more efficient kilns and forest management principles and techniques, leading to a modernization of the charcoal value chain and professionalization of workers. Increased income for local people is expected and thereby investment in child education will increase. Other associated activities with the NAMA implementation is awareness for all relevant actors in the charcoal value chain on climate change and need for adoption of more efficient technologies and sustainable practices of forest management; production, charcoal combustion, and use of sustainably produced and certified charcoal
	Improved ability to produce charcoal sustainably by capacity, skills and knowledge development	
	Increased number of people aware of climate change, training and research	
Access to land and its resources	Increased legal access to land and its resources	Land tenure is one of the most significant structural conditions required for the sustainable management of resources and therefore the sustainable production of charcoal. The sustainable use of forests is based on the creation of borders and rules that determine who can use the resources and under what conditions. The right to the use of long-term, clear and safe forest resources is crucial for sustainable forest management.
Poverty reduction	Reduction of poverty of households in NAMA covered areas	Local people will have a possibility to increase their revenues and investments with the NAMA alternative income generating activities.

Impact Category	specific impacts	Brief Description (relevance and significance)
Gender equality and equity	Increased gender equality promotion and women empowerment by created association	With the formalisation of the charcoal sector, the NAMA is expected to promote gender equality and the empowerment of women across the value chain
	Improving income and opportunity equity	The NAMA will promote equal opportunities and fair and equitable sharing of benefits.
Time spent in working activity	Reduced time on labour activities	Saved time from the carbonization process will be used for activities that ensure sustainable charcoal production such as management, preparing the firewood piles in the kiln, inventories and pre-mapping of trees to be felled, pre-defined hauling routes etc.
ECONOMIC DIMENSION		
Economic diversity	Increase of companies associated with the sector	The NAMA is expected to result in new economic activities and strengthen and promote the growth of new industries involved in the value chain of sustainable production and consumption of charcoal. There is however not any activity described for local communities to engage in the production of improved stoves with available local material.
Labour (Jobs)	Increased number of employed people in the charcoal value chain (green jobs)	The NAMA is expected to significantly affect this category by promoting employment in sustainable charcoal production
		The NAMA will provide procedures that promote the fairness of income and costs to those involved, promoting, among the different actors involved in the value chain an increment of their wages
Income	Increase in per-capita income from green jobs	The NAMA is expected to significantly affect the income of different actors involved in the charcoal value chain. The increase will result from the adoption of technologies with greater efficiency, from which the time allotted to charcoal production can be reduced, maintaining or even increasing the volumes produced.
	Local communities will receive 20% of the shared revenue of charcoal licencing.	Currently, only 4% of the sector's revenues are formalised. The formalization, registration and control of the revenues obtained in the sector will lead to increased revenues to the local communities, calculated on the formal and accounted value of charcoal production.
	Increase in global revenue in the forest sectors sector (% GDP)	NAMA implementation will contribute to a formalization of the charcoal sector, which will as well contribute to improved control of the charcoal activities: improved licensing, registration and control. Increased formal licensing will allow an increase in sector revenue.

Impact Category	specific impacts	Brief Description (relevance and significance)
Financing	Access to loan or credit	It is assumed that the NAMA provides a great opportunity for increasing access to credit, especially for producers, who proposed a revolving fund scheme in the field work survey conducted. The initial value can be obtained from the 20% benefit or others funds if available. In case of the 20% benefit being used, a recognized and elected committee will define the mechanisms for credit. Associations should lead the process of selecting beneficiaries on the basis of individual borrowing capacity, and the financier should present the criteria that they find most effective for selecting the eligible person. Financing doesn't need to be in cash, each potential beneficiary can also state specific needs (e.g. purchasing a chainsaw). Partnerships with companies can be established to perform bulk procurement of needed tools and materials and enable repayment through instalments, aiming to achieve economies of scale and ensure the best price/ quality ratio. Money borrowed must be repaid through monthly instalments (at a reduced interest rate of 5%).
Costs of health care	Reduction on economic costs of health losses	Better working conditions are expected with the alternative technologies, and consequent formalization and certification of charcoal, which will result in reduction of occupational diseases in the sector and health costs associated.

1.2 Qualitative assessment

Having identified the specific impacts, these are analysed qualitatively and characterized based on the probability of occurrence, magnitude and nature of the change (positive or negative). For probability, the interval table below is used.

Table 2: Assessing significance of impacts

Likelihood	Description	Approximate likelihood (rule of thumb)
Likely	Reason to believe the impact will happen as a result of the policy or action.	≥ 90%
Likely	Reason to believe the impact will probably happen as a result of the policy or action	< 90% e ≥ 66%

Possible	Reason to believe the impact may or may not happen as a result of the policy or action. About as likely as not. Cases where the likelihood is unknown or cannot be determined should be considered possible.	< 66% e ≥33%
Unlikely	Reason to believe the impact probably will not happen as a result of the policy or action.	< 33% e ≥ 10%
Very unlikely	Reason to believe the impact will not happen as a result of the policy or action	<10%

Source: ICAT Sustainable Development Guideline, 2018

Magnitude represents the degree of change from the result or expected of the policy or action. According to the ICAT guidance, if there is no data or evidence to estimate the relative magnitude, experience and consultation with interested and affected parties can be used to rate the impact as major, moderate or minor. If this is not possible, this impact should be classified as "uncertain" or "cannot be determined". In this study, the magnitude of impact was assessed together with stakeholders during the workshop in Maputo, and also with some results from questionnaires in the field. The table below presents estimates of relative magnitude of sustainable development impacts according to ICAT (2018).

Table 3: Estimating relative magnitude of sustainable development impacts

Relative Magnitude	Description
Major	The change in the impact category is expected to be substantial in size (either positive or negative). The impact significantly influences the effectiveness of the policy or action with respect to that impact category.
Moderate	The change in the impact category is expected to be moderate in size (either positive or negative). The impact somewhat influences the effectiveness of the policy or action with respect to that impact category.
Minor	The change in the impact category is expected to be insignificant in size (either positive or negative). The impact is inconsequential to the effectiveness of the policy or action with respect to that impact category.

Validation of the impact

A questionnaire was applied to gather responses from charcoal producers, drivers of charcoal transportation, local institutions and local traders. The result of the interview at district level was used to make the last judgment of the significance and magnitude of each selected impact. For the description of the specific impact, the current scenario (baseline) was considered and compared to a description of the expected future scenario.

It is also expected that unintended specific impacts will occur, i.e. impacts that do not contribute to the achievement of NAMA objectives. An unintended impact is the emissions in

transport that will increase with the NAMA since the NAMA will result in increased production of charcoal, and consequently, increase the transport of this charcoal from the place of production to the cities.

From the collective interview held at district level, one of charcoal producers said that they produce charcoal to sell and obtain financial resources to purchase food, pay their children's education expenses (in secondary education) and other household expenses, since there are no favourable conditions for agriculture activity due to lack of rain. They referred to the poor working conditions, resulting from lack of proper tools for the cutting of trees for the production of charcoal (using an axe) as well as tools to protect against smoke produced in the carbonization process. They also reported on the disappearance of the people who managed the values assigned to the community. Asked whether they would be interested in participating in an initiative that would train them to use more efficient technologies for charcoal production and sustainable forest management, resulting in an increase in the quantity of charcoal, and improvement of the working conditions, they were receptive to the initiative. On activities that could be carried out with the extra time they would have, they were unanimous in saying that they would increase the rotation of charcoal production, meaning that they would be able to produce twice the amount of charcoal produced today.

The District Services of Economic Activities (SDAE), the key stakeholder at district level stated that there is now a restriction for external licensed charcoal producers in the district covered by the study. Charcoal production is made by community members and sold to intermediaries who have the financial capacity, and are legally authorized to transport charcoal. Charcoal producers (member of existing charcoal association) and charcoal traders perceive the NAMA to have a potential to contribute to an increase in charcoal producers' income, and forest sector revenue from taxation, since formalization of the charcoal value chain will allow local producers to have a secured market.

An issue that was raised is that the district currently does not have any benefit from licensed charcoal transportation licensing fees, as the district has no capacity to conduct monitoring and patrolling services due to limited financial capacity. Allowing the collection of tax revenue from charcoal licensing would enhance forest law enforcement in the charcoal value chain at the pilot NAMA district and at National level.

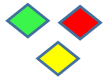
Another issue that was raised is the limitation of licensing to local producers rather than also including external operators. Although this might be seen as negative for potential external operators (license holders) as it will reduce their potential income, the NAMA concept has positive impacts for both sides. Local charcoal producers will have an opportunity to increase their income, and the external operators will benefit from other parts of the chain such as transport, and a secure market. More balanced benefits to local stakeholders and external operators will be one of the results with the NAMA implementation.

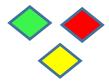
QUALITATIVE IMPACT ASSESSMENT RESULTS

Table 4 below presents the results of the qualitative assessment of the specific impacts, and provides a classification of impact dimension (environmental, economic and social), and contribution to SDGs. The table also provides data sources and justification for exclusion of certain impacts from the quantitative assessment. Data limitations that would allow a quantification of impacts at this stage is the primary reason for the exclusion of impacts from the quantitative assessment. Another issue that hinders quantification is the lack of available methods to establish attribution of impacts to the NAMA activities from impacts that could result from a variety of measures, such as *reduced air pollution*, and *reduction on economic costs of health losses*.

Table 4: Qualitative impact assessment of Charcoal NAMA and Link to SDGs

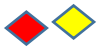
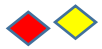
Impact categories included in the assessment	Specific impacts identified	In- or out-of-jurisdiction	Likelihood	Magnitude	Positive or negative impact	Significant	Summary of qualitative assessment results for each impact category	Methods/sources used	Feasibility to quantify	Included in the quantitative assessment boundary?	Justification for exclusions or other comments	Impact dimension	SDGs
Climate Change Mitigation	Reduction of GHG emission from the introduction of new technologies and practices	Both	Very likely	Moderate	Positive	Yes	Major positive impact from charcoal production technology. While negative impacts do exist, they are insignificant	Stakeholder consultation, field studies, CDM methodologies and IPCC (2006) guidance	Yes	Yes	Included		
	Increased emissions from increase in transport need		Likely		Negative	No	Emission from transport, product distribution might be increased, however not significant	Field estimates and IPCC (2006) guidance	Yes	yes	No reliable data		

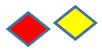
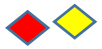
Impact categories included in the assessment	Specific impacts identified	In- or out-of-jurisdiction	Likelihood	Magnitude	Positive or negative impact	Significant	Summary of qualitative assessment results for each impact category	Methods/sources used	Feasibility to quantify	Included in the quantitative assessment boundary?	Justification for exclusions or other comments	Impact dimension	SDGs
Fire prevention	Reduction in the amount of accumulated residual biomass that may cause natural fires	Both	Very likely	Moderate	Positive	Yes	Major positive impact from the mobilization of charcoal waste and other biomass material that will allow the increase of raw material for charcoal production, which will reduce the need for forest clearing for energy production and prevention of forest fires	Stakeholder consultation, Mate et al, 2014; Mate at al, 2015	Yes	No	No reliable data		
Water availability	Increased water available	Both	Likely	Moderate	Positive	Yes	Reduction of the silting effects on rivers, and improved ecosystem services important for water quality and availability	Stakeholder consultation and field work interview	N/A	No	No reliable data		
Water Quality	Increased amount of available water of adequate quality for domestic use, and irrigation												

Impact categories included in the assessment	Specific impacts identified	In- or out-of-jurisdiction	Likelihood	Magnitude	Positive or negative impact	Significant	Summary of qualitative assessment results for each impact category	Methods/sources used	Feasibility to quantify	Included in the quantitative assessment boundary?	Justification for exclusions or other comments	Impact dimension	SDGs
Biodiversity of terrestrial ecosystems	Increased land areas managed in a sustainable way and reduction of disturbance of ecosystems	In	Very likely	Major	Positive	Yes	Major positive impact from charcoal production technology. While negative impacts do exist, they are insignificant	Kalaba et al. (2013) and stakeholder consultation	No	No	No reliable data/methods available		
Soil	Reduction of eroded areas Increased soil fertility	In	Very likely	Major	Positive	Yes	Major positive impact from charcoal production technology. While negative impacts do exist, they are insignificant	Stakeholder consultation	N/A	No	No reliable data/methods available		
Energy produced in sustainable manner	Increased access to charcoal and other energy carriers (briquettes, torrefied material) produced in a sustainable way	Out	Very likely	Major	Positive	Yes	Major positive impact from charcoal production technology. While negative impacts do exist, they are insignificant	Stakeholder consultation	yes	yes	No reliable data/methods available		
Air quality / health	Reduction of air pollution	Both	Possible	Major	Positive	Yes	Major positive impact from	Stakeholder consultation	No	No	No reliable		

Impact categories included in the assessment	Specific impacts identified	In- or out-of-jurisdiction	Likelihood	Magnitude	Positive or negative impact	Significant	Summary of qualitative assessment results for each impact category	Methods/sources used	Feasibility to quantify	Included in the quantitative assessment boundary?	Justification for exclusions or other comments	Impact dimension	SDGs
impact due to air pollution	Reduction of occupational diseases in the charcoal production sector						charcoal production technology. While negative impacts do exist, they are insignificant	and field work interview			data/methods available		
Hunger, nutrition and food security	Improved access to food in quantity, quality and diversity	In	likely	Major	Positive	Yes	Major positive impact from possibility to increase their revenues and investments with the NAMA alternative income generating activities. While negative impacts do exist, they are insignificant	Stakeholder consultation	No	No	No reliable data/methods available		
Education	Improved access to education for local children	In	Likely	Major	Positive	Yes	Increased income for local people is expected and thereby investment in child education, awareness for all relevant actors in the charcoal value	Stakeholder consultation	Yes	Yes	Included		
	Improved ability to produce charcoal sustainably by capacity, skills and	In	Very likely	Major	Positive	Yes		Stakeholder consultation	No	No	No reliable data/methods available		

Impact categories included in the assessment	Specific impacts identified	In- or out-of-jurisdiction	Likelihood	Magnitude	Positive or negative impact	Significant	Summary of qualitative assessment results for each impact category	Methods/sources used	Feasibility to quantify	Included in the quantitative assessment boundary?	Justification for exclusions or other comments	Impact dimension	SDGs
	knowledge development						chain. While negative impacts do exist, they are insignificant						
	Increased number of people aware of climate change, training and research	In	Likely	Moderate	Positive	Yes		Stakeholder consultation	Yes	No	No reliable data/methods available		
Access to land and its resources	Increased legal access to land and its resources	In	Likely	Moderate	Positive	Yes	Secure land access will be enhanced as NAMA includes land certification. Secure land rights enable secure and long-term investments	Stakeholder consultation	Yes	No	No reliable data/methods available		
Poverty reduction	Reduction of poverty of households in NAMA covered areas		Very likely	High	Positive	Yes	increase their revenues and investments with the NAMA alternative income generating activities		Yes	No	No reliable data/methods available		

Impact categories included in the assessment	Specific impacts identified	In- or out-of-jurisdiction	Likelihood	Magnitude	Positive or negative impact	Significant	Summary of qualitative assessment results for each impact category	Methods/sources used	Feasibility to quantify	Included in the quantitative assessment boundary?	Justification for exclusions or other comments	Impact dimension	SDGs
Gender equality and equity	Increased gender equality promotion and women empowerment by created association	In	Likely	Moderate	Positive	Yes	NAMA will increase opportunities and fair and equitable sharing of benefits	Stakeholder consultation	No	No	No reliable data/methods available		
	Improving income and opportunity equity	In	Possible	Moderate	Positive	Yes		Stakeholder consultation	Yes	Yes	Included		
Time spent on working	Reduced time on labour activities	In	Very likely	Major	Positive	Yes	Reduction of time spent on Charcoal production as result of improvement of charcoal production efficiency, leads to extra time to spend on other activities (family time, diversify economic activities, etc.)	Stakeholder consultation, Manjate, 2018	Yes	No	No reliable data/methods available		
Economic diversity	Increase of companies associated with the sector	Both	Likely	Major	Positive	Yes	New economic activities and strengthening and promoting growth	Stakeholder consultation	Yes	No	No reliable data/met		

Impact categories included in the assessment	Specific impacts identified	In- or out-of-jurisdiction	Likelihood	Magnitude	Positive or negative impact	Significant	Summary of qualitative assessment results for each impact category	Methods/sources used	Feasibility to quantify	Included in the quantitative assessment boundary?	Justification for exclusions or other comments	Impact dimension	SDGs
							of new industries. Major positive impact from charcoal production technology. While negative impacts do exist, they are insignificant				hods available		
Labour (jobs)	Increased number of employed people in the charcoal value chain (green jobs)	In	Likely	Moderate	Positive	Yes		Stakeholder consultation	Yes	Yes	Included		
Income	increase in per-capita income from green jobs	Both	Likely	Moderate	Positive	Yes	Increase in income of different actors involved in the charcoal value chain and from formalization of the charcoal sector.	Stakeholder consultation	Yes	Yes	Included		
Income	Local communities will receive 20% of the shared revenue of charcoal licencing (20% from forest resource use royalties).	In	Likely	Major	Positive	Yes		Stakeholder consultation, Manjate, 2018	Yes	Yes	Included		
Revenue	Increase in total revenue in the sector (% GDP)	Both	Likely	Moderate	Positive	Yes		Michaque et al. 2003; Nhancale et al, 2009	Yes	Yes	Included		
Financing	Access to loan or credit	In	Likely	Moderate	Positive	Yes		Stakeholder consultation	Yes	No	No reliable data/met		

Impact categories included in the assessment	Specific impacts identified	In- or out-of-jurisdiction	Likelihood	Magnitude	Positive or negative impact	Significant	Summary of qualitative assessment results for each impact category	Methods/sources used	Feasibility to quantify	Included in the quantitative assessment boundary?	Justification for exclusions or other comments	Impact dimension	SDGs
											hods available		
Costs of health care	Reduction on economic costs of health losses	In	Very likely	Major	Positive	Yes	Reduction of occupational diseases in the sector and health costs associated are positive major impacts for exposed people	Stakeholder consultation	No	No	No reliable data/methods available		

Legend:

1.2.1 Scenario development

The impact categories included in the quantitative assessment were selected based on the existence of methods and relatively reliable data, allowing a quantification of the NAMA impacts ex-ante. Table 5 presents the description of each scenario, based on the results of Deliverable #2, field work and stakeholder consultations, and available reports and national statistics. Impact indicators were established for each specific impact, which is also used to establish the indicators used for monitoring and evaluation of the NAMA during implementation.

Eight scenarios were developed, three related to the environmental component, two to the economic and three to the social component. For all scenarios a baseline was established, and scenarios were estimated based on future expectations (predictions). Two distinct periods are considered in the time horizon covered by the assessment, the first 2020-2025 and the second 2026-2030. By 2030 it is expected that the project will have already been established and be fully operational. As stated in the NDC, its implementation is contingent upon the availability of international support, which is also the case to enable a full implementation of the NAMA, within the timeline described.

Coefficients were generated and used to predict the parameters variation for the period of assessment 2020-2025 for the modelling exercise, based on available data. This exercise allowed the development of the equations that express the expected changes of the specific studied impact category.

Generation of new activity data is seen as the most challenging process as most of the existing MRV system are established to accommodate MRV needs of older policies, and not necessarily data collection or measurements for new activities. Improvement in data gathering and information flows to appropriate levels will be needed for a continuous and robust assessment of the NAMA impacts. To enable such improvements there will be a need for capacity building and reporting guidance to charcoal producers, and training of district level staff in methodologies and procedures for data, reporting and monitoring.

The following table provides a textual description of the baseline and NAMA scenario, and the assumptions behind the scenarios. The previous deliverable reports contain more information on the construction of the Baseline and NAMA Scenario.

Table 5: Description of Baseline and Policy Scenarios for the Charcoal NAMA

Impact categories	Specific impacts identified	Indicator	Baseline (Business as usual - BAU) – National	Source	NAMA Scenario 2020-2030
ENVIRONMENTAL DIMENSSION					
Climate Change Mitigation	Reduction GHG emission from distributed improved kilns and implemented sustainable forest management Increased emissions from increase in transport need	CO_2e emission from charcoal production process and transport from production area to Maputo	- Charcoal producers will keep using traditional kilns (100% use of traditional kilns) -Charcoal emission from transport around 25.71 t CO_2 -The area where charcoal production takes place has some mopane regeneration and coppicing -There is no forest management -Both large scale producers and small scale producers use the same area for charcoal production -Charcoal is produced using traditional kilns with low efficiency (10-20%), and the charcoal waste powder and small fragments remain non-utilised - There is no Torrefaction activity - O% producers applying knowledge acquired on the use of improved kilns or modern energy (briquettes and pellets) - 100% of charcoal waste and logging residues unutilized and left in the field.	Deliverable Report # 2: Cumulative Scenario, Field estimates	-Introduce 200 improved kilns, with gradual increase over time (Casamance kiln with 20 - 30% of average conversion, and 30% of efficiency) -Charcoal transport emissions increased, but energy content versus transport emissions will reduce the significance -Trees are cut selectively for charcoal production -More than 40% of charcoal producer use improved kilns -Coppice management will happen with no interruption -Small scale producer do not overlap with large scale producer -More than 50% of producers will start using improved kilns (All kiln technologies will be introduced throughout the country. The average efficiency considered for all technologies is 40%, with average conversion 3:1) -Reduction in 25% of the amount of CO_2 emitted because of the prevention of deforestation -At least 25% producers applying knowledge acquired on the use of improved kilns or modern energy (briquettes and pellets), certified in using improved kilns, sustainable forest management practices, by 2025.

Impact categories	Specific impacts identified	Indicator	Baseline (Business as usual - BAU) – National	Source	NAMA Scenario 2020-2030
					-at least 2% increase of waste utilized for charcoal and briquette production per year, from 2020
Energy produced in sustainable manner	Increase in complementary biomass and charcoal waste used, which will increase access to charcoal and other energy carriers (briquettes, torrefied material) produced in a sustainable way	Number of licensed charcoal producers engaged in charcoal efficiently produced and environmentally friendly	- 4% of licensed operators -100% of charcoal produced unsustainably;	EDM, 2012; ME, 2012; Renewable energy Strategy, DINAF, 2009	- The NAMA is expected to contribute to the increase of sustainable charcoal produced 2% per year. At least 20% of produced charcoal sustainable by 2025
		Number of charcoal consumers using sustainably produced charcoal	-28% population with access to clean energy (electricity, gas) -80% of urban and peri-urban areas are dependent on charcoal and wood for energy production. At least 60% can be assumed as charcoal dependent population.	EDM; 2012 Brower et al, 2004; Falcão, 2008	An increase by 25% per year of people consuming sustainable charcoal in urban and peri-urban areas of the major cities Maputo, Matola and (if National level, Nampula, Zambézia) is expected.
SOCIAL DIMENSSION					

Impact categories	Specific impacts identified	Indicator	Baseline (Business as usual - BAU) – National	Source	NAMA Scenario 2020-2030
Education	Improved access to education for local children	Number of children enrolled in school	Assumptions of the scenario provided by de PEE (2012-2016) in which the entry (10%) and transition rates between different levels of education are expected to be maintained. The rate of school drop outs (31.4%) and class repetition (28.2%). Transition between grades 7 to 8 (80%), 10 to 11 (60-70%). School entry and transition rates will be maintained between different levels of education.	MINED (2012-2016) Fieldwork estimates; Baumert et al. 2016	Increase on income will allow coverage of education expenses by charcoal stakeholders involved in the value chain.
	Improved ability to produce charcoal sustainably by capacity, skills and knowledge development	Number of workers in the charcoal value chain using more efficient and sustainable charcoal production technologies, and forest management practices	Previous projects reports that awareness campaigns for sustainable charcoal production have been conducted. However, no records are available.	ACES project, 2017; Chaposa Project, 2001, OSRO project, 2006, FAO GCP, 2004, Baumert et al. 2016	The NAMA project includes awareness and trainings as activities.
Gender equity	Increased gender equality promotion and women empowerment by created charcoal associations	% of women involved in activities in the charcoal value chain	The percentage of women in charcoal production at national level, historically does not exceed 10%.	Fieldwork estimates, Greenlight (2016)	Organization of charcoal producers in associations will allow integration of women and other groups in the value chain. NAMA has activities of forest management and stoves that might create opportunities.
ECONOMIC DIMENSSION					
Labour	Increased number of employed people in the charcoal value chain (green jobs)	Number of people working in the sector	87 000 people employed	Alberto et al, 2003; Nhacale et al, 2009	Increased to 100000 workers by 2025 and 150000 by 2030 (average of 15 years)
Income	Local communities will receive 20% of the shared	Amount of revenues from charcoal's licensing	The government accesses only about 4% of the sector's revenue through charcoal licencing.	Nhancale et al. (2009)	SDAE could increase their revenue by about 50.1 million Mt in 2025 and 100.7 million Mt by 2030, With 10.0 million MZN per year going to the

Impact categories	Specific impacts identified	Indicator	Baseline (Business as usual - BAU) – National	Source	NAMA Scenario 2020-2030
	revenue of charcoal licencing.	delivered to the community			communities in 2025, and 20.1 million MZN per year in 2030, as their 20% shares of license revenue.
Revenue	Increase in total revenue in the sector (% GDP)	% change in the forest sector revenue as result of NAMA	Forest sector GDP varies between 4 to 11%, increased illegal logging and lack of recording limits the contribution	Alberto et al, 2003; Nhacale et al, 2009	Improvement of registration and control of licensed charcoal and produced efficiently, is expected an increase in forest sector revenue by 5% a year, from the NAMA implementation

1.2.2 Quantitative impact assessment for impacts in the Environmental Dimension

Several impact categories were identified for the environmental assessment, such as: climate change mitigation, fire prevention, water availability, water quality, biodiversity of terrestrial ecosystems, soil, and energy produced in sustainable manner, air quality / health impact due to air pollution. Due to data availability for scenario development or quantification of environmental impacts, the key categories were selected such as: Climate Change Mitigation, Fire prevention and Energy produced in sustainable manner. The other categories, such as water quality, biodiversity, soil and air quality, would be complicated to monitor and attribute to the NAMA by isolating the impacts from other actions. Longer-term assessments would be required to infer changes resulting from those impacts.

Table 6: Key parameters and indicators for tracking environmental impacts of NAMA

Parameter	Key Performance Indicators	Entity responsible for measuring	Entity responsible for Reporting	Entity responsible for data sharing	Monitoring frequency
GHG emission Reduction	CO_2e emission from charcoal production process and transport from production area to Maputo	Charcoal Operators or Associations (producers, transporters, traders)	SDAE, SPFFB, DINAF	MITADER_DINAB	Annual
Reduction in the amount of accumulated residual biomass that may cause natural fires	Tons (mass) of residual biomass from forest logging and charcoal waste mobilized for charcoal production	Charcoal Operators or Associations (producers)	SDAE	SPFFB, DINAF	Monthly
Increase in complementary biomass and charcoal waste used, which will increase access to charcoal and other energy carriers (briquettes, torrefied material) produced in a sustainable way	Tons of charcoal efficiently produced and environmentally friendly	Charcoal Operators or Associations (producers)	SDAE	SPFFB, DINAF	Monthly
	Number of charcoal consumers using sustainably produced charcoal	DINAF	DINAF MIREME-DNE	DINAF MIREME-DNE	Annual

1.2.2.1 GHG emission reduction

The quantification of the NAMA's impacts on GHG emissions is extensively reported in Deliverable #2. We here provide a summary of the GHG emission reduction potential from Deliverable #2 and provide an overview of parameters and indicators to enable MRV of GHG emissions from the NAMA. Neither the deliverable reports #2 nor #3 did considered the scenario or impact of the NAMA on the consumption level in the charcoal value chain. Consumption requires a set of data totally different from the production case, and most of the data are scarce and incomplete. However, we recognize that data such as population growth rate, stove efficiency, historical amount of charcoal consumed and emission factor of charcoal, policy developments, increasing income patterns and the likelihood of implementation of new technologies or energy alternatives are needed to build a robust scenario of charcoal consumption. Notwithstanding, it is assumed unanimously that charcoal consumption will decrease in the future due to displacements by new energy alternatives (e.g. gas, biodiesel, etc).

There is in general a large potential for emission reductions if the NAMA is implemented, with estimates showing that net zero emissions could be reached compared to the BAU during the first 2 years, and even potentially achieving net sequestration over time. By 2025 emission reductions could be as large as 314 521 ± 45 138 t CO_2-eq, corresponding to a 119% emission reduction compared to the BAU. By 2030 emission reductions could reach 442 706 ± 26 766 t CO2-eq, corresponding to a 113% Reduction (**Figure 1**). The NDC target is to reduce 31, 19 Mt CO_2-eq, by 2025 being the NAMA contribution 1 to 1.5% of the target. The methods and calculations behind **Figure 1** are reported in Deliverable report #2. The amount of cumulative emission reduction is extremely high, highlighting the impact of briquetting which had the highest emission reduction potential amongst the three technologies.

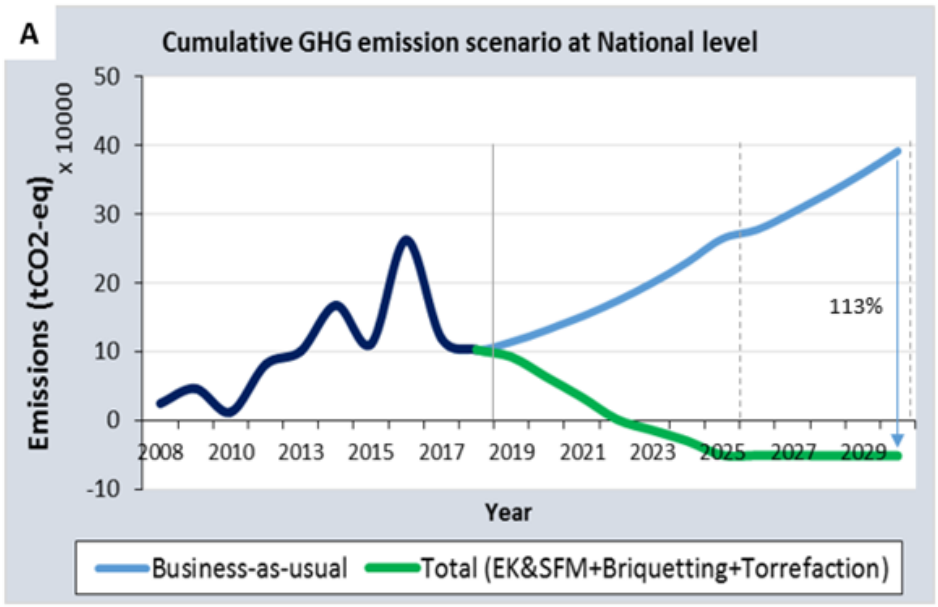


Figure 1: Cumulative emission reduction potential scenario from all technologies: improved kilns and sustainable forest management plus briquetting charcoal waste material against its BAU scenario.

The key monitoring parameters presented in table 6, are somehow complex as they need first order parameters, meaning that to be able to calculate the emissions from charcoal production and transport, there are a number of parameters that needs to be gathered first by SDAE, SPFFB and be shared with MITADER-DINAB to be reported as GHG emission. The key parameters for GHG calculation are described in the following:

The area of forest used for charcoal production per specific forest type and forest species is a central key parameter to calculate emission reductions. The area is identified annually by each operator, but not reported as sector statistics yet. Assessment of charcoal activities is based on total area of influence requested for used for charcoal production or inference is made based on total area not real affected area as result of the established licensing procedure. Data reported at the moment are related to the operator (individual or association), location of area, extension of the area (max. 500ha), and annual licensed and harvested charcoal amount (max. 1000 charcoal bags for simple licensed). For concession operators, however, not yet operational, harvesting amounts will be defined by the forest inventory. Other parameters not reported yet but needed to allow GHG calculation are: degraded forest area by charcoal (ha), and forest area converted to charcoal production (ha). SDAE does not report of forest cover changes and associated drivers. Forest inventory reports were supposed to be produced every 5 years, but unavailability of funding has prevented this from happening. For instance, existing inventories are dated 1980, 2007 and 2018. Judgement on changes in forest cover are limited not only on by the scale of inventories for District use, but also by un-regular assessment and changes in methodologies used. A robust monitoring of the NAMA implementation will require a vast effort at district level, and capacity building on what and how to collect the needed data is therefore crucial for an effective monitoring. Financial, technical and technology support is needed to allow not only a successful NAMA implementation, but also it monitoring and evaluation.

Some of the needed data parameters for GHG emission estimation should be obtained from charcoal operators (**Table 7**). Currently, only the total area per licensed producer, where charcoal activities take place, and number of charcoal bags produced per operator are recorded. To be able to precisely estimate charcoal emissions the following additional data would be needed: number of trees per species used for charcoal production, proportion of residual tree biomass left per category (stem, branch), number of tree coppicing in the area (number of trees regenerated), number of kilns and type to obtain the produced charcoal amount, number of produced charcoal bags. Studies should be conducted to develop equations that predict amount or volume of extracted forest resources for charcoal production (m^3, bags) per type of technology, and quantity of biomass per tree component (stem, branches, leaves) used for charcoal production (ton) to support impact assessments.

All charcoal value chain players have a role in data provision, monitoring and reporting. Therefore, charcoal transporters, which are part of the value chain, would need to report to SDAE on quantity of charcoal bags transported, amount of fuel and lubricants consumed, markets supplied or distance travelled (provenance to charcoal area and from here to end users). The introduction of a simple form for different actors stating the key data needs would be crucial to allow data base development and operationalization of the existing institutional arrangement. The frequency of reporting for charcoal producers, transporters and traders should be done on a monthly base.

Table 7: Key parameters and indicators for tracking the GHG emissions related to NAMA Charcoal

Parameter	Key Performance Indicator	Entity responsible for measuring	Entity responsible for Reporting	Entity responsible for data sharing	Monitoring frequency
Area of forest area used	hectares of forest used for charcoal production	Charcoal Operators or Associations (producers)	SDAE, SPFFB	DINAF	Monthly
Resource use	number of trees per species used for charcoal production				
Tree use	Ton of biomass per tree component (stem, branches, leaves) used for charcoal production per tree				
Coppice	number of tree coppicing in the area (natural regeneration or regrowth)				
Forest management	hectares under sustainable forest management				
Kilns installed or used for charcoal licensed	Number and type of kilns				
	efficiency rate of each kiln				
Charcoal produced	Number of charcoal bags produced/ licensed per kiln type				
Charcoal Transported	Quantity of charcoal bags transported per trip	Charcoal transporters			
Distance travelled from to charcoal	amount of trips and kilometres travelled for transport				

production area/ markets to end-users					
Fuel and lubricants consumption	amount of fuel and lubricants				

1.2.2.2 Increase in complementary biomass and charcoal waste used, which will increase access to charcoal and other energy carriers (briquettes, torrefied material) produced in a sustainable way

Licensed charcoal producers engaged in charcoal efficiently produced and environmentally friendly

In Africa, and Mozambique in particular, more than 80% of the population relies heavily in traditional sources of biomass fuels, mainly charcoal and firewood to meet their energy needs. Pressure on forest resources can lead to short-term resource scarcity and increase short- and long-term poverty levels of forest-dependent populations. Increasing rural-urban migration, poverty levels increase result in household difficulties in accessing other energy sources (Malate, 2017). **Table 8** presents the impact quantification or expected variation of charcoal efficiently produced from 2020 to 2024, as result of NAMA implementation.

Table 8: Quantification of the access to charcoal produced in a sustainable way

Energy produced in sustainable manner												
Specific impact	Increase in complementary biomass and charcoal waste used, which will increase access to charcoal and other energy carriers (briquettes, torrefied material) produced in a sustainable way											
Indicator	Number of licensed charcoal producers using more efficient techniques and kilns, good forest management principles and contributing to greenhouses reduction.											
Assessment method	Scenario method											
Equation	• $\%Ch = \begin{cases} Ch_f = Tc_1 * Ch_o \ de\ 2018 \text{ à } 2015 \\ Ch_f = Tc_2 * Ch_o \ de\ 2026 \text{ à } 2030 \end{cases}$ Tc_1 = 95% Tc_2 = 80%											
Parameters needed	Initial value of unsustainably produced coal and evolution rate											
Assumptions	Until 2025, the entry rate will be lower due to the establishment of the system along the entire value chain. After 2025, these rates will tend to accelerate when the system will be fully established.											
Assessment period	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
With NAMA (%)	0	10	14	19	23	26	30	44	55	64	71	77
Base scenario (%)	0	7	9	11	13	15	17	19	21	23	25	27
Increase (%)	0	3	5	8	10	11	13	25	34	41	46	50

With the NAMA implementation, the share of licensed charcoal producers using efficient technologies and good forest management principles will increase, thus contributing to GHG emission reduction (Table 8). Increase in numbers is presented in Figure 2.

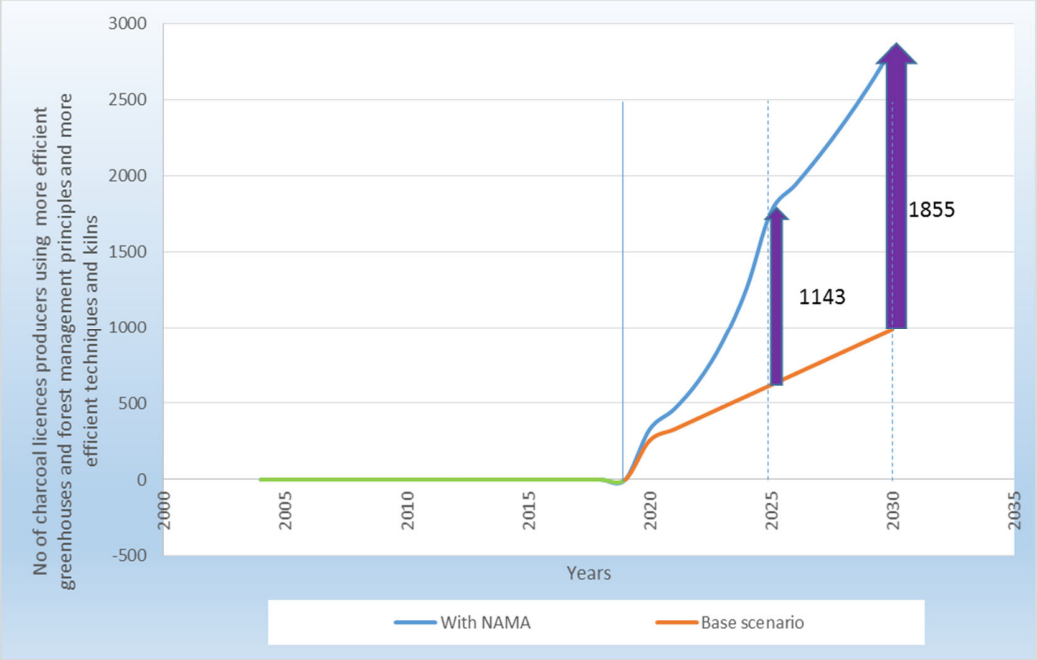


Figure 2: Number of licensed charcoal producers using more efficient techniques and kilns with NAMA implementation

Charcoal consumers using sustainably produced charcoal

Increase in charcoal sustainably produced, and increase in awareness of consumers on impacts of charcoal production, will provide a shift from unsustainable to sustainably produced charcoal. Increasing amounts of sustainable charcoal in trade places or markets will be accessible to consumers as the value chain develops. Table 9 presents the impact quantification or expected variation of consumer using sustainable produced charcoal from 2020 to 2024, as result of NAMA implementation.

Table 9: Quantification of availability to sustainable charcoal

Energy produced in sustainable manner												
Specific impact	Increase in complementary biomass and charcoal waste used, which will increase access to charcoal and other energy carriers (briquettes, torrefied material) produced in a sustainable way											
Indicator	Number of charcoal consumers using sustainably produced charcoal											
Assessment method	Scenario method											
Equation	• $\%Ch = \begin{cases} Ch_f = Tc_1 * Ch_o \ de\ 2018 \text{ à } 2025 \\ Ch_f = Tc_2 * Ch_o \ de\ 2026 \text{ à } 2030 \end{cases}$ $Tc_1 = 1.6$ $Tc_2 = 1.3$											
Parameters needed	Initial value of unsustainably used charcoal and evolution rate											
Assumptions	By 2025 the intake rate will be high and after that slow and stabilizing rate will be observed as sustainable charcoal and briquettes will be substituting the traditional charcoal as low production of the later take place.											
Assessment period	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
With NAMA (%)	0	2	3	5	8	13	21	27	35	46	60	78
Base scenario (%)	0	2	3	3	4	5	6	8	10	12	15	19
Increase (%)	0	0	1	2	4	8	15	20	26	34	45	59

Currently less than 2% of charcoal is produced sustainably in Mozambique, as adoption of efficient technologies is limited. An increase to 15% by 2025 and 59% in 2030 is expected with NAMA implementation (**Figure 3**).

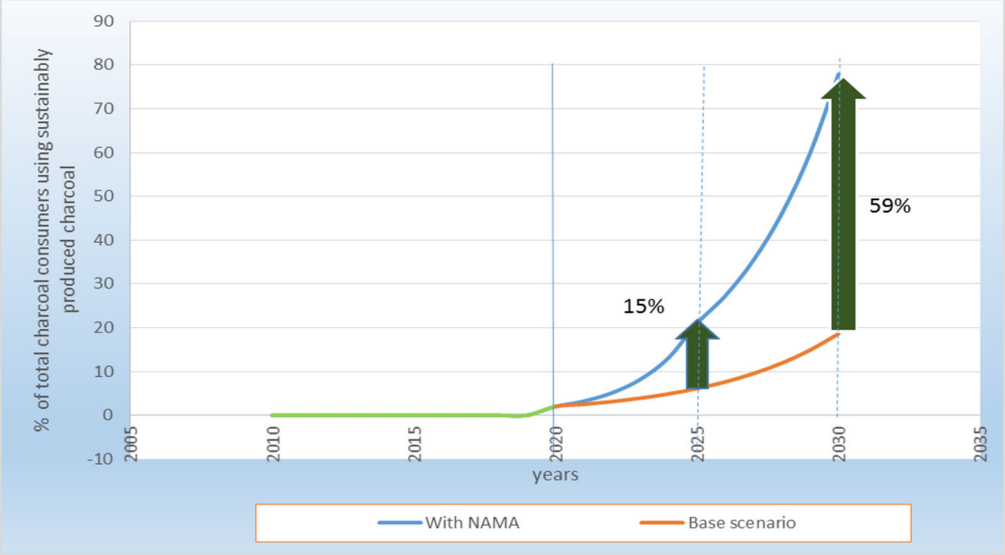


Figure 3: Proportion of charcoal consumers using sustainably produced charcoal

1.2.3 Quantitative impact assessment for impacts in the Social dimension

Social impact categories identified are: hunger, nutrition and food security, education, access to land and its resources, poverty reduction, gender equality and equity. Increase in income in the charcoal value chain will have a spillover effect onto household wellbeing, The NAMA will positively contribute to poverty reduction, and thus improved access to food that will ultimately contributing to reduced hunger and food insecurity and mal nutrition. The increased income is also expected to lead to investment in child education. No data on gender and household economy profile is systematically collected at district level with a detailed disaggregation level, which limits the assessment of other potential impacts. Therefore, only the following quantifiable impacts of the NAMA are presented: education and gender / equity (**Table 10**).

Table 10: Key parameters and indicators for tracking social impacts of NAMA

Parameter	Key Performance Indicator	Entity responsible for measuring	Entity responsible for Reporting	Entity responsible for data sharing	Monitoring frequency
Education	Number of children enrolled in school	District Education Directorate	District Services of Planning and Infra-structure (SDPIs)	Ministry of Education,	Annual
		National bureau of Statistics (INE), from the regular based national statistics			

	Number of workers in the charcoal value chain using more efficient and sustainable charcoal production technologies, and forest management practices	District Services of Economic Activities (SDAE) Charcoal associations	Provincial Forest and Wildlife Services (SPFFB)	National Directorate of Forests (DINAF)	Quarterly
Gender equity	% of women in different sectors and activities in the charcoal value chain	SDAE	SDPI	DINAF (disaggregated by gender)	Quarterly

A database of charcoal producers or associations in the NAMA target areas should be established. From the technical assistance side at the pilot stage, surveys should be conducted in order to track the NAMA implementation. It would be beneficial if records charcoal producers income and expenditures are also collected, as it will allow to have a clarity of the NAMA benefits without uncertainty of attribution of impacts to other activities.

1.2.3.1 Improved access to education for local children

Number of Children enrolled in school

The potential positive impact of NAMA technologies options on income generation include increase investment in education at local level, thus increasing literacy level as the illiteracy still high around 60% in rural areas (INE, 2007). The number of children enrolled in schools in different areas is regularly collected and can easily be used to access the progress of NAMA contribution to households involved in the charcoal value chain, even though attribution of this impact to the NAMA activities can be discussed. In the BAU it is assumed that the Education Strategy 2012-2016 aim at maintaining the increasing rate of children enrolled in schools. Table 11 shows a variation pattern of children enrolment and the equations used. It is expected that an increase by 20% and 16.5% will be achieved as NAMA income opportunities allow parents to invest in education (**Figure 4**).

Table 11: Quantification of the improved access to education for children, due to improvements in income

Education												
Specific impact	Improved access to education for local children											
Indicator	Number of children enrolled in school											
Assessment method	Scenario method											
Equation	$E = \begin{cases} E_f = E_o + 6340\ de\ 2018 \text{ à } 2025 \\ E_f = E_o + 5971\ de\ 2026 \text{ à } 2030 \end{cases}$ Ef = Next year's student's MOo = Student's year's before											
Parameters needed	Student population growth rate over time/ school infrastructure capacity, ratio of school-aged children that going to school, to total school-age children,											
Assumptions	By 2025, the arte on intake will be high as result of improvement of charcoal actors income as NAMA is fully implemented. From 2025, a slow down as almost all children at schooling age will not be much left.											
Assessment period	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
With NAMA (%)	164060	177137	190213	203290	216367	229443	242520	248491	254463	260434	266406	272377
Base scenario (%)	164060	170400	176740	183080	189420	195760	202100	208440	214780	221120	227460	233800
Increase (%)	0	6737	13473	20210	26947	33683	40420	40051	39683	39314	38946	38577
Increase	0	4	8	11	14	17	20	19	18.5	18	17	16.5

Figure 4, shows the graphical variation of children school enrolment as result of NAMA implementation. Household surveys are suggested as tool to gather data from charcoal producers or along the value chain on the link between child enrolment in school and NAMA benefits.

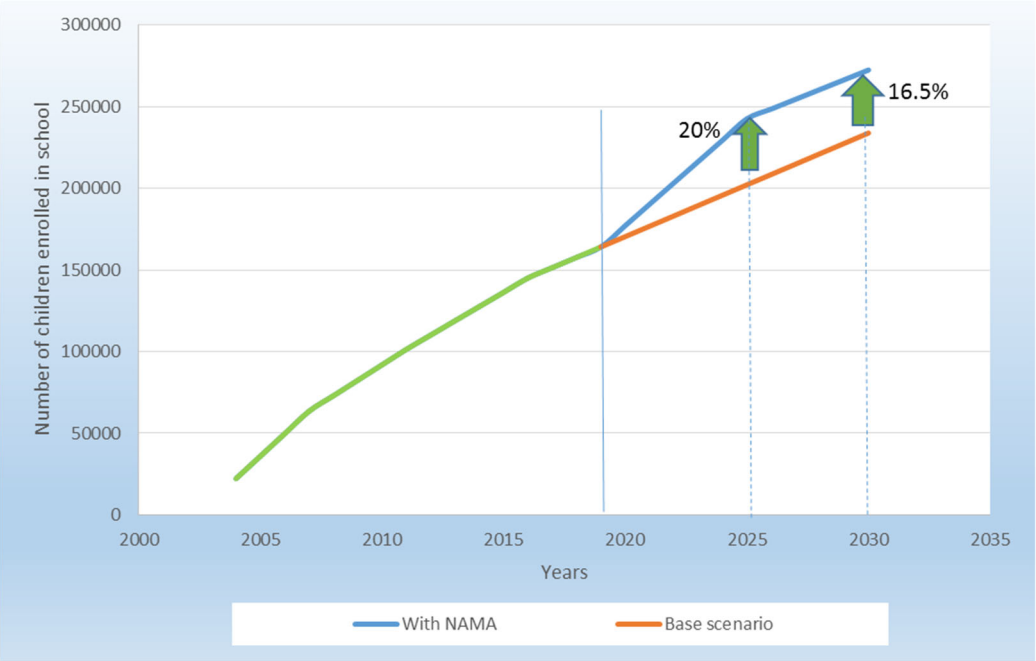


Figure 4: Increased in Children enrolled in school as result of investment in education by charcoal actors

1.2.3.2 Number of workers in the charcoal value chain using more efficient and sustainable charcoal production technologies, and forest management practices

Increasing probability of charcoal sustainably produced and consumed, will require training and capacity building for charcoal producers and stakeholders at the segments of the value chain. It is assumed that an increase of 75,436 m^3 and 28,7143 m^3 of sustainably produced charcoal by 2025 and 2030 respectively will be achieved as result of NAMA implementation. Table 12 shows the basis for expressing the variation of charcoal producer's number using efficient technologies as result of the NAMA. Graphical representation is showed in (**Figure 5**).

Table 12: Quantification of charcoal producers using more efficient and sustainable charcoal production technologies ad forest management principles

Education													
Specific impact	Improved ability to produce charcoal sustainably by capacity, skills and knowledge development												
Indicator	Number of workers in the charcoal value chain using more efficient and sustainable charcoal production technologies, and forest management practices												
Assessment method	Scenario method												
Equation	$Ch = \begin{cases} Ch_f = Tc_1 * Ch_o \ de\ 2018 \text{ à } 2025 \\ Ch_f = Tc_2 * Ch_o \ de\ 2026 \text{ à } 2030 \end{cases}$ Chf = % of charcoal producers using more efficient greenhouses and forest management principles and more efficient techniques and kilns Cho = % of charcoal producers using more efficient greenhouses and forest management principles and more efficient techniques and kilns year's before TC_1 = 1,4 Tc_2 = 1.1												
Parameters needed	Average rate of change in the sector's charcoal producers using more efficient greenhouses and forest management principles and more efficient techniques and kilns												
Assumptions	Until 2025 the charcoal producers entering in the production chain, because to the very low initial base and the effect of NAMA, will grow at a rate following an arithmetic progression, by the year 2025, from which it slows and stabilizes at a constant rate.												
Assessment period	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
With NAMA (%)	0	0	9	13	18	25	35	48	53	59	64	71	78
Base scenario (%)	0	0	7	9	11	13	15	17	19	21	23	25	27
Increase (%)	0	0	2	4	7	12	20	31	34	38	41	46	51

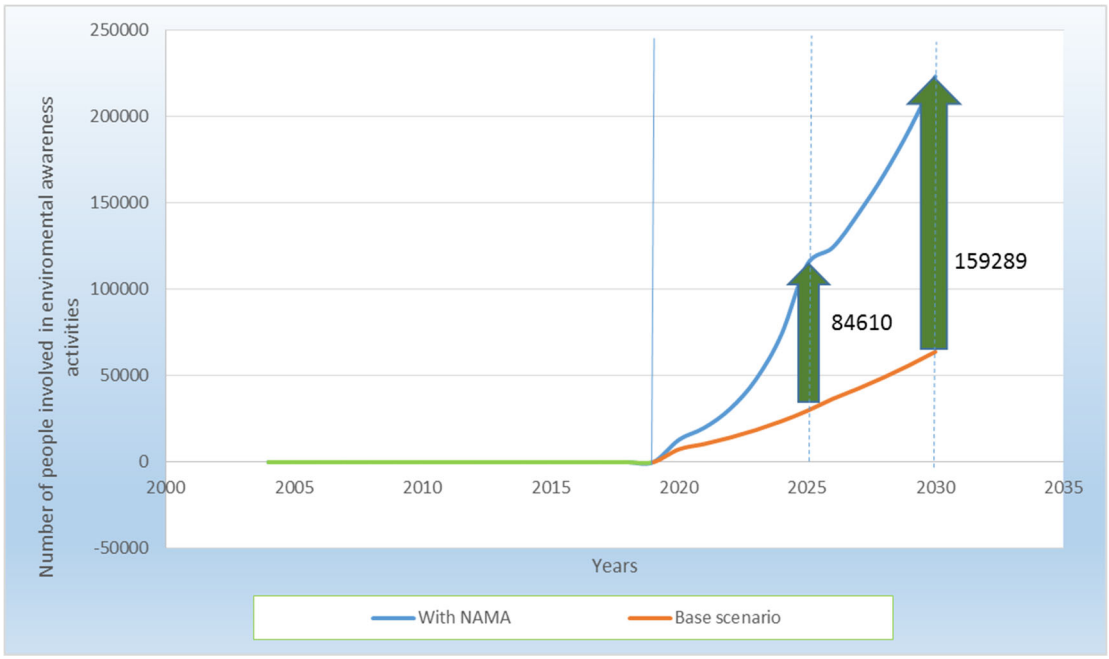


Figure 5: Number of workers in the charcoal value chain using more efficient and sustainable charcoal production technologies, and forest management practices

1.2.3.3 Improving income and opportunity equity

Increased gender equality promotion and women empowerment by created association

Different groups have different vulnerability levels based on gender and age. Social exclusion and access to opportunities is also based on social context or culture. Different access opportunities to resources and benefits is observed. The charcoal producers profile raises the need for looking at gender relations and create a balance between genders (Martins et al., 2016). Women participation is very low in the NAMA pilot area, close to 10%. The socio-economic context, make the women less involved in charcoal production, as they are more engaged in household activities and farming. Need for increased income is general, regardless of gender and social group.

With the formalization and modernization of the charcoal value chain, an increase from the actual 43,335 (10%) to 89,605 (39%) women involved in the charcoal value chain, as a result of NAMA implementation is expected. Job opportunities that can be easily performed without interfering with actual women responsibilities will be created such as:

i) forest management activities and honey production that can be performed in areas close to agriculture fields,

ii) briquette packaging and labelling,

iii) production and trade of efficient stoves.

It is as well expected that additional economic activities can be developed as application of income from charcoal in commercial activities, opening of small shops or stimulation of local industry. Table 13, shows the variation pattern of expected change in women proportion involved in charcoal activities. Figure 6 shows the graphical variation.

Table 13: Quantification of share of women participating in charcoal production

Gender equity												
Specific impact	Increased gender equality promotion and women empowerment by created association											
Indicator	% of women involved in activities in the charcoal value chain											
Assessment method	Scenario method											
Equation	$$\%W = \begin{cases} \%W = 10\%T \; year \leq 2018 \\ \%W_n = an * W_{n-1} \; 2019 < Anos \leq 2025 \; with \; a_n = 1.025 + 0.075n \\ \%W_n = 1.075W_{n-1} \; for \; year \; \in]2025, 2030] \end{cases}$$ Onde: W = Percentage of women before 2019 (10%) T = Total Workers Wn = Percentage of women in year n an = Annual growth rate in the years 2019 to 2025 0.075 = Annual growth rate in the years 2026 to 2030 n = values ranging arithmetical from 1 to 7 with 1 corresponding to 2019 and 7 corresponding to 2025											
Parameters needed	Historical data of the level of women's participation in charcoal production,											
Assumptions	Until 2025 the female population entering in the charcoal production chain will grow at a progressive rate against the actual 10%, tending to stabilize at a constant rate from 2025.											
Assessment period	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
With NAMA (%)	10	11	12	15	19	25	35	36	37	38	38	39
Base scenario (%)	10	10	10	10	10	10	10	10	10	10	10	10
Increase (%)	0	1	2	5	9	15	25	26	27	28	28	29

Women proportion engaged in charcoal value chain as result of NAMA is represented in **Figure 6** below.

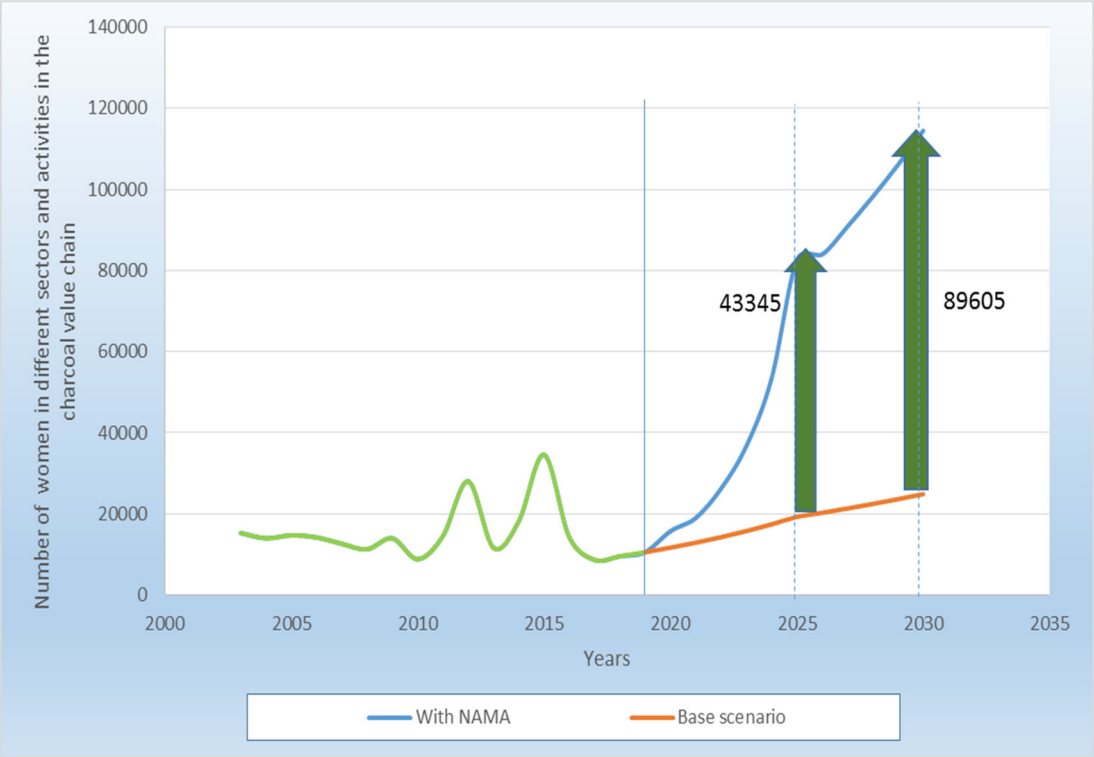


Figure 6: Expected changes in number of women involved in charcoal business as result of NAMA

1.2.4 Quantitative impact assessment for impacts in the Economic dimension

The identified specific impact categories for the economic dimension are economic diversity, labour, income and sector revenue. Due to data limitations for quantification, scenario development for economic impact are: labour and revenue. Effects assessed are related to positive increase in new long-term employment opportunities and negative effect on reduction of employment where traditional and unsustainable technologies are used.

1.2.4.1 Increased number of employed people in the charcoal value chain (green jobs)

Number of people working in the sector

New employment opportunities and training are expected to offset the potential negative impacts. The forest sector has been reported to employ 600,000 people (Alberto et al, 2003) and the charcoal sector around 1,500,000 (Nhancale et al., 2009). Statistics data shows a reduction of employment from 2015, compared to average of 87,000 people. NAMA implementation will contribute to increased employment locally and at national level by 22.5% by 2025 and 15% by 2030 (**Figure 7**). The lower increase by 2030, is due to the fact that, not many additional jobs will be created when the new charcoal chain will have been established and stable.

NAMA implementation will contribute to increased employment locally and at national level. Organization of charcoal associations along the value chain will allow better statistics on employment benefits for local and external people. The increase will be associated by the fact that formalization of the charcoal value chain will open new opportunities along the chain from where people may choose where to take benefits, either from production, trading or transporting or distribution. As formal contracts will be required security of employment will be ensured, thus attracting more people and allowing wider coverage of NAMA efficient technologies or practices. **Table 14** presents the basis for the expected variation in people benefiting from employment, and graphical representation is found in **Figure 7**.

Table 14: Quantification of increased number of people in the charcoal value chain

Labour													
Specific impact	Increased number of employed people in the charcoal value chain (green jobs)												
Indicator	Number of people working in the sector												
Assessment method	Scenario method												
Equation	$MO = \begin{cases} MO_f = Tc_1 * MO_o \; from \; 2018 \; to \; 2015 \\ MO_f = Tc_2 * MO_o \; from \; 2026 \; to \; 2030 \end{cases}$ MOf = Next year's workforce MOo = Workforce year's before TC_1 = 11% Tc_2 = 5%												
Parameters needed	Average rate of change in the sector's labor force, excluding outlier, ratio of total labor introduced by NAMA												
Assumptions	Up to 2025 will be a greater increase in number of employed people as result of new activities (briquettes, torrefied briquettes or pellets), that are not currently performed, and forest management which is currently not very intense. However after 2025 demand will be reduced as some activities will have been properly established.												
Assessment period	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
With NAMA	117286	129609	143228	158277	174907	193285	213594	236037	233227	245480	258377	271951	286238
Base scenario	95743	105803	116921	129206	142782	157784	174363	192683	202806	213461	224675	236479	248903
Increase	21542	23805	26307	29071	32125	35501	39231	43353	30420	32019	33701	35471	37335
%	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	15	15	15	15	15

Figure 7, shows how changes in the number of employed people in the charcoal value chain will change as result of NAMA implementation.

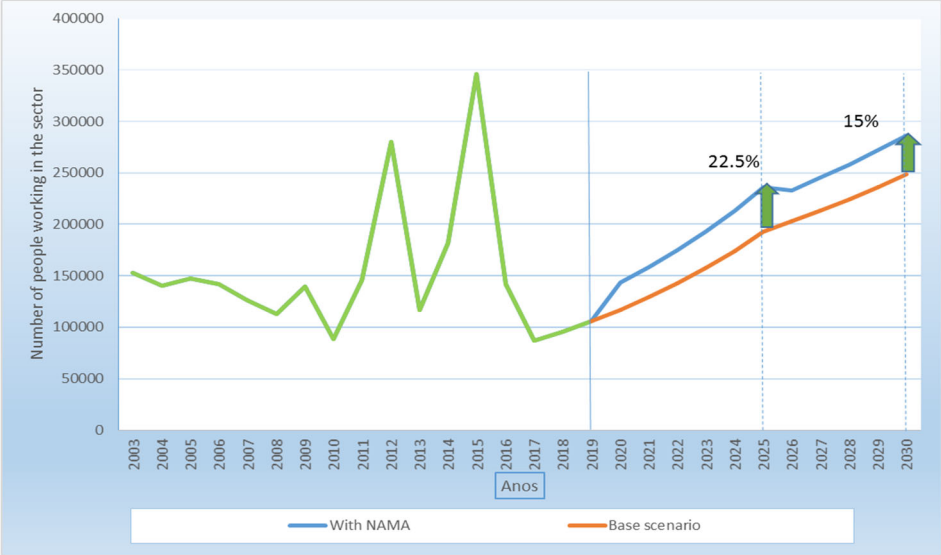


Figure 7: Increase of employments associated with charcoal sustainable technologies options

1.2.4.2 Increase in community benefits

According to Nhancale et al. (2009), only 4% of charcoal producers are licensed, and about 96% are illegal producers (the local community holds a customary right on local resources). This means that currently the communities only get 0.8% of the charcoal revenues, instead of 20% which should be the actual share for the communities. With the NAMA, this scenario will be reversed, as the formalisation of the sector will induce the current producers to formalize their charcoal activity by requesting a licence, thus contributing to the increase in the percentage margin that remains with the communities. On the other hand, the NAMA intends to allocate a percentage of the increased profits to the producers, in order to compensate them for the increased activities (i.e. forest management), and to make them aware of the value of the standing tree, thereby encouraging them to value the regeneration of the forest and waste minimization. According to the assumption, the scenario revealed that the NAMA will increase government's licensing income by about 50.1 million MZN per year by 2025 which will be collected by SDAE, with 10.0 million MZN going to the communities as their 20% share. By 2030 the SDAE be able to collect 100.7 million MZN per year, and the communities will get roughly 20.1 million MZN. We assume that the amount of people or producers willing to get license and formalize their charcoal activity will increase by 7% per year. This is an optimistic scenario, and to realize this scenario many issues must be resolved, such as corruption, governance, building infrastructure, promotion of local community charcoal institutions etc.

Table 6: Quantification of economic benefits to the communities

Income													
Specific impact	20% of charcoal licensing revenue delivered to the community												
Indicator	Amount of revenues from charcoal's licensing delivered to the community												
Assessment method	Scenario method												
Equation	$$VN_{n+1} = \frac{(V_n - 7\%V_n) * P_{n+1}}{4} \cap V_{n+1} = V_n - 7\%V_n$$ Vn: amount of earlier year V_{n+1} : next year's amount of business as usual scenario VN_{n+1}: amount of year (n+1) with NAMA P_{n+1}: percentage of charcoal produced with license in the year (n+1)												
Parameters needed	Percentage of revenue gathered with and without NAMA, average license fee, number of licenses awarded.												
Assumptions	The current amount of license revenue collected by the SDAE without NAMA is about 4%. It is generally assumed that the formalization or licensing of the illegal charcoal production will increase gradually. A yearly increase of 7 % in licensed producers is assumed throughout the period. This means that with the NAMA, the amount of licenses will increase and progressively the revenue.												
Assessment period	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
With NAMA (MZN)				32248125	39206250	47190000	55860000	64968750	74255625	83557500	92651250	102813750	111101250
Base scenario (MZN)				19845000	18450000	17160000	15960000	14850000	13815000	12855000	11955000	11115000	10335000
Increase (MZN)				12403125	20756250	30030000	39900000	50118750	60440625	70702500	80696250	91698750	100766250
%				62.5	112.5	175	250	337.5	437.5	550	675	825	975

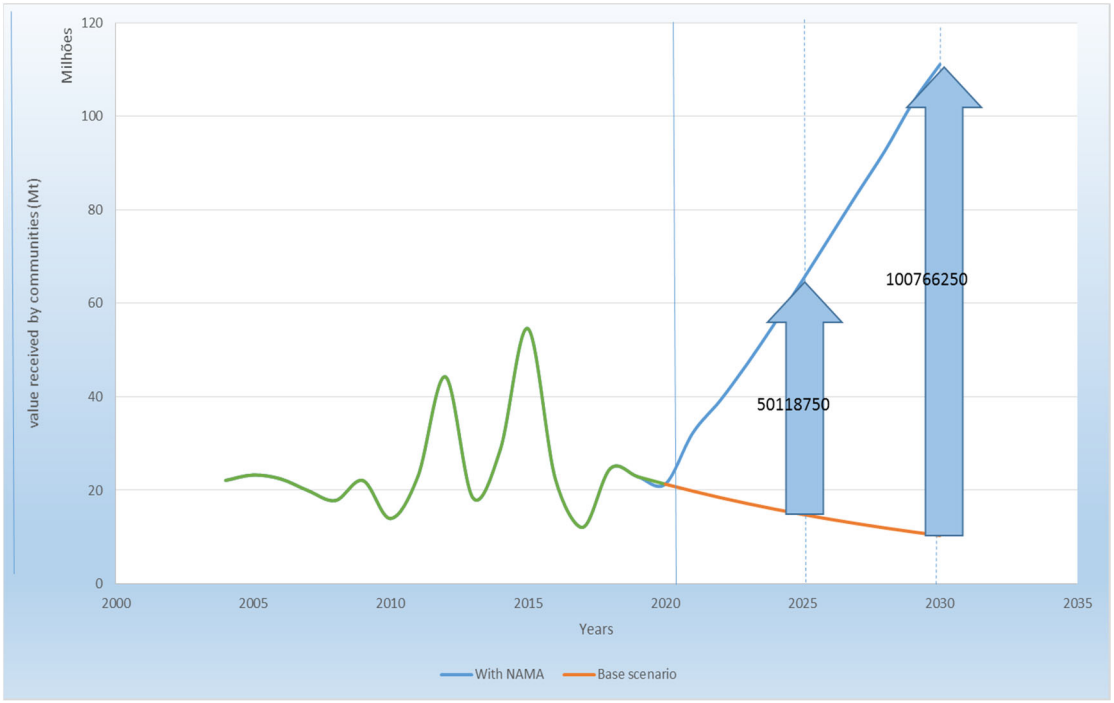


Figure 8: Increased the amount of 20% of revenue from charcoal licensing delivered to the community

1.2.4.3 Increase in total revenue in the sector (% GDP)

According to Nhancale at all (2009), only 4% of charcoal was officially recorded and accounted for in the sector statistics. According to Alberto et al (2003) and Nhancale et al (2009) the sector GDP varied between 4-9%. Studies have reported that almost 50% of harvested wood goes unrecorded as result of illegal logging (Egas et al, 2013). It is expected that sector GDP might have decreased at the same proportion to 2-5%. The formalization of the charcoal value chain will benefit from better control of the charcoal produced and increase in sector revenue from licensing. The contribution of the forestry sector to the country GDP will increase up to 10% (**Figure 9**), as result of increased productivity of the sector. **Table 15**, presents the basis for the equation development to express the expected changes in forest sector revenue as the charcoal value chain is formalized.

Table 15: Quantification on the impacts on the revenue from the charcoal sector

REVENUE													
Specific impact	Increase in total revenue in the sector (% GDP)												
Indicator	% change in the forest sector revenue as result of NAMA												
Assessment method	Scenario method												
Equation	$\% \, Of \; PIB = \{\%PIB_f = Tc_1 * \%PIB_o \; de \; 2018 \text{ à } 2030$ PIBf = Next year's PIB PIBo = PIB year's before TC_1 = 1.10												
Parameters needed	Average change rate in the sector's GDP, Average change rate in the national global GDP												
Assumptions	In the period 2020-2025 is expected a constant increase rate, however an exponential increase in GDP will be experienced in the sector as charcoal value chain is modernized and revenue captured more efficiently.												
Assessment period	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
With NAMA	2.6	2.6	5.5	5.7	6.0	6.3	6.6	7.0	7.3	7.7	8.1	8.5	8.9
Base scenario	2.6	2.6	2.7	2.9	3.0	3.2	3.3	3.5	3.7	3.8	4.0	4.2	4.4
Increase	0.0	0.0	2.7	2.9	3.0	3.2	3.3	3.5	3.7	3.8	4.0	4.2	4.4
%	2.6	2.6	5.5	5.7	6.0	6.3	6.6	7.0	7.3	7.7	8.1	8.5	8.9

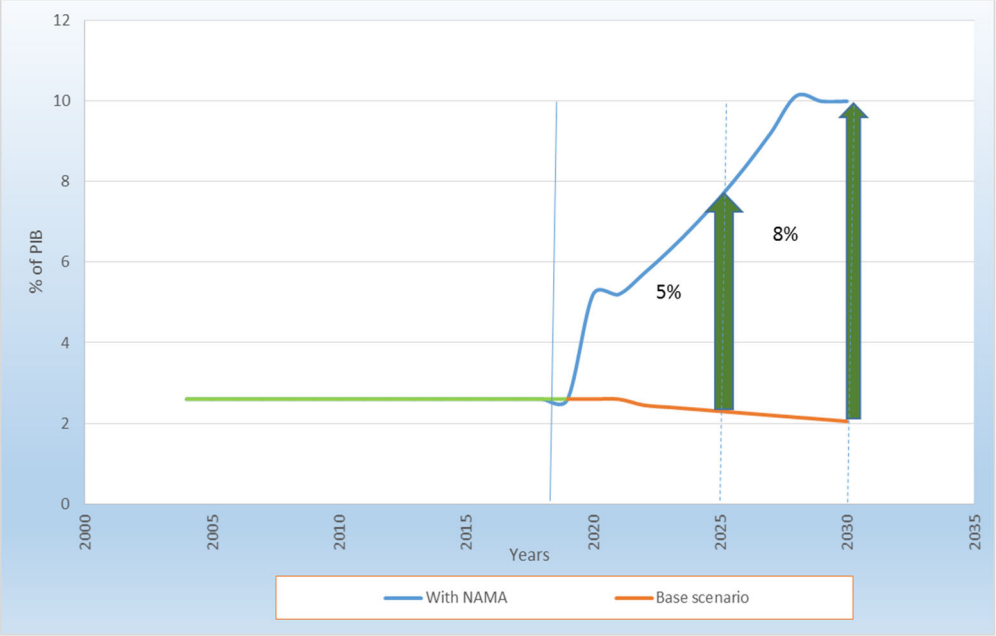


Figure 9: Total revenue change in the forest sector GDP as result of the NAMA

CHALLENGES OF THE NAMA IMPLEMENTATION AND FINDINGS FROM STAKEHOLDER MEETINGS

The qualitative and quantitative assessment have so far discussed the data limitation to the identification of the impact categories to include in the assessment. The NAMA implementation is expected to contribute to emission reduction and removals, improvement in social and economic conditions for involved charcoal stakeholders and to the sector's economic contribution. Apart of the direct NAMA impacts, additional benefits may come from REDD+ initiatives, which also were referred to at stakeholder meetings. Those initiatives are coordinated by the National Fund for Sustainable Development (FNDS), under the Forest Investment Programme (Moz FIP) funded by the World Bank. An Association named Moz Bamboo was selected through a bid process, and is currently implementing a sustainable biomass energy production component in Zambézia Province. The component currently covers sensitization on improved technologies with a focus on retort kilns, and next phase will consist of a trial of technologies.

Other past initiatives were shared, with reference to one implemented by the University Eduardo Mondlane (UEM) through the Department of Forestry, in Mabalane. The initiative analysed resource availability, mapping, economic assessment, and other activities, including the establishment of charcoal producers associations, and carrying out sensitization on improved production technologies. As strategic measure, to ensure long-term assistance to

the District in regards to sustainable charcoal production, a research station in Mabalane was established. Represented at district level, academia would support in providing robust monitoring data of charcoal production in the country, specifically in the Pilot NAMA region. Unfortunately, the project has ended in 2017, and so far no funds are available to allow a continuity of the activities. Continuity, is being done solely through Research. Ongoing assessment of alternative biomass sources that could be used for briquette production with the use of agriculture and forest residues, making use of the retort technology have been started at the Forest Department in collaboration with UEM, and funded by the Scientific Directorate / Swedish International Development Agency. It is a continuity of the research activities started in 2012 aiming to evaluate the country´s potential on biomass residues that can be mobilized from forest concession areas and forest plantations to reduce pressure under primary and secondary Mozambican forests.

The ex-National Directorate of Forest and Wildlife (now DINAF), has between 2000 to 2006 implemented projects in the country founded by FAO, aiming at sustainable forest use for energy purposes, through the formalization of charcoal associations under the community based committees. Efficient production technologies, such as a casamassa were widely implemented through the country. Civil society organizations such as ADELMA in Sofala, Greenlight in Maputo, and Program of Biodiversity Conservation (ProBec) funded by GIZ, have also implemented several initiatives on improved kilns and improved cooking stoves.

Drawbacks of the improved kiln technology adoption was on the long time for preparation, kiln design, need for permanent supervisor and demand for labour. The benefits were clear on the high efficiency and allowed reduction of nomadism of charcoal producers, which is the major challenge for impact monitoring of charcoal activities. The improved stoves at household level showed good results in biomass savings, translated in economic savings for energy purchase. Wide adoption of stoves had high initial costs and limited dissemination as limiting factors.

Metal kilns (retort), using 210l metal containers that were adapted as mobile kiln has been piloted in Manica and Sofala, with support of the Forest Research Center (CIF) in Marracuene District. Lower production amount by kiln was the major drawback. The benefits were ability to use any biomass material size, high efficiency and mobility. Overall, the sustainability of the initiatives has been very much reliant on external funding, and no continuity after project end. The concept of community-based enterprises formed by local charcoal associations constitute a sustainability factor per se. Capacity building on business management, forest management and value added products are key elements of the NAMA activities.

The following lists the challenges shared by the stakeholders meetings and from past initiatives that may influence the operationalization of the NAMA project:

- The need for a legal determination through a decree that only certified charcoal shall be traded to allow reduction of offer of unsustainable charcoal.
- Charcoal producers and other value chain actors are largely informal and difficult to locate and contact. NAMA implementation would require a mapping of charcoal producers and other actors as well as organizing individual producers into formal supplier associations and networks. Gradual changes are required as external charcoal income dependent stakeholders would be affected negatively, which would undermine NAMA implementation.
- Need of public awareness on affected people by the NAMA to identify other activities along the charcoal value chain which they may benefit from.
- Low adherence of producers to use more efficient kilns (past experience with other projects). It is part of the lesson learnt form past projects and MozFip ongoing project implementation that there is low adoption. Some reasons are associated to: technologies not feasible with the scattered occurrence of resources and need to change location. Some technologies demand time to be implemented on site, plus time spent on travel or walking just make technology adoption impossible, the higher production do not compensate the physical effort. This stresses the need to incorporate the efficient technologies with sustainable forest practices.
- Demand for intensive logistics for collection of residues might be a limiting factor for large exploration. Small-scale enterprises formed by various charcoal associations may enable the effective operationalization of the NAMA idea.
- Dependence on an incentive system for producers to use efficient production kilns through the certification model. Premium price to be paid for charcoal produced with improved kiln technologies not well documented and willingness to pay not assessed. Information on the feasibility period of the premium price and what legal measures are needed are not clear.
- Still low adoption rate of more efficient stoves at households and industry (hospitals, bakeries, ceramic units, boarding schools). There would need a legal decision on taxes reduction for improved stoves or their usage (reduction on the electricity bill, for instance), including increase in the number of companies involved in the production and / or sale of these technologies.
- Awareness campaigns on the benefits of the NAMA and use of improved stoves and kilns, reduction on price (initial cost of the technologies) might favour adoption of the efficient technologies. Technologies can be subsidised to lower the cost of improved charcoal stove, improved biomass stove, gas stove and bottle. Piloting would be needed in the urban areas.
- As changes in forest regulation might take some time, due to the nature of the process, there is a risk of monitoring being delayed, even if activities start before regulation is in place. It is recommended that from the start of the implementation

the SDAE should be involved and pilot the new data forms to monitor the activities and track operators.

- NAMA monitoring needs high financial, technical and technological capacity. The formalization of the charcoal business will increase competition and corruption problems may increase. There is a need to ensure law enforcement. Development of a tracking system connected to the central level to allow real time communication (computers, smart phones, vehicles for patrolling, fuel costs).
- Need for new tax royalties sharing mechanisms between the SDAEs and the Government. Licensing Districts do not share the revenue, as result no investment on monitoring and financial and technological capacity limits successful implementation and monitoring.
    - Apart from the 20% royalties for local community benefits, an additional fraction (10%) should be delivered as District Benefit to allow coverage of operational costs.
    - Additional taxes for the sector, would be in the form of introducing procedure fees similar to the land policy. A person submitting the request for land title pays 1500 mts to cover the costs (administrative, printing and mailing) to provincial and central levels. This fee could be paid by the charcoal operator to ensure covering the costs of processing and monitoring from district, to the province.
    - The revenue collected from infractions (illegal actions), 50% is given to the involved actors and 50% to the Government, however no revenue goes to the District that conducted the operation (vehicle, fuel etc). It should be considered to what extent the Government can assist the District level, by as well sharing a fraction of the infraction revenue proportionally to the amount mobilized by the Districts.

As conclusion, efforts on creation of legal basis, capacity building of charcoal associations and development of value chain including an operational certification system, will need to be tested during the pilot phase, to enable changes needed to upscale to the national level.

1.1 Uncertainties associated with the assessment

Use of the ICAT Sustainable Development guidance requires reliable and consistent data that allows comprehensive assessment of potential impacts of the action or policy. Thus, a large quantity of quality data is needed to conduct the assessment as recommended by the guidance. As the access to quality data was a constraining factor, the data used was from available published papers, sector reports and stakeholder consultation for validation on impact categories, specific impacts and methodologies proposed. Field data collection was conducted to gather additional information, and provided valuable inputs. However, according to the forest regulation requirements, all types of forest extraction and harvesting are not allowed from 1 January to 31st March, and the field work was carried out while charcoal production activities were not yet started, so the period of field work could potentially have been more effective if carried out during charcoal producing activities. Limited data collected by local Districts puts limitations on the analysis of potential impacts and their quantification. For the NAMA scenario development, the analysis was combined with available sector strategy targets, as no reliable data on the activity existed. For the NAMA and forest sector in general better control and reporting need to be improved.

1.2 Institutional arrangements and lesson applied across sectors

In terms of mandates for the implementation of the Charcoal NAMA, the roles of the Ministry of Energy and Mineral Resources (MIREME), FUNAE, Ministry of Lands, Environment and Rural Development (Directorate of Environment, Directorate of Forests, District Services of Economic Activities, District Services of Planning an Infrastructures etc.), Academia and Civil Society Organization (CSOs) are clear. Although the implementation of activities related to the Charcoal NAMA and participation of these stakeholders remains low.

The use of renewable biomass for energy purposes is one of MIREME's targets, and it is included in the Biomass strategy (2012), which envision the promotion of use of upgraded fuels such as charcoal from efficient production technologies (improved kilns), and the production of improved energy carriers (briquettes and pellets).

The District Services of Economic Activities (SDAE), has the role of licensing for charcoal extraction. The SDAE reports the number of licenses issued to Provincial (Provincial Forest and Wildlife Services, SPFFB) and central level (National Directorate of Forests, DINAF) in quarterly intervals, including information on authorized volume of firewood, charcoal bags, and amount covered from related licensing of firewood and charcoal (traditional biomass forms). The licensing is made in units of estere of wood, where 1 estere (1 m^3) of wood is paid 10.000 meticais as defined by the Forest regulation. For charcoal, the licensing is made through inference of 1 bag of charcoal equivalent to 1 estere of wood, or approximately 75

kg (Greenlight, 2016). Although, licensing is done for charcoal transporters (license holders), and not the charcoal producers. Since producers are not licensed (only in the case of Inhambane Province charcoal associations and charcoal transporters are licensed) the amount of biomass and number of trees used to produce the licensed charcoal amounts is not known. Improvements to the licensing scheme, to include charcoal producers will be needed to ensure a more robust measurement of biomass extracted for SDAE to be able to report activity data at this level.

However periodically requested, not all provinces report on all quarters, which creates gaps in the official statistics, thus not reflecting the actual amounts licensed, authorized and harvested. Published reports have already appointed weakness on registration and control over biomass energy use in Mozambique (Nhancale et al, 2009; Del Gato, 2003; Michaque, 2003). From those report it is estimated that only around 4-5% of extraction of firewood and charcoal is formally recorded and registered. Consequently, any judgement on numbers, and sector contribution to emissions is not robust, due to data limitations.

It is the role of charcoal transporters to identify the charcoal producers' areas, and submit among other documents, the request for licensing including a map of location of the area used for production, and report it to the Province for Licensing. The local transporters although buy the charcoal directly from producers and are not necessarily involved in the production process, and have therefore no track of the harvested forest area, amount of wood used for charcoal production, type of kilns used, amount of kilns made, and this data doesn't reach the SDAE.

There is an option for local individuals to form an association or individually to apply for a license, as long they have financial resources to cover the licensing and input costs. Input costs include equipment (chainsaws purchase or rent), sacs for packaging the charcoal and vehicle rent for instance. External individuals can also apply for a license. External individuals or collective entities can organize themselves and apply for a license, but they need prior authorization by local communities through a community consultation process and agreement. These type of license has limits on: the type of species to extract, harvesting area up to 50ha, a period of harvesting of 5 years, and production of 1000 esteres a year or 1000 bags of charcoal of 75 Kg per year. The cost per bag licensed is 75 Mt, paid before or after production.

To regulate production sites, there are maps confirming the availability of biomass for charcoal production for a specific area. The map generation regularly conducted by DINAF is supported by the National forest inventory, and enforced by Detailed Provincial Inventories of GAZA Province. There are two inventories that are used to make the maps, one conducted by the Japanese International Cooperation Agency (JICA) and the other by Eduardo Mondlane University (Greenlight, 2016). Existence of those instruments is basis for ensuring ecological limits for resource use, however it needs appropriate control and monitoring, and the current

lack of tracking of actual biomass harvested undermines the efforts of having detailed inventories to support sustainable resource use and forest management.

The flow of data will be from charcoal producers to charcoal producers associations submitted at the District level (MITADER-SDAE). Capacity building and formalized procedures and tools on data collection for all individuals along the charcoal value chain is need to raise their awareness on activity data needs for proper tracking of the NAMAs progress. Producers would need to report on biomass use data, kilns, labor, income, social benefits, and health issues regularly. District entities (SDAE, District Services of Planning and Infrastructure -SPDI) will report districts statistics on NAMA indicators to the Provincial level (SPFFB), and these to the Central level (DINAF). Health data will be provided by the District level entity with the relevant mandate – SDPI. All data harmonized is shared to the Province at quarterly basis and then at the same time sent to the central level institutions: MITADER-DINAF and the Ministry of Energy and Mineral Resources (MIREME), through the National Directorate of Energy (DNE). MIREME-DNE complies the energy matrixes and consumption patterns annually, and MITADER reports to United Nations Framework Convention on Climate Change (UNFCCC). The overall, MRV system for mitigation will be coordinated by MITADER-DINAB, while MITADER-DINAF and MIREME (National Directorate of Energy) will provide collected activity data at its various levels.

Change in attitude is central behind NAMA implementation. It is expected that the number of people aware of climate change, trained and able to conduct research, and general knowledge and awareness on climate impacts will be improved through NAMA activities, with a potential for upscaling to national level. For tracking the impact of the NAMA the number of people involved in environmental awareness activities through several projects would have to be registered and shared with SDAE. For instance, information on conducted awareness campaigns for sustainable charcoal production has already been reported by previous projects reports. Although no records have been systematically stored, and no monitoring on changes performed. Nomadic and migration behaviour of charcoal producers limits progress, not the same people a trained even in the same region as people move around. On the other hand, the perception of activities being scattered project initiatives rather than one consolidated agreed initiative, influence people's behaviour towards not changing behaviour permanently. There is a need to switch to a more participative and community led NAMA implementation with SDAE as leading level of action, which would allow for a successful NAMA implementation and documentation of learning that could be used to bring change for the whole charcoal value chain.

Under the various MRV systems for ENAMMC and NDC, MITADER is responsible to coordinate the Inter-Ministerial Working Groups for climate change, represented by the Inter-Institutional Group for Climate Change (GIIMC). GIIMC has a role as key stakeholder to be

consulted, and responsible for quality assurance and quality control (QA/QC). MITADER, being the focal point of the UNFCCC, is responsible to verifying that the information is of good quality, complete, reliable and transparent, in other words should check on GIIMC QA/QC. Good communication mechanism will be needed among the above appointed stakeholders. The proposed structure of information flow between the relevant stakeholders is proposed in **Figure 9**, based on the analysis, mapping of stakeholders, their mandates, roles and responsibilities, and data needed for NAMA tracking.

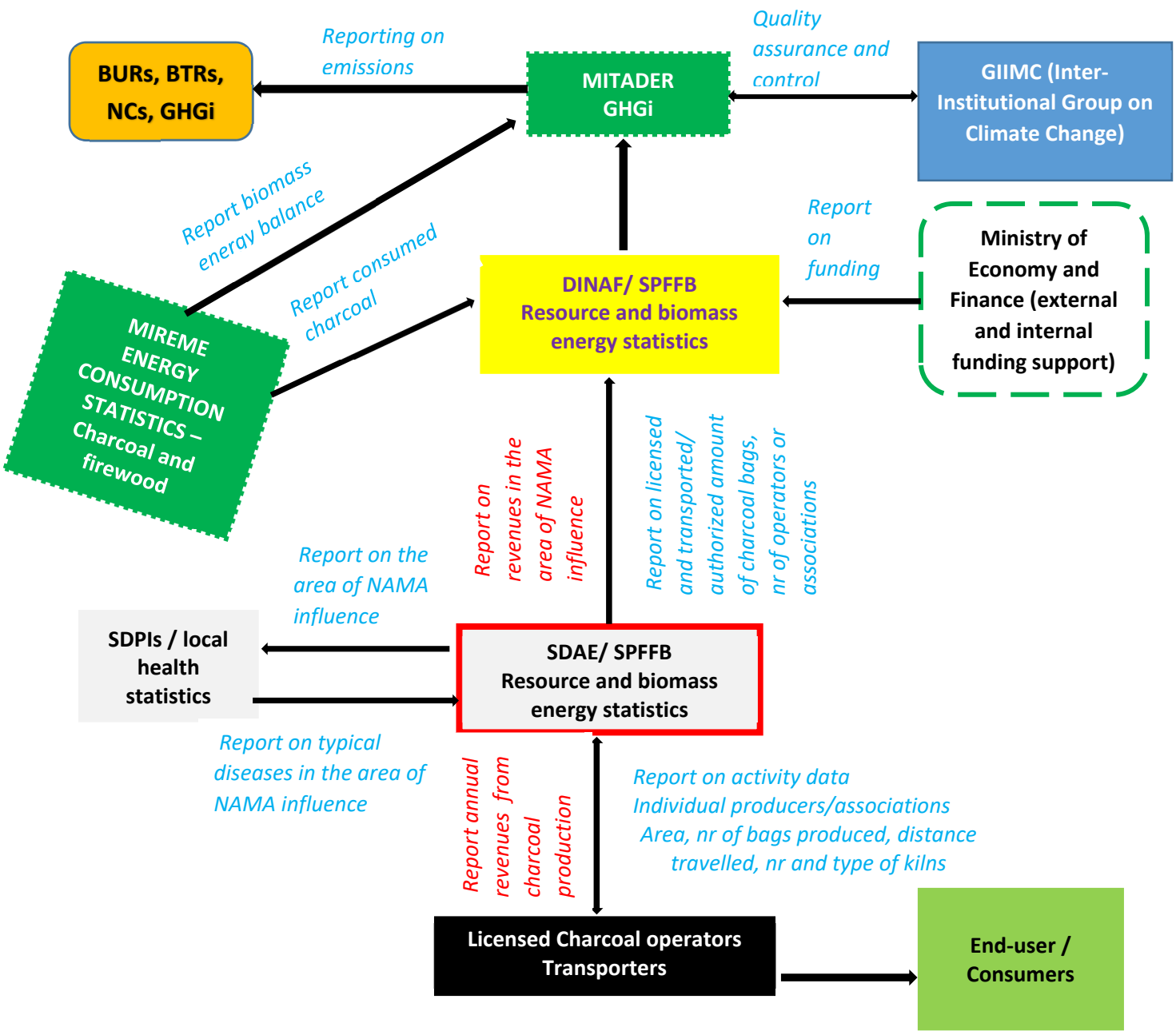


Figure 10: Mapping of Key stakeholders and roles for Reporting, Monitoring and Evaluation of the Charcoal NAMA

A detailed description of stakeholders and data needs for the monitoring is presented in **Table 16**. The indicators were selected based on the specific impact categories included in the assessment.

Table 16: Proposed monitoring and reporting for tracking NAMA progress

Impact category	Indicator	Source of data	Monitoring frequency	Measurement method	Responsible entity or institution	Historical value in 2019	Goal value for 2025
Climate Change Mitigation	CO_2e emission from charcoal production process and transport from production area to Maputo	Charcoal Associations, MITADER-SDAE (District) and MITADER-SPFFB (Provincial) - Statistics sent to DINAF	Annually	Sector level	MITADER-DINAF, FNDS, Ut-REDD, MITADER-DINAB, MIREME-DNE	Not recorded yet	314 521 t CO2-e
Fire Prevention	Tons (mass) of residual biomass from forest logging and charcoal waste mobilized for charcoal production	District Statistics	Annually	Sector level	MITADER-SDAE/ SDPI	Not recorded yet	12 t
Energy produced in sustainable manner	Number of licensed charcoal producers using more efficient techniques and kilns, good forest management principles	District Statistics	Annually	Sector level	MITADER-SDAE/ SDPI	Not recorded yet	1143 (13%)
	Number of charcoal consumers using sustainably produced charcoal	Consumers		Charcoal Associations	MITADER-SDAE	0%	15%
Education	Number of children enrolled in school	District Statistics	Quarterly	Charcoal Associations	MITADER-SDAE	Not recorded	20%
	Number of workers in the value chain using more efficient and sustainable charcoal production technologies ad forest management principles	District Statistics	Quarterly	Charcoal Associations	MITADER-SDAE	Not recorded	84610
Equality equity	% of women involved in activities in the charcoal value chain	District Statistics	Quarterly	Charcoal Associations	MITADER-SDAE	10-12%	25%
Labour	Number of people working in the sector	District Statistics	Quarterly	Charcoal Associations	MITADER-SDAE	Average (5years) 87000	236037 (22.5%)
Revenue	% change in the forest sector revenue as result of NAMA	District Statistics	Quarterly	Charcoal Associations	MITADER-SDAE	1%	4%

1.2.1 Suggestions to improve the monitoring challenges

According to the modalities, procedures and guidelines (MPG) for Article 13 (transparency) of the Paris Agreement, countries have to provide information to track progress and achievements of their NDC. The Charcoal NAMA, being one of the mitigation actions under Mozambique's NDC, will need to be reported upon, in terms of its progress of implementation in the Bienneal Transparency Reports (BTR), the first one to be submitted by December 2024. Mozambique is under the process of producing its first Biennial Update Report (BUR), to be completed and submitted by 2020, where countries also are requested to report on their mitigation actions, of which the Charcoal NAMA is also part. Data needed to report on the progress of mitigation actions is provided by the MPG. It includes the following information to be provided in tabular format:

- Name
- Description
- Objectives
- Type of instrument (regulatory, economic instrument or other)
- Status (planned, adopted or implemented)
- Sector(s) affected
- Gases affected
- Start year of implementation
- Implementing entity or entities

In addition, (developing) countries have the flexibility to report on the following information if they have the needed capacity, or may report if relevant for them:

- Estimates of expected and achieved GHG emissions reductions
- Costs (may report)
- Non-GHG mitigation benefits (may report)
- How the mitigation actions interact with each other (may report)

The mitigation actions will also have to be described in textual format, including methodologies and assumptions used to estimate the GHG emissions reductions or removals, and (developing) countries have the flexibility to report on how the actions, policies and measures are modifying longer-term trends in GHG emissions and removals, and provide and assessment of economic and social impacts of the response measures. Developing countries also are encouraged to report on support needed and received.

By 2020 very little will be possible to report as is the first implementation year, if funding will be available. There is no information so far on funds availability for the Charcoal NAMA. Any

changes on the NAMA will be reported in the BTR to be submitted to UNFCCC by 2024. Continuous monitoring, evaluation and reporting will be required at different levels.

The MRV of mitigation actions can be divided in: i) MRV of GHG emissions reductions; ii) MRV of non-GHG mitigation benefits, and MRV of support (can be financial, technological, and capacity-building). Identified aspects that might hinder effective monitoring varies, with reference to:

1. *Lack of policies and legal mechanisms to regulate legal and sustainable charcoal production.*

The implementation of the NAMA will require in-depth work to develop or adapt the regulatory framework, for instance priority licensing to local associations; changes in the application form to allow gathering of information from the charcoal producers and activity data itself; and development of a certification system from the pilot to across the country.

2. *Limited alignment of NAMA MRV with existing MRV systems and institutional arrangements*

Following the recommendation of the NDC operational plan (MITADER, 2018), the responsibility to monitor implementation of the ENAMMC and NDC is attributed to the National Directorate of Planning of Budgeting (DNPO) at Ministry of Economy and Finance (MEF). As the Charcoal NAMA is one of the priority actions under Agriculture, Forest and other land uses (AFOLU) sector in the Mozambique NDC, approved in 2018, it is logic to align the NAMA with the existing processes in the country. The benefits of such approach is: avoidance of overlapping of efforts, rational use of financial resources, direct harmonization with SDGs monitoring, easier coordination with the relevant sectors and stakeholders, including CSOs, Academia, Private sector and Development partners.

3. *Inter and intra institutional coordination*

Different actors are involved in different stages of the charcoal value chain at different levels, and thus their roles in monitoring and evaluation will differ. MITADER-DINAF, has a responsibility to report to the UNFCCC, to monitor the resource use for charcoal production, to monitor licensed and authorized charcoal amounts, and production of forest sector statistics. These information is channelled through the provincial level who license the operators, and monitored at District level. Successful implementation and monitoring will require a strong effort of all actors to ensure that roles and responsibilities are complied with. The mandates of different institutions at different levels is defined by law, but an effective enforcement of the law through a clarification of roles and responsibilities is needed. An

example could be an additional law instrument to clarify the roles, in a form of climate act, similar to Kenya or Zimbabwe.

4. *Limited skilled personnel/ technicians has to gather, process and manage data*

When it comes to needed data for emission estimates, there is a need for standardized data collection instruments to allow the sector and relevant stakeholders to channel information in a correct form, as required by MITADER and IPCCC software. The collected information should go through the established data flow mechanisms from local charcoal producers and transporters to district (SDAE), to SDPI, to Provincial level (SPFFB), MIREME and MITADER. MITADER - DINAB will only be left with the task to compile the data to produce the reports either for National Communications (NCs), Biennial Update Reports (BURs) or Biennial Transparency Reports (BTRs), NDCs and GHG Inventories.

5. *Weak data management system and data sharing*

Definition and clarification on data needs, data collection protocols and information sharing is crucial to allow systematic data collection, monitoring and reporting. There is a lack of institutionalized data management and sharing mechanisms or identified specific body for it. This is aggravated by the lack of a mechanisms for data collection and established mechanisms to ensure continuous or regular updates. Data is updated only when needed and requested and if additional funds are available. This leads to a non-sustainable system, as the Government can't ensure its continuity. The responsibilities for monitoring and reporting should be assigned to specific institutions, based on mandates and specific data requirements provided by the indicators and methods presented in this analysis, which ultimately will improve ownership and transparency. The method and indicators presented in the analysis can therefore be used to structure measurement and reporting protocols to be used by the relevant institutions. Although, even if the data is in the right form it needs to be accessible to allow the institutions to analyse it and report on activities assigned to them. For instance, a global and accessible platform for climate relevant data sharing would allow DINAB to elaborate their reporting with regard to climate change: National Communications, BUR, upcoming BTR, and national annual climate change reports.

For the MRV of support obtained and required

The support is obtained through various forms, by individual institutions and not all support is documented in a transparent way. There is a need for transparency in budget use and allocation by actions, and progress obtained. Limited information on support obtained, limits access to additional support.

CONCLUSIONS AND RECOMENDATIONS

The report provides a pilot assessment using the Initiative for Climate Action (ICAT) Sustainable Development Methodology for the Charcoal NAMA in Mozambique. The methodology was developed as tool assess impacts of policies, actions or project, ex-ante, ex-post and during implementation, and is applicable to assess the Charcoal NAMA. The assessment performed will inform not only the NAMA implementation and provide guidance for its effective monitoring, but also of the Mozambique's NDC 2020-2025, as the Charcoal NAMA charcoal is part of it.

The impacts were assessed both in a qualitative and quantitative manner, covering the three dimensions: environmental, social and economic, grouped by impact categories and specific impacts. There were many potential impacts that would result from NAMA implementation, but in-depth analysis and quantification was made for the impact categories with available data to support the scenario development. Major impacts includes: Climate Change Mitigation, Energy produced in sustainable manner (environmental dimension); education, gender equity (social dimension); and labour and revenue (economic dimension). A part from the dimensions, all impacts regardless of the possibility for quantification, were assessed based on their potential contribution to the SDGs. The integrated assessment that the ICAT guidance provides, is beneficial as it gives a holistic and systemic perspective on the policy or action studied.

Results of the assessment shows that NAMA implementation could result to GHG emission reductions of 314 521 ± 45 138 t CO_2-eq by 2025 (119% emission reduction compared to the Baseline) and 706 ± 26 766 t CO2-eq by 2030 (113% Reduction). This would contribute to 1 to 1.5% of the NDC target from the forestry sector. The NAMA implementation could also contribute to a reduction of 12 ton of accumulated residual biomass that may cause natural fires it not mobilized for charcoal or other sustainable energy carrier (briquettes, pellets).

The number of charcoal producers using efficient technologies and good forest management principles is expected to increase to up to 1,143 operators. It is as well found that NAMA implementation will allow a gradual increase in number of workers in the value chain adopting sustainable practices and technologies, reaching 84,610 by 2025. With regard to the number of consumers using sustainable charcoal, it was found that there is limited records, and current estimates pointed to 2%, while NAMA implementation would allow an increase to 15% by 2025.

Implementation of NAMA technology options may allow income increase as productivity will increase. Income from charcoal may increase investment in education at local level, allowing

that more children can be enrolled. A 20% increase in number of enrolled children is expected by 2025.

Equity of opportunities between gender is desired. Formalization of the value chain was found to be beneficial, as it will allow integration of women along the various sub-chains: production, trade, labelling, registry, forest management, etc. Engagement of around 43,345 women is expected by 2025, and gradually more thereafter. Opportunity for higher income will attract more local producers improving therefore the local economy, and by 2025 an increased employment by 22.5% is expected. Formalization will also have a positive impact to the economic contribution of the forests sector. The contribution of the forestry sector to the country GDP will increase up to 10% as compared to 2-5%.

An effective monitoring, reporting, and verification (MRV) system is key to track the NAMA progress. Discussion of issues that may hinder the MRV systems to track the NAMA impacts is discussed and recommendations provided. Indicators and parameters for MRV were identified and challenges for effective MRV discussed, with reference to: limited technical capacity and limited availability of resources or means for implementation such as financial resources and technology, unclear institutional responsibilities for reporting, monitoring and verification, weak coordination between institutions, lack of consistent data and data collection standard protocols, and lack of mechanisms for data collection, processing, repository and sharing.

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