Global Green Growth Institute

Green Growth Potential Assessment

Mozambique Country Report

May 2018

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Executive Summary

The Green Growth Potential Assessment (GGPA) is a diagnostic tool developed by the Global Green Growth Institute (GGGI) which consists of a combination of data analysis and stakeholder consultation in order to identify and prioritize a country's opportunities for green growth. Based on these priorities, specific recommendations are developed, building on scientific evidence, successful examples from other countries, considering existing policy documents and technical analysis. This report presents the findings of the GGPA of Mozambique, detailing the recommendations underfed by a solid rationale, for each of the green growth priorities.

Data analysis and stakeholder consultation identified five priorities for green growth in Mozambique. Three of these priorities can be described as technical or economic challenges. These are:

- Improve agricultural productivity,
- Support renewable energy to improve rural livelihoods, and
- Reduce the depletion of natural resources (including forests, water, fish stocks, etc.).

The remaining two priorities represent cross sectoral challenges and participants regarded them as enablers to make advances in the first three areas. These are:

- Good governance, and
- Education.

The identified green growth priorities served as the basis for this report. GGGI was asked to focus on rural development in its assessment. Therefore, this report addresses two essential aspects to foster rural development and increase agricultural productivity, i.e. the use of renewable energy and more efficient use of natural assets. Recommendations were developed for both aspects, considering how education and good governance can work as enablers. The analysis was informed by existing policy documents, technical analysis, and a series of interviews with a wide range of technical experts in Mozambique.

The recommendations discussed in this report are meant to guide national, sectoral and sub-sectoral planning as well as investment activities toward sustainable development and economic growth. For example, the assessment aims to support the implementation of the Green Economy pillar of the 5 Year Plan (2015-2019), the Sustainable Rural Development Program (2015-2030), as well as other sectoral plans and strategies over the short and mid-term. The report highlights specific interventions on how to achieve some of the existing targets. Furthermore, the recommendations are also intended to support the Government of Mozambique (GoM) to achieve its international commitments, such as the Sustainable Development Goals (SDGs) and the Nationally Determined Contributions (NDCs).

First, the report recommends for the GoM to promote the use of off-grid electricity from renewable sources. The use of off-grid electricity from renewable sources has a large range of benefits. First, it allows for increased electricity access, particularly in rural areas as electrification through off-grid solutions is cheaper than extending the grid to remote areas**.** Second, the extensive use of biomass and charcoal is associated with considerable environmental costs, particularly for forests and soils. The use of renewable energy sources allows protecting these natural assets and helps mitigating Mozambique's GHG emissions. Third, the use of renewable energy sources allows mitigating health risks from indoor air pollution as a result of burning biomass and charcoal in closed environments. Finally, electricity from renewable sources can save money, with renewable energy solutions already being a cost-efficient alternative to fossil fuels, such as kerosene for lighting.

To realize these benefits from renewable energy the report recommends strengthening the role of the private sector. The participation of private sector in the off-grid market is essential to achieve rural electrification targets. The private sector can provide much-needed investment and reduce the burden on public finances. The presence of several private companies instead of a single state business will strengthen competitiveness, improve quality of equipment and service, and bring down costs. The

private sector can make modern renewables technology more accessible. It would allow end-users to take advantage of the latest improvements in equipment efficiency, instead of relying on a single provider, particularly when opening the market was combined with the introduction of quality standards for equipment. Finally, the private sector can also help to address the current maintenance and operation problems, support the creation of a skilled labor force, and thereby increase rural income levels.

The renewable energy industry has identified financial, political, and regulatory risks as the most significant barriers for the deployment of renewable energy projects. Therefore, in order to strengthen the role of the private sector, the report elaborates on a set of specific recommendations reducing these risks. Specifically, to strengthen regulator certainty it is recommended to (1) increase policy coherence and developing operational plans, (2) clarify the roles and responsibilities among government institutions related to renewable energy, (3) establish an independent regulator, (4) create a tariff system that allows to cover operational costs and provides a return on investments, and (5) reform taxes and import duties related to renewable energy equipment. To facilitate access to finance for private investors, the report recommends for the Government of Mozambique to (6) reduce capital controls, (7) improve access to local finance, and (8) open up access to international funds for private off-grid ventures.

Second, the Mozambique is endowed with a large amount of natural assets such as arable land, forests, fisheries, wildlife, water and mineral resources. However, many of these assets are under pressure. Forests play a central role for maintaining many of the country's other natural assets. Forests provide essential ecosystem services from carbon sequestration and storage, to soil fertility, water quality and regulation. They also play an important role in mitigating and adapting to the adverse impacts of climate change, constituting important carbon reservoirs and reducing the probability and impact of natural disasters related to climate change. Furthermore, forests play an important role in Mozambique's economy and the livelihoods of the country's rural population, with the forest sector contributing about 3-4% to GDP. Finally, fuelwood and charcoal are critical to meet household energy needs, with more than 70% of the population depending on them for cooking.

Given the central role of forests in Mozambique, recommendations focus on conserving forests and addressing the drivers of deforestation. As an essential first step for forest conservation, it is recommended (1) for the Government of Mozambique to define forests consistently considering user rights. Currently, there is no consistent definition that clearly distinguishes between different categories of forests – considering their use. The lack of a coherent definition renders forest inventories largely useless, as the extent of forest cover has been reported differently in various sources and over time. This has led to high uncertainty regarding levels of deforestation as it is impossible to identify whether existing discrepancy are due to real changes or changes in classification. Distinguishing between different types of forest is essential to assess the forest sector, design and track conservation efforts, determine use, determine the mitigation potential for GHG emissions, assess opportunities and constraints for commercial use, develop legislation for forest management, and divide responsibilities between different government branches involved in forest management.

In order to reduce the deforestation caused by itinerant agriculture, it is recommended for the Government of Mozambique to (2) support agroforestry and (3) small-scale irrigation schemes to extend cultivation periods, reduce depletion of soils, improve yields, and enhance food security for subsistence farmers. To reduce deforestation as the result of legal and illegal logging, the GoM should (4) introduce certification as a means to access more lucrative markets for timber. This would allow to reduce the overdependency on a single market. Adherence to international certification schemes is also a precondition to access global carbon funds through the REDD+ scheme. Furthermore, certification provides opportunities for improved governance and transparency, for strengthening forest laws and regulations, and to attract technical assistance for sustainable forest management. Finally, to reduce demand for fuel as a driver of deforestation, the report recommends for the GoM to (5) support the sustainable production and use of fuel wood and charcoal, and (6) support the use of clean cooking technologies.

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ALER	Lusophone Renewable Energy Association
AfDB	African Development Bank
AIDS	acquired immune deficiency syndrome
APA NEWS	African News Agency
AQUA	National Agency for Environmental Quality Control
ARENE	Energy Regulatory Authority
BERF	Business Environment Reform Facility
BNE	Global Energy Balance
BNEF	Bloomberg New Energy Finance
BoM	Bank of Mozambique
BoP	Bottom of the Pyramid
BRILHO	DFID's off-grid energy programme in Mozambique
CARE	Cooperative for Assistance and Relief Everywhere
CDM	UN's Clean Development Mechanism
CEAGRE	Center for Agriculture and Natural Resources Studies
CIP	Public Integrity Centre
CNELEC	National Electricity Council
CO_2e	carbon dioxide equivalent
DALYs	Disability-adjusted life years
DFID	UK's Department for International Development
DINAF	National Directorate of Forests
DINAT	National Directorate of Land
DUAT	Acquisition of Land Use Rights
EAC	East African Community
EDENR	Strategy for New and Renewable Energy Development
EdM	Electricidade de Moçambique (public utility company)
EIA	Environmental Impact Assessment
EIU	The Economist Intelligence Unit
EnDeV	Energising Development
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FEWS NET	Famine Early Warning Systems Network
FONERWA	Rwanda's Green Fund
FUNAE	Fundo de Energia (Energy Fund)
GADM	Global Administrative Areas database
GAN	a business anti-corruption portal
GDP	gross domestic products
GFDRR	Global Facility for Disaster Reduction and Recovery
GGGI	Global Green Growth Institute
GGPA	Green Growth Potential Assessment
GHG	Green House Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH [German society for International Cooperation (GIZ) GmbH]
GoM	Government of Mozambique
GWp	Giga Watt Peak
ha	hectares
IEA	International Energy Agency
IFAD	International Fund for Agricultural Development
IIED	International Institute for Environment and Development
IIM	Institution Industrial de Maputo

IIP	National Institute of Fisheries Research
IMF	International Monetary Fund
INAE	National Inspectorate for Economic Activities
INE	Mozambique's National Statistics Institute
IDA	International Development Agency
Inter.	Interview
IPCC	The Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
IUCN	International Union for Conservation of Nature
LIC	Low Income Countries
KCIC	Kenya Climate Innovation Center
KfW	Kreditanstalt für Wiederaufbau (Reconstruction Credit Institute, a German government-owned development bank)
KNOEMA	a search engine for data connecting public and private sources
kt	kilotons
kWh	kilowatt-hour
LED	Light Emitting Diodes
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
MASA	Ministry of Agriculture and Food Security
MEF	Ministry of Economy and Finance
MIGA	Multilateral Investment Guarantee Agency
MITADER	Ministry of Land, Environment and Rural Development
MIREME	Ministry of Mineral Resources and Energy
MozFIP	Mozambique Forest Investment Project
MVA	Mega Volt Amp
MW	Mega Watt
MWp	Mega Watt Peak
MTCS	Malaysian Timber Certification Scheme
MZN	metical
M-KOPA	Kenyan solar energy company
NDCs	Nationally Determined Contributions
NES	National Electrification Strategy
NGO	non-governmental organization
NNV	Norwegian Society for the Conservation of Nature
OECD	Organisation of Economic Co-operation and Development
PARPA	Programme for Reduction of Absolute Poverty
PAYG	Pay-As-You-Go
PEDSA	Strategic Plan for the Development of the Agrarian Sector
PES	Economic and Social Plan
$PM_{2.5}$	particulate matter of 2.5 micrometers or less in diameter
PNISA	National Investment Plan of Agrarian Sector
PROFOR	Program on Forests
PV	Photovoltaic
RBF	Result Based Financing
REFIT	Tariff Regime for New and Renewable Energies
RECP	Africa-EU Renewable Energy Cooperation Programme
REDD+	Reduction in Deforestation and Degradation
SADC	Southern African Development Community
SDGs	Sustainable Development Goals
SEforALL	Sustainable Energy for All
SHS	Solar home system
SNV	Stichting Nederlandse Vrijwilligers (Netherlands Development Organisation)
tCO_2	Tons of carbon dioxide
TFC	Total Final Consumption
TIB	Tanzanian bank

TJ	terajoule
TPES	Total Primary Energy Supply
TVM	Television of Mozambique
UEM	Eduardo Mondlane University
UN	United Nations
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organisation
UNIQUE	United Nations Info Quest
UT-REDD	Technical Unit of REDD
WFP	World Food Programme
WWF	World Wide Fund for Nature
VAT	Value Added Tax

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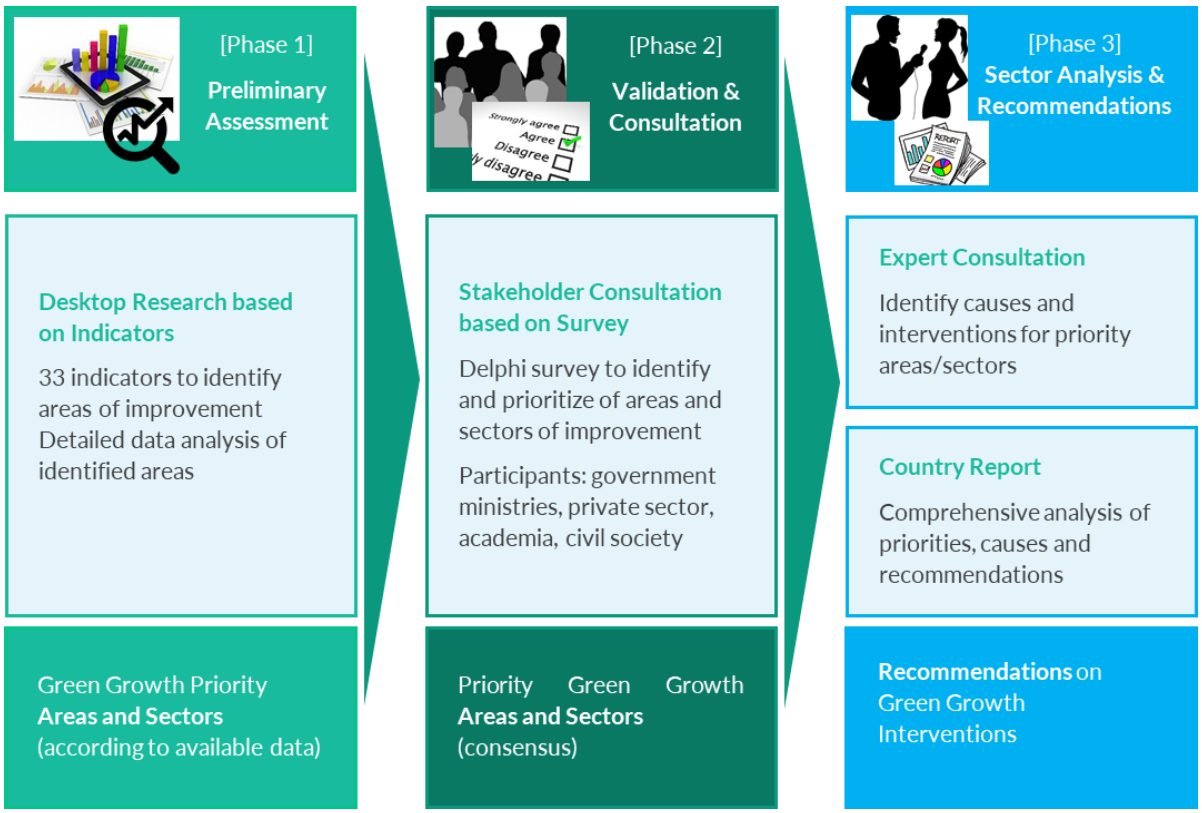
1. Introduction

There are many ongoing efforts to plan and implement green growth in Mozambique. However, currently there is no shared understanding of green growth or a clear national agenda. To address these needs, the Ministry of Land, Environment and Rural Development (MITADER) has requested the support of the Global Green Growth Institute (GGGI) to undertake an evidence-based and results-oriented assessment as the first step in setting its green growth priorities and targets.

As part of this work, GGGI conducted a Green Growth Potential Assessment (GGPA). The GGPA is a diagnostic tool which consists of a combination of data analysis and stakeholder consultation in order to identify and prioritize a country's opportunities for green growth. The GGPA process consists of the following three stages: (1) a preliminary assessment based on quantitative data analysis; (2) a validation of the preliminary assessment and consultation with stakeholders; and (3) a sector analysis and the development of recommendations (Figure 1). This design aims to ensure that the assessment process is systematic, objective, and participatory.

The GGPA identified green growth interventions offering the greatest potential for a more sustainable development of Mozambique. This report presents the findings of the GGPA process, detailing the recommendations for the identified priorities, each of which is underfed by a solid rationale. This set of recommendations is meant to guide national, sectoral and sub-sectoral planning as well as investment activities toward sustainable development and economic growth. For example, the assessment aims to support the implementation of the Green Economy pillar of the 5 Year Plan (2015-2019), the Sustainable Rural Development Program (2015-2030), as well as other sectoral plans and strategies over the short and mid-term periods.

Figure 1 Overview of the GGPA Process

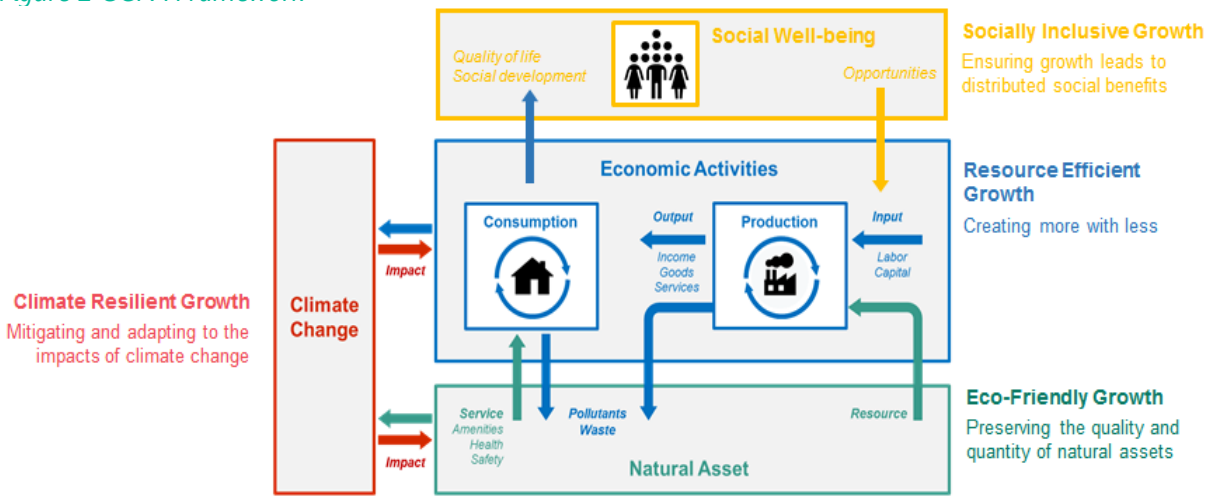


2. Methodology

2.1. Data Analysis

To analyze Mozambique´s current performance on green growth, the country was compared to the average score of Low Income Countries (LIC) and a selected group of peer countries, including Malawi, Tanzania and Zambia. This comparison is based on 33 indicators across four green growth dimensions, namely Resource-Efficient Growth, Eco-Friendly Growth, Climate Resilient Growth, and Socially Inclusive Growth. (Figure 2) A list of the indicators with details on their definition and sources is provided in Appendix A1.

Figure 2 GGPA Framework



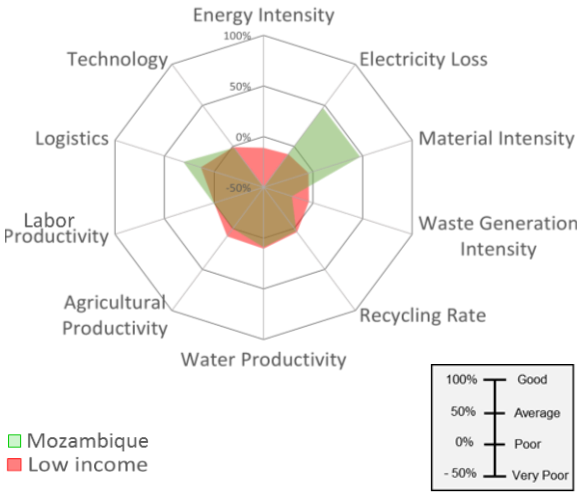
Source: GGGI

2.1.1. Resource-Efficient Growth

The results of the data analysis show that compared to the LIC average, Mozambique scores relatively higher for electricity losses and material intensity. The country receives comparatively low scores for energy intensity, waste generation, and agricultural productivity.

Final consumption of energy is dominated by the residential sector (IEA 2018a). There is limited productive use of energy in Mozambique, with the MOZAL aluminum smelter alone accounting for about three quarters of electricity consumption (Mahumane and Mulder, 2015). Agricultural productivity is of particular importance in Mozambique, accounting for about 25% of GDP and employing about 80% of the workforce (FAO 2018a).

Figure 3 Resource-Efficient Growth

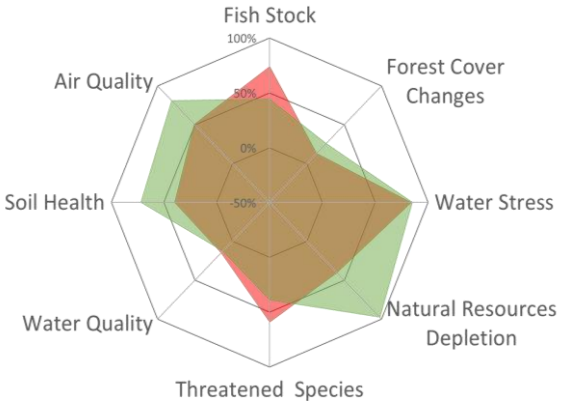


2.1.2. Eco-Friendly Growth

According to the indicators used for the GGPA, Mozambique performs well in natural resources depletion, soil health and air quality when compared to the LIC average. However, it should be noted that the results for soil health are misleading as the data on which the indicator is based is largely outdated.

In general, Mozambique scores lower than its peers regarding the sustainability of the county's natural assets and biodiversity, including fish stocks and threatened species. Individual comparisons with Malawi and Zambia showed that water stress is also an area of concern. Finally, loss of forest cover though comparable to other countries in the region scores low when considered on a global scale.

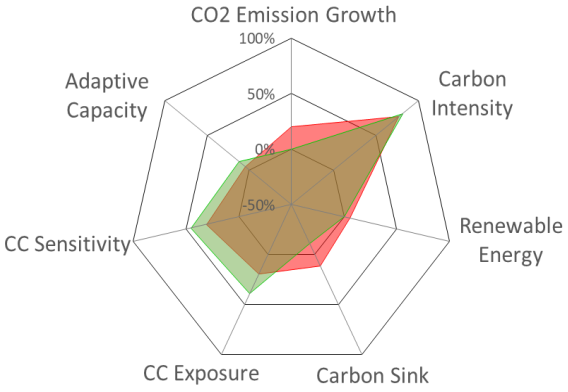
Figure 4 Eco-Friendly Growth



2.1.3. Climate Resilient Growth

Mozambique performs well regarding the carbon intensity of its economy. The country received low scores for growth of CO_2 emissions, carbon sink and renewable energy (which under the GGPA methodology excludes hydropower). Climate change indicators are presented as a disaggregation of three indicators capturing vulnerability to the adverse impacts of climate change. In this context, sensitivity and adaptive capacity towards climate change received lower scores than its regional peers. This is particularly relevant given the prominence of the country's agriculture sector.

Figure 5 Climate Resilient Growth

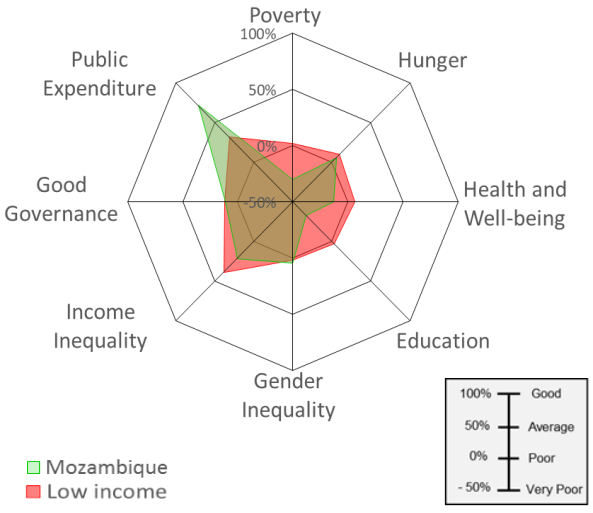


2.1.4. Socially Inclusive Growth

For indicators measuring socially inclusive growth, Mozambique scores consistently lower in a variety of areas compared to its peers. This includes poverty, hunger, health, education and income inequality. Individual comparisons with Tanzania and Zambia add gender inequality and good governance to the list.

Both, good governance and education are basic necessities to reduce poverty and raise income levels. While education is more of a technical challenge, good governance can only be addressed on a political level. Both areas also figured prominently during the stakeholder consultation.

Figure 6 Socially Inclusive Growth



2.2. Stakeholder Consultation

An essential part of the GGPA is to gather input from a broad range of stakeholders through an interactive Delphi-based workshop. This workshop serves to validate and/or revise the initial findings of the preliminary assessment. Presenting the results of the data analysis, coupled with a systematic participatory process, is essential to ensure broad stakeholder consensus on green growth priorities.

The GGPA consultation workshop was held on 11 October 2017 in Maputo, bringing together about 40 participants, representing different ministries and departments of the Government of Mozambique (GoM) as well as developing partners, NGOs, academic institutions, and the private sector.

Participants identified five priorities for green growth in Mozambique (Figure 7). Three of these priorities can be described as technical or economic challenges:

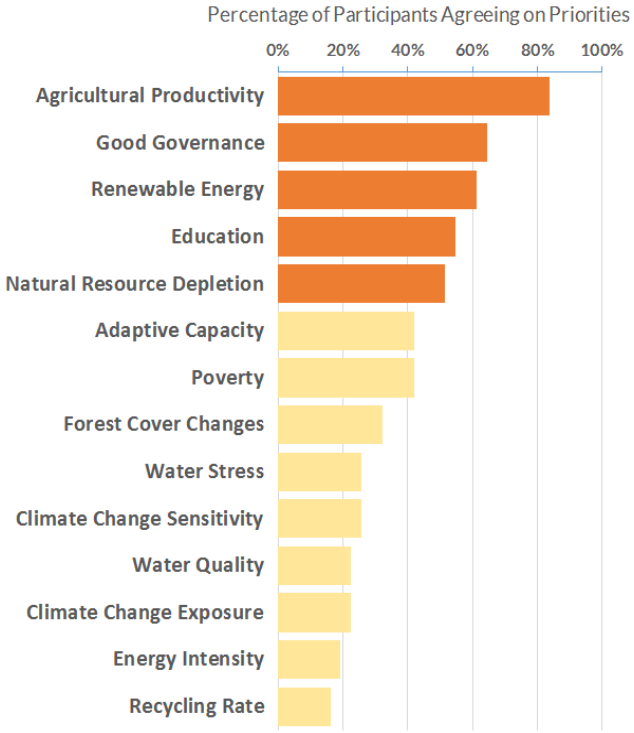
- Improve agricultural productivity,
- Support renewable energy to improve rural livelihoods, and
- Reduce the depletion of natural resources.

Participants explicitly pointed out the linkages between increasing agricultural productivity by using resources more efficiently.

The remaining two priorities represent cross sectoral challenges. Participants regarded them as enablers for advances in the first three areas:

- Good governance, and
- Education.

Figure 7 Identified Priority Areas

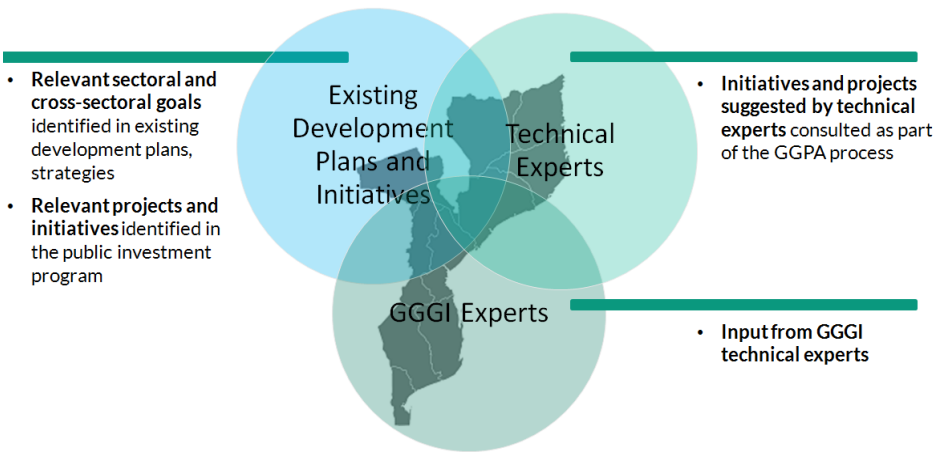


2.3. Country Report

The identified green growth priorities served as the basis for this report. Due to the focus on rural development and the interconnections between the priority areas, the report addresses two essential aspects to foster rural development and increase agricultural productivity, i.e. the use of renewable energy and more efficient use of natural assets.

Recommendations were developed for both aspects, considering how education and good governance can work as enablers. The analysis was informed by existing policy documents, technical analysis, and a series of interviews with a wide range of technical experts.

Figure 8 Schematic of Analytical Framework for GGPA Final Report



3. Agriculture and Rural Development

Rural areas play a central role for the development of Mozambique as a whole. As of 2018, more than 30 million people live in Mozambique, of which about two thirds live in rural areas (United Nations 2017a).[1] Mozambique's rural population has grown from about 13 million people in 2000 to more than 20 million in 2018 and is projected to continue growing at about 2.5% per year.[2] In 2014/15, poverty levels in rural areas stood at more than 50%, compared to about 40% in urban areas.[3] Unemployment was high at nearly 17% (UNECA 2016).

Agriculture and particularly subsistence farming play a vital role in rural areas. In 2016, the agriculture sector contributed more than a quarter to Mozambique's GDP and about 80% of the country's population were employed in the sector (FAO 2018a). Subsistence agriculture plays a dominant role as a source of food and income to the majority of the rural population (UNECA 2016). Some 3.2 million

[1] According to preliminary results of 2017 census published by the National Statistics Office (INE 2017), the total population of Mozambique in that year stood at close to 30 million people. The United Nations (2017a) estimated a population of more than 30 million people in 2017. It is noted that this estimate is consistent with the 1980, 1997, and 2007 censuses and adjusted for under-enumeration, fertility, mortality, and international migration.

[2]. At the time of writing, the INE had neither published disaggregated data from the 2017 census on the share of the rural population nor any projections for population growth. Projections for population growth are based on World Bank estimates (World Bank 2017b)

[3] UNECA (2016) does not state how poverty it defined. However, since it is an official UN document, poverty likely refers to the international poverty line of USD 1.90 per day.

smallholder farmers account for 95% of the country's agricultural production, with roughly 400 commercial farmers producing the remaining 5% (FAO 2018b).[4]

Over the past decade agricultural output has shown solid growth of 5% per year on average (FAO 2016a). However, this increase in output is not the result of higher productivity. Rather, it reflects the expansion of cultivated areas and a growing workforce employed in the sector (Fenita and Abbas 2017; Abbas 2015; World Bank 2011; Uaiene, 2012). Agricultural productivity is among the lowest in the world. The main cause behind the low levels of agricultural productivity is the dominance of itinerant subsistence agriculture relying on dryland farming,[5] which is characterized by an insufficient use of fertilizers, irrigation, improved seeds, pesticides, animal traction and machinery (Uaiene, 2012; World Bank, 2011).[6]

Table 1 Overview of the Agriculture Sector

Indicator	%	Source	Year
Rural Population	68.5%	UN (2017)	2017
Contribution of agriculture to GDP	25%	FAO (2018a)	2016
Contribution to employment	80%	FAO (2018a)	2016
Small (less than 10 hectares) and medium scale farming (10 to 50 hectares)	98%[7]	FAO (2016b)	2016
Agriculture land under irrigation	2%	FAO (2016a)[8]	2016
Farmers with access to improved seeds	10 %	INE (2010)[9]	2010

Rural development and improving agricultural productivity faces a number of challenges. First, the practice of itinerant agriculture has become unstainable due to the large increase in the rural population. Second, the lack of infrastructure and services such as roads, storage facilities, irrigation systems, and electricity undermines productivity and reinforces the negative impacts of itinerant agriculture. Third, several other factors prevent the negative consequences arising from itinerant agriculture and lack of

[4] These numbers appear to be roughly in line with the Agro-Livestock Census 2009-2010 (INE 2011). The census found that, of the 3,827,797 inventories of agricultural holdings, 99% have an average area per farm of 1.4 ha, occupying 96% of the total cultivation area.

[5] The literature on the topic refers to "itinerant agriculture", "shifting agriculture" and "shifting cultivation". These terms are largely used synonymously. As the Portuguese term "agricultura itinerante" is widely used to describe the practice in Mozambique, this report will use the English equivalent of "itinerant agriculture" when referring to this practice.

[6] Only about 4% of the smallholder farmers are using chemical fertilizers and pesticides. 10% of farmers use improved maize seeds (World Bank 2011). Levels of animal traction (12%) and use of machinery were also low with less than 2% of farms reporting the use of tractors and ploughs (Uaiene 2012).

[7] According to FAO (2016c) "[t]he smallholder "family" sub-sector accounts for about 98 percent of the area under production and produces almost all the food crops, such as maize, cassava, rice and beans. It is characterized by small areas (1.8 ha each on average), low inputs, inadequate equipment and low yields and returns."

[8] Based on 118,000 hectares of total agricultural area under irrigation divided by the product of 0.24 hectares of cultivated land per capita and a total population of 25 million people. All numbers refer to the period 2011-2012 (FAO 2016a).

[9] Data is based on the most recent agricultural census, conducted in 2009 and 2010.

infrastructure to be addressed. These include poor quality of extension services, limited access to finance, low levels of education, absence of necessary governance, and the adverse impacts of climate change.

First, conversion of forests to agricultural land as a result of itinerant subsistence practices is the dominant driver of deforestation in Mozambique, accounting for about two thirds of total deforestation (MITADER 2016c, CEAGRE and WINROCK 2016). Under this practice, an area is cultivated for 4-6 years. The natural characteristic of the dryland combined with a lack of using fertilizers or other retention techniques for improving soil fertility reduces productivity over time. Therefore, the cultivated area is abandoned for a fallow period of a similar duration. During that fallow period, soil fertility and nutrient levels are restored as the natural vegetation recovers in the area. However, due to the considerable growth in rural population, such agricultural practices have become increasingly unsustainable, with an increasingly large land area being needed for agriculture and ever shorter fallow periods (MITADER 2016a, 18).

Second, lack of infrastructure and services undermines productivity and perpetuates unsustainable agricultural practices and unsustainable use of natural assets. Examples include missing access to electricity, a lack of irrigation, and inadequate storage. Less than 6% of the rural population have access to grid electricity, relying primarily on biomass for cooking and lighting (ALER 2017; GGGI, 2017). While estimates for the potential area that could benefit from irrigation vary considerably,[10] many existing irrigation schemes predominately benefit large-scale farmers and companies involved in cash crops production for the export market (CARE 2017, 10).

Post-harvest losses are estimated to be as high as 30% (WFP 2017). Such losses are directly related to a large range of activities in the market chain, including the lack of adequate conservation and storage, transportation, processing and access to market. To give just one example, nearly half of the smallholder farmers in Mozambique rely on storage practices that contribute to the deterioration of the products, such as keeping the harvest in sacks (UN Standing Committee on Nutrition, 2013). Recognizing the impact of high postharvest losses, the Strategic Plan for the Development of the Agrarian Sector, 2011-2020 (PEDSA) sets out numerous targets to reduce post-harvest losses. However, these targets are often not translated into actions, mainly due to lack of funds. In recent years, only 1.5% of the funds for agriculture have been allocated for storage and public stockholding (CARE 2017, 35).[11]

> The adoption of agriculture technology is low, they still use archaic techniques and structures for the capture of water are from colonial times.
>
> (In-country interview)

Third, there are several factors that perpetuate the negative consequences arising from itinerant agriculture and lack of infrastructure, preventing them from being addressed effectively. These factors include the poor quality of extension services, limited access to finance, low levels of education, insufficient governance, and the adverse impacts of climate change.

[10] Sousa et al. (2017) estimate that about 3 million hectares are suitable for irrigation. However, World Bank (2016b) estimates the potential for irrigation more than ten times lower at about 200,000 hectares.

[11] This 1.5% share of the agriculture budget translates roughly into USD 10 million (or MZN 200 million). This estimate is based on the following calculation. According to the Ministry of Economy and Finances (2018), the total national budget for agriculture in 2018 is about USD 213 million (or MZN 13,232.8 million). Applying the 1.5% (CARE, 2017, 35) to the total budget, means that about USD 10 million are spent for storage and public stockholding of agricultural products.

Extension is a central theme in Mozambique's agricultural policies, prioritized in the PNISA[12] and the PEDSA, and together with research also prioritized in the budget. Nevertheless, existing funds are insufficient, with only one out of ten small-scale farmers being able to profit from extension services (CARE 2017, 10). As a result, despite following progressive approaches such as conservation agriculture and the establishment of farmer field schools, the implementation of these approaches often fails due to the lack of proper extension services, as well as roads, means of communication, value chains, and market access (Cammaer 2016).

Extension staff lack the means and incentives to perform well in their role. Extension workers often live in precarious conditions with no access to decent housing. Few staff dispose of transportation means other than bicycles, preventing them from reaching the poorest farmers, which are scattered across large areas not serviced by main roads. There are few opportunities for career development. As a result, extension services cannot compete with other careers to attract well-educated staff, leading to low levels of education among extension workers, perpetuated by poor access to training (Francisco, A., et. al. 2010)

Very few smallholder farmers have access to credit and those who do face high interest rates in both real and nominal terms. (CARE 2017, 16) Very few banks possess branch offices in rural areas as the cost of having a physical presence in sparsely populated areas is too high. The few financial services that exist are directed towards large-scale farmers, traders and processors (World Bank 2006). Similarly, many of the donor funded projects to improve access to finance in agriculture focus on medium- and large-scale farmers, not on small-scale subsistence farmers (CARE 2017, 16).

> For rural development formal education is essential, including schools in rural areas up to 10th grade basic education, followed by professional education. Training the trainers is also essential.
>
> (In-country interview)

Education, training and good governance play crucial roles in enabling sustainable development in rural areas.[13] Lack of either is a major obstacle for rural development. Education levels in rural areas are very low. More than half of the rural population cannot read or write (56.6%), less than 2% have completed secondary education, and fewer than 1% have a university degree (INE 2015). Strengthening the education system is intertwined with improving governance. However, efforts towards improving governance face numerous challenges of their own.

Generally, complex institutional arrangements are a major impediment to policy making and implementation. In addition, while implementation of policies is highly decentralized to the local level, poor working conditions and low qualification of staff undermine policy implementation and enforcement of regulations. Furthermore, even though a relatively well-established legal framework is in place, corruption is widespread in Mozambique. Clientelism still dominates the political sphere, giving rise to poor governance and endemic graft as well as small-scale corruption (OECD 2016), particularly in public procurement as well as in the tax and customs administrations. Donor countries have shown dissatisfaction over the country's anti-corruption efforts (GAN 2016).

Mozambique's land law highlights some of those governance challenges. Mozambique's 1997 Land Law established a right to use land.[14] It has specific provisions on protecting local communities from

[12] National Investment Plan of Agrarian Sector (PNISA), 2013-2017.

[13] In particular, the importance of formal education was mentioned repeatedly during the in-country interviews.

[14] The 1997 Land Law together with the 1995 National Land Policy and the 1998 Land Law Regulations constitute the legal framework upholding Mozambique's land tenure system. The land use right is known under its acronym DUAT, Direito de Uso e Aproveitamento dos Terras ('right of use and

expropriation, including a requirement for fair indemnification and/or compensation, as well as an obligation for investors acquiring land to consult with the current occupants. However, in practice, most smallholder farmers have traditionally occupied land but lack documented ownership. They face unsecure land tenure rights and cannot legally challenge investors' land acquisitions. Furthermore, although consultation with local communities is part of the statutory process for land allocation foreseen in the Land Law, this process has been widely criticized for being conducted without sufficient preparation or representation on the part of the community. In many cases, only the local elites have been involved in the consultation process. In some communities, leaders have personally approved investment projects despite strong community objections (CARE 2017, 30).

Finally, many of the challenges in rural areas are exacerbated due to the adverse impacts of climate change. Mozambique is highly vulnerable to climate change and extreme weather events (FAO 2018b), ranking third among the African countries most exposed to risks from multiple weather-related hazards (GFDRR 2017). The country's geography combined with the limited capacity to prevent and mitigate damaging losses are major causes for the high levels of risk. Over 25% of the population is exposed to natural hazards. The cost of inaction on climate change was estimated at a staggering USD 450 million per year (Climate Investment Funds 2012).

Based on observed trends and future scenarios, climate change will increase current weather variability, leading to more intense droughts, unpredictable rains, cyclones, floods and uncontrolled fires. These phenomena will particularly affect the agricultural sector and rural livelihoods, reducing productivity while increasing poverty and food insecurity. (CARE 2017, 19; FAO 2016a, 6).

benefit of land'). While the DUAT does not confer full ownership, it is a renewable long-term user right that covers a period of up to 50 years. It is comparable to a lease. The Land Law is meant to provide communities and local people with a secure title to land. Furthermore, it gives the state the authority to allocate land concessions to commercial businesses, providing security to investors. (World Bank 2008).

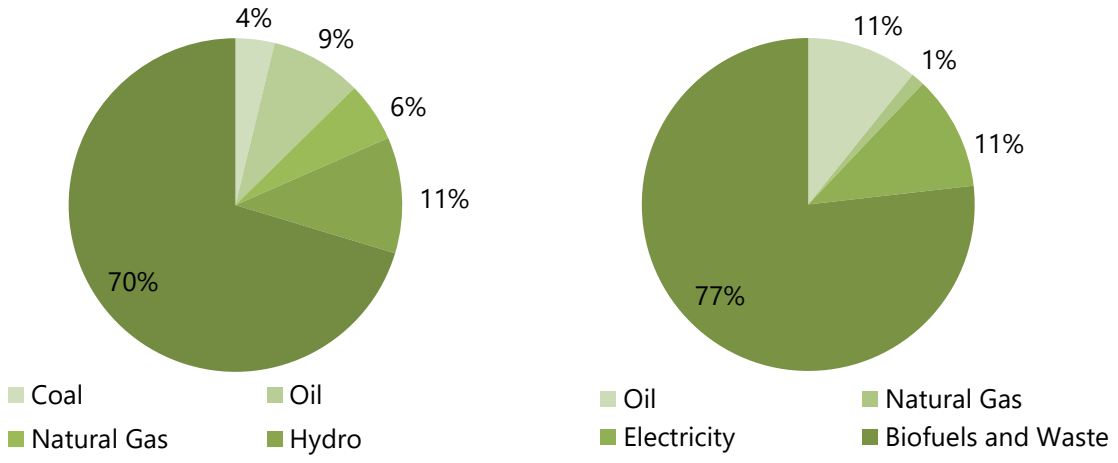
4. Renewable Energy

4.1. Promote the Use of Off-Grid Electricity from Renewable Sources

The use of renewable energy sources allows for increased electricity access, particularly in rural areas.

While a large majority of Mozambique population lives in rural areas (around 70%), electrification rates in rural areas are very low. The country's Total Primary Energy Supply (TPES) is dominated by biomass, accounting for more than 70% in 2015, followed by hydro power (11.3%), oil (8.8%), and natural gas (5.8 %) (IEA 2018a, Figure 9). Only a quarter of the country's households rely on grid electricity for lighting, the share being much lower in rural areas (5.7%) (ALER 2017, 82). Around 80% of the country's 30 million inhabitants rely on biomass for cooking, lighting and heating (ALER 2017; GGGI, 2017).

Figure 9 Total Primary Energy Supply and Total Final Consumption in 2015



Source IEA 2018a

Table 2 Distribution of household use of energy sources for lighting (%)

Households Consumption	Electricity (grid)	Generator	Solar	Oil	Candle	Battery (Portable)	Battery (Pack)	Fuel Wood	Other
Rural	5.7	0.1	2.1	13.9	1.,7	2.5	51.9	19.5	2.5
Urban	68.0	0.1	0.3	11.6	4.3	1.3	11.9	2.1	0.3
Total	24.8	0.1	1.5	13.2	2.5	2.1	39.7	14.2	1.9

Source: SEforALL Africa Hub, 2017 in ALER 2017, 82

The use of renewable energy sources allows protecting Mozambique's natural assets.

The extensive use of biomass and charcoal is associated with considerable environmental costs, particularly for forests and soils. Estimates suggest that the use of biomass for cooking and lighting contributes to deforestation by 0.6% (National Forest Inventory data), with contribution to local deforestation of more than 3%.[15] Replacing the use of fuelwood and charcoal with electricity from renewable source can reduce deforestation rates significantly.

Promoting electricity from renewable sources will also help mitigating Mozambique's GHG emissions (ALER 2017 18, GGGI 2017). Though per capita emissions of CO_2 remain comparatively low, emission levels have been rising by about 12% per year between 1996 and 2013 (World Bank 2018a, KNOEMA 2018). In 2014, emissions from burning biomass amounted to 37,725kt of CO_2, compared to 8,427kt of CO_2 emissions from the burning of fossil fuels and the manufacture of cement for the same year (World Bank 2018b).[16]

The use of renewable energy sources allows mitigating health risks

The extensive use of biomass and charcoal is also associated with considerable health risks. The use of off-grid renewable energy will mitigate air pollution and the associated health costs from burning biomass in closed environments.

This is particularly relevant in Mozambique, where exposure to indoor air pollution is the third most prominent cause of death, after malaria and AIDS-related diseases (Loayza, and Galimberti, 2017). Estimates suggest that exposure to high levels of fine particulate matter were associated with 11,750 premature deaths and 501,700 disability-adjusted life years (DALYs) (Lim, SS., et al., 2013). The high

[15] According to National Forest Inventory data, fuel wood used for cooking results in an annual deforestation rate of 219,000 ha (0.58%). Studies in particular areas show much higher rates, e.g. over 3% in the Beira Corridor (IIED 2018).

[16] It should be noted that emissions from the burning of biomass are not counted towards the total national emissions, as biomass is considered as a renewable energy source. However, given the unsustainable use of biomass in Mozambique as indicated by the high percentage of forest cover loss, a considerable amount of the emission from burning biomass is not stored in new forests.

The estimate for CO_2 emission from the burning of biomass is based on the following calculation: The total final consumption of biomass as a fuel amounted to 336,828TJ (2014). This amount was converted into kilotons of CO_2, using a conversion factor of 112,000 kg of CO_2/TJ (conversion factor for wood/wood waste, suggested by the IPCC Guidelines for National GHG Inventories) (IEA 2018b; IPCC 2006).

number of premature deaths that occur each year due to indoor air pollution mostly affect women and children in rural areas where healthcare facilities and services are almost inexistent.

Electricity from renewable sources can save money

For use in private households, renewable energy solutions are already a cost-efficient alternative to fossil fuels, such as kerosene for lighting. Private companies in Mozambique[17] sell pico solar and solar home systems[18] at prices that are competitive with the costs that households spent for battery torches or kerosene. An assessment conducted by M-KOPA Solar in March 2016 estimated that an average household spends around MZN 689 (USD 11.5) per month on energy, including battery torches or kerosene for lighting, radio and mobile phone. The amount is comparable to the monthly payment for the company's household solar system, at MZN 750 per month (GreenLight 2016, 29). Other companies offer solar systems within comparable price ranges. For examples, Bop Shop sells pico solar systems at prices between USD 12 and USD 100, depending on the system's capacity. SolarWorks offers off-grid solar home solutions on a Pay-As-You-Go (PAYG). Low-income households pay as little as USD 8 per month via a mobile application (Cuamba et al. 2014, ALER 2017, 104).

Levels of savings for consumers on the African continent are estimated to amount to USD 3.15 on average for every dollar spent on pico-solar PV systems (BNE, 2016). Household savings are likely lower in Mozambique as fossil fuel prices in the country are subsidized (BERF 2016, 8; GreenLight 2016). While these subsidies reduce costs for individual consumers, they represent a significant drain on public budgets. The IMF estimated that fuel subsidies during 2012-14 amounted to 1.1 to 1.5 % of Mozambique's GDP (GGGI 2017). The GoM has started to gradually remove the subsidies and increase retail prices. This move will safe public funds and further increase the cost-competitiveness of renewable solutions. Finally, in rural areas, renewable energy cannot compete with biomass (mostly fuelwood) which consumers can acquire for free. However, as described above, the extensive use of fuelwood is not sustainable over the long term due to the severe environmental damage it is causing.

Renewable energy for productive use, in particular solar power, is a cost competitive alternative to diesel generators (Universiteit Gent 2013). However, renewable energy solutions cannot compete with existing infrastructure that relies on manual labor. For example, according to information provided during in-country interviews, solar water pumping systems cost about USD 25,000-30,000 (MZN 2 million),[19] compared to USD 11,000 for a manual pump system.[20]

While the costs associated with renewable energy technologies are high in Mozambique compared to other countries, absent political interference, prices are projected to decrease over the coming years.[21] According to the International Renewable Energy Agency (IRENA), process for solar PV modules have fallen by about 80% between the end of 2009 and the end of 2015 (IRENA 2016a, 32). The organization

[17] Total, Bop Shop, Fosera, SolarWorks are examples for such companies.

[18] Pico solar systems refer to a photo voltaic panel smaller of less than 10W capacity. Solar home systems refer to systems with a higher capacity, capable of powering several lights, phone charging stations, a radio, and possibly a TV and a fridge (BERF 2016, 16).

[19] The cost estimate includes costs for drilling the well and the installation of all necessary technical equipment. The estimate was provided during in-country interviews.

[20] This is the cost for a manual pump system that the GoM is providing to rural communities, with about 30 households and an average household size of five persons. The cost figure includes costs for drilling the well and the installation of all necessary technical equipment. The figure was provided during in-country interviews.

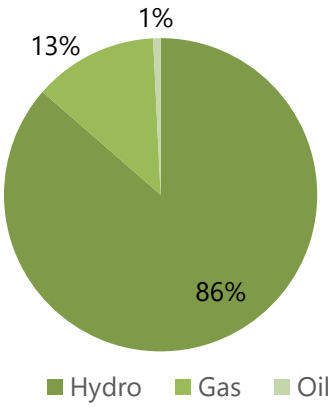
[21] Cost are comparatively high due to the small market in Mozambique and a number of reasons further discussed in the following section (see 2. Strengthen the role of the private sector).

estimates that the global weighted-average installed costs of utility-scale PV systems could fall by 57% between 2015 and 2025 while module costs are expected to fall by around 42% over the same period (IRENA 2016a, 12).

Off-grid electricity is cheaper than extending the grid to remote areas

Currently, about 27% of Mozambique's population has access to electricity. The large majority (25%) via the grid with electricity mainly being generated from hydropower. About 2% of the population have access to electricity via off-grid solutions (World Bank, 2017; DFID 2016, v; IEA 2018a). Though the grid connects all 128 district capitals of Mozambique, access is largely limited to urban areas, with schools, health centers and administrative institutions being given priority.[22]

Figure 10 Electricity Mix in 2015



Source IEA 2018a

The geographical spread of Mozambique and low population densities in rural areas make it extremely expensive to achieve universal access to electricity through grid extension alone. The scale of investment required to achieve the official target of 100% electrification by 2030 to then 8 million households is beyond the capacity of public finances (World Bank 2015). To meet the universal access target by 2030, more than 400,000 new connections would be required annually, compared to the current rate of about 120,000 new connections per year (World Bank 2015; DFID 2016).

Even achieving the more modest target, set by MIREME's 2014-23 electrification strategy, of connecting 50% of households by 2023, would still require large and likely unrealistic amounts of investment. EdM would need to increase the connection rate considerably (by about 50% to 175,000-185,000 connections per year), requiring around USD 8-9 billion in investment (compare World Bank 2015; DFID 2016). It should be noted that these investment projections are largely confined to the cost of extending the

[22] It should be noted that data on the electricity sector is scarce in Mozambique. As noticed in other reports (ALER 2017, 92), limited official data is publicly available, with EdM and FUNAE publishing annual reports on their activities. However, the available data is often inconsistent, incomplete and outdated.

country's transmission and distribution system. They do not include costs for additional electricity generation capacity.[23]

Considering EdM's weak financial situation and the fact that electricity tariffs remain at sub-commercial levels (see *Establish a more flexible tariff system*), achieving 50% electrification – let alone achieving 100% – exclusively via extending the national grid, seems unrealistic.

Therefore, even if the ambitious target of 50% grid electrification by 2030 was to be achieved, 4 million households in the country are likely to remain without access to electricity. That means there is a clear need for off-grid electrification in Mozambique, with the added advantage that for a large share of the country's rural areas, off-grid electrification comes at a much lower cost than extending the grid.

Solar power is among the most suitable off-grid solutions for Mozambique. DIFD (2016) estimated the investment costs to electrify four million households via off-grid solutions at about USD 750 million. The connection cost per household for an off-grid solar system, such as a solar home system is less than USD 200 in Mozambique – a mere 6% compared to the USD 3,500 required for grid connection (World Bank 2017a, 36; DFID 2016, 1; GGGI 2017, 3).[24]

In contrast to extending the national grid, off-grid electrification can be driven by the private sector, requiring only very small commitments of public funds. Off-grid solutions have a higher potential to provide electricity access at prices that consumers are willing and able to pay, particularly if the capital costs are spread through PAYG schemes. A study in Uganda showed that while purchasing a solar unit can temporarily raise household expenditure, in the longer term the share of household expenditure on energy declined from 13% to 3% (d.Light et al. 2016). Savings for off-grid households using solar lights range between USD 20 and USD 40 per year (BNEF and Lighting Global 2016).

There are several other factors that contribute to deployment of off-grid renewables, and in particular solar power, in Mozambique. First, the country is endowed with large solar energy potential, estimated at 23,000 GWp (FUNAE 2014, 94). Solar irradiation in Mozambique compares with world's best, averaging at around 2000 kWh/m^2/year,[25] enabling it to take advantage of the low-cost and widely available crystalline and thin-film solar technologies used in off-grid standalone systems or mini-grids (GGGI 2017).

[23] In 2015, electricity demand from the residential sector amounted to about 1,600GWh. net exports of electricity amounted to about 2,300GWh, compared to about 17,600GWh of domestic supply (including about 3,400GWh of transmission and distribution losses). (IEA 2018a) Assuming that the number of households connected to the national grid would double with average household demand remaining stable, the installation of additional capacity for electricity generation can only be avoided under two conditions. Either net exports are reduced considerably, or transmission and distribution losses are reduced significantly (in recent years, electricity losses amounted to about 25% (IEA 2018a).

[24] This figure is roughly in line with the investment requirement of 8-9 billion USD identified DFID (2016) and World Bank (2015).

[25] This is comparable to solar irradiation in California and above levels in Portugal and Spain (both, about 1700 kWh/m^2/year). The numbers refer to Global Horizontal Irradiation, based on irradiation data from (Global Solar Atlas 2016) and border data from GADM (2018). The program used to calculate national total is ArcMap.

Second, there is an increasing interest from donors in supporting the private sector in the area of off-grid renewables. Examples include the operationalizing of a renewable energy credit line (KfW/BoM), setting up an Energy Project Preparation Facility[26] and the BRILHO[27] program funded by DFID.

> Diesel is no longer subsidized. Because of this renewable energy is more competitive.
>
> (In-country interview)

Third, with the GoM gradually removing the subsidies for fossil fuels, retail prices for kerosene and diesel are increasing, making the renewable energy solutions more cost competitive.

Finally, the high penetration of mobile phones (currently at ~85%) offers the potential to introduce mobile payment services, though sources disagree in how far this potential is already realized (compare GGGI 2017, 11; GreenLight 2016, 29).

Off grid electricity can support rural development

The use of off-grid electricity from renewable sources can spur development in Mozambique's rural areas. It can be used domestically and for productive use, both reinforcing one another. Using local small-scale hydropower sources to feed mini-grids and solar power solutions in different sizes from household stand-alone systems to micro-grids and mini-grids are identified as the most feasible and cost-efficient approaches. Kilowatt-scale mini-grids can provide reliable electricity for productive uses and can be developed into larger mini-grids, integrating and optimizing several sources of generation (Cuamba et al. 2014). FUNAE has recognized this potential with plans to rely on both, solar and hydropower, for increasing rural electricity access, and has identified hundreds of projects (FUNAE 2014; ALER 2017, 100).

> No doubt off-grid renewable energy could be a solution to rural development. It would allow to operate radios, televisions, and access to news. Schools would be able to have class after work hours. It could support all kinds of businesses, from banks to milling machines.
>
> (In-country interview)

Mini-grids provide capacity for both domestic appliances and local businesses and have the potential to become the most powerful technological approach for accelerated rural electrification (Cuamba et al. 2014). At the household level, access to electricity provides longer hours of more quality light. This allows for more productive hours after dark and provides an opportunity to children to increase the quality and time of their study and homework. [28]

[26] The Energy Project Preparation Facility is an initiative led by the European Union. Its aim is to facilitate private sector investment in renewable energy to improve access to sustainable and affordable energy, particularly in rural areas. For that purpose, the facility's funds are to be used to strengthen institutional capacity, improving the regulatory framework, and support the development of investment projects.

[27] A US$ 45 million project (2016-2022) to expand market access of off-grid renewable energy products and related services to rural communities and businesses in Mozambique. One of the focus areas will be on promoting technological solutions, such as mobile phone-based pay as you go systems, to overcome the problem for households of high up-front capital costs of the equipment. BRILHO will provide support to government and non-state energy providers (private sector and NGOs) and is expected to leverage a matching amount of investment from the private sector (US$45 million), implying a total subvention for 'base of the pyramid' household energy in Mozambique of US$90 million (DFID 2016, 4).

[28] "There is clear evidence that better access to lighting provides children with opportunities to increase the quality and time of their study/homework. SolarAid (2012-15) data shows that before solar light

Off-grid solutions allow to operate mobile phone chargers, radios, TVs, and laptops, increasing the access to information. Larger systems offer the possibility to have a refrigerator and preserve food. Finally, off-grid electricity can increase the sense of safety that night light provides.

Off-grid technologies also benefit rural development by providing electricity for productive use. They can support a large variety of economic activities that allow to increase agricultural productivity, such as water wells, irrigation, processing (e.g. electric mills), storage and cooling, and other value-adding activities. Such applications allow to increase rural incomes.

> Off-grid renewable energy could be a solution to increase agriculture production, but it must be used for productive activities, such as water wells and irrigation. This would allow to increase production and generate more income.
>
> (In-country interview)

In addition, the deployment of off-grid renewables allows for the electrification of social facilities, such as schools and healthcare centers, improving living conditions and services in rural areas (examples include night classes, adult education after work hours, conservation of vaccines and other medicaments).

Finally, off-grid electrification via renewable sources requires maintenance services to sustain the infrastructure over the medium and longer term. This is an opportunity for developing private sector businesses in rural areas. (Inter. 3; ALER 2017, 109). It would allow for creating new income-generating economic activities, stimulating entrepreneurship, rural employment and gender equality.[29] Potential business opportunities are manifold from selling solar torches, batteries and large equipment to installing and maintaining the equipment.[30]

4.2. Strengthen the Role of the Private Sector

Currently, off-grid electricity is a state business, with little to no room for the private sector.

Currently, in Mozambique, off-grid electricity is dominated by the state. Although national legislation, strategies and plans often mention the importance and objective to involve the private sector in improving electricity access, the operating and business environment is not conducive for private sector initiatives (ALER 2017, 146).

FUNAE was set up as the rural electrification fund and has two decades of experience in the off-grid power sector. FUNAE pools donor resources and national contributions for off-grid projects. However,

---

ownership, children were studying for 1.7 hours on average each night and were often constrained by lack of access to light due to money for kerosene, or candles running out. After purchasing a solar light, children in the same households were studying for an average of 3.1 hours a night". (Harrison, Scott and Hogarth 2016, 15).

[29] UNEP (2014) found that renewable energy deployment is estimated to create 30 jobs for every 10,000 off-grid households connected. With an increasing population and continued economic growth, rural energy demand will rise further.

[30] For example, the Lojas de Energia project (Energy Shops) supported the establishment of stores where customers can charge mobile phones and rechargeable solar light batteries and in some to buy energy saving light bulbs, improved cookstoves, photovoltaic systems, mobile phone chargers, and fridges. The project was designed to improve the population's access to clean energy in disadvantaged rural areas of the country. Women are the main target group for managing the stores. In December 2015, there were already 35 stores at national level, of which 25 were run by women and 10 by men (ALER 2017, 104).

it has also largely taken on the role to design, implement and operate projects with donor grants (GGGI 2017), acting simultaneously as promoter, regulator, financier, implementer and manager of off-grid renewables projects in rural areas.

Besides having its own projects, FUNAE holds public tenders to which the few private companies currently active in the market apply.[31] It owns a factory which can produce solar modules with a total nameplate capacity of 5 MW per year. The recent NES draft proposes for FUNAE to continue in its central role in building infrastructure for off-grid electrification (World Bank, 2017).[32] In the current model, private sector participation is limited to primarily supplying and installing equipment under public contracts.

What problems does that bring?

The dominance of the state in establishing off-grid renewable energy leads to several issues that inhibit the development of more private sector activities. These issues include off-grid renewables almost exclusively depending on donor finance, off-grid projects being largely regarded as social projects, the absence of a viable tariff system as a consequence of the former, conflicting policy objectives, and conflicts of interest between the multiple roles assigned to FUNAE.

According to FUNAE, 11 cities, 669 schools, 623 health centers and 77 public buildings were electrified through off-grid solar PV installations during 2005-2014. Financing of off-grid renewables is completely dependent on donor/government money.[33] Private sector participation limited primarily to supply and installation of systems under public contracts. (GGGI 2017) Private businesses have been focused on public (FUNAE's tenders) or donor-funded initiatives. As existing projects do not generate sufficient revenue to finance their operation and maintenance, off-grid renewables are only economically sustainable as long as donor support does not dry up.

> When I had my company, 80% of my work was for the government the rest for NGOs that worked with social issues and are subsidized by private companies. I have done some work for the private sector, holes with connection to the river, and other small things.
>
> (In-country interview)

FUNAE's current monopoly, allied to the absence of a tariff scheme for off-grid projects inhibit the private sector from participating more actively in the market. Private sector investment will not arrive until there is a functioning market, where installing and maintaining the infrastructure generates revenue. In addition, FUNAE's dual role in manufacturing solar panels and participating in public solar tenders has raised questions about unfair competition and lack of a level playing field, limiting private sector participation. Similarly, lack of legislation around mini-grids means that small or community-driven businesses have no other option but to operate through FUNAE, leaving little room for private sector activities. (GGGI 2017)

The dominance of the state in the off-grid renewables sector is closely related to the government's vision of rural electrification as a "social project". This premise has led to conflicting policy objectives. It

[31] Only one private company is directly targeting private customers (BERF 2016, 18).

[32] EdM is a second potential public player regarding off-grid electricity. The state utility has recently created (May 2017) a Directorate for Renewable Energy and Energy Efficiency which includes a division on isolated systems. However, it remains unclear which role EdM will play concerning off-grid renewable energy (ALER 2017, 38).

[33] Among others, FUNAE projects have received grants and loans from, Belgium, China, Denmark, Finland, the European Union, Germany, India, Portugal, South Korea, Spain, UNIDO, and the World Bank.

is not clear how the aim to provide universal access to electricity, which requires considerable amounts of investment, can be reconciled with maintaining low electricity tariffs. Furthermore, while official documents repeatedly urged to strengthen private sector engagement, the fact that acquisition and maintenance costs are subsidized discourages private sector involvement and undermines the financial sustainability of the entire off-grid sector (ALER 2017, 103, 147). The mandate of proving universal access to electricity is still perceived to be implemented by public institutions only, giving the private sector the limited role of a sub-contractor. The fact that private sector interests can be directed to deliver public benefits has not been fully realized.

> In Mozambique, beneficiaries are supported, not the producers. There are not incentives for production. Existing policies support schools, sanitary units, etc. There is no policy that incentivizes the private sectors to produce energy.
>
> (In-country interview)

Finally, there is an inherent conflict of interests between FUNAE's role as a fund to promote the deployment of off-grid renewables and the institutions activities in building solar equipment and implementing projects. For example, FUNAE's solar panel factory is not competitive on the global market, but enjoys protection from foreign competition, ultimately leading to higher prices and additional subsidies for deployment.[34] This conflict of interest is also apparent regarding data sharing. Public funds were used to map Mozambique's endowment with renewable energy resources and the information was consolidated in the Renewable Energy Atlas of Mozambique. However, FUNAE charges considerable amounts to share the information, to the disadvantage of small entrepreneurs and investors (ALER 2017, 141).[35]

Why is private sector engagement necessary?

The participation of private sector in the off-grid market is essential to achieve rural electrification targets. Private sector participation can reduce the burden on public finances, contributing to sustainable and economic development in rural areas. The private sector can also help to address the current maintenance and operation problems, support the creation of a skilled labor force, and thereby increase rural income levels.

The private sector can provide much-needed investment. Currently, donor money plays a dominant role in financing the deployment of off-grid renewables. Private participation can help achieve rural electrification targets with a reduced burden on public finances. Reducing the role of the state and providing a more conducive environment for the private sector can mobilize significant financial resources and allow for off-grid infrastructure to become financially sustainable.

The presence of several private companies instead of a single state business will strengthen competitiveness, improve quality of equipment and service, and bring down costs. As a result, potential applications for renewable electricity will expand.

The private sector can make modern renewables technology more accessible. It would allow end-users to take advantage of the latest improvements in equipment efficiency, instead of relying on a single

[34] The factory is not competitive regarding production costs. At the same time, it has not been able to keep up with progress in solar technologies, compromising the competitiveness of its panels regarding performance and efficiency. (BERF 2017, 31-32)

[35] For example, three months online access to the FUNAE-ATLAS website, including access to the Renewable Energy Atlas of Mozambique (300-pages book) costs MZN 13,500 (USD 227). Access to preliminary feasibility studies costs between MZN 67,500 (about USD 1,150) for a single project and MZN 3,375,000 (about USD 56.700) for 50 projects (ALER 2017, 97).

provider, particularly when opening the market was combined with the introduction of quality standards for equipment.

> It is crucial to come up with a strategy for the development of the private sector because this could guarantee maintenance and other arrangements. Sometimes is just a question of cleaning the equipment.
>
> (In-country interview)

The private sector could provide essential services for operating and maintaining off-grid renewable infrastructure. Such a service sector would support rural development by allowing for local entrepreneurship, providing employment, and create demand for skilled labor. This would include demand for basic technical skills to maintain the equipment, but also extend to basic skills in accounting and finance. (ALER 2017, 185).

Finally, the presence of private sector will support the creation of a skilled labor force, either by providing training to employees and staff or by private and public training institutions, professional schools and universities reacting to private sector needs.

How to Strengthen the Private Sector?

All relevant ministries and the country's development strategies recognize the need for private sector participation and the potential of off-grid solar solutions in accelerating access to electricity and development in rural areas.[36] To encourage such participation, MIREME/FUNAE developed the Renewable Energy Atlas of Mozambique that maps high potential areas for major renewable resources across Mozambique. Based on the Atlas, MIREME/FUNAE has also recently released a USD 500 million off-grid energy project portfolio to help attract private sector and donor financing (APA NEWS 2017, GGGI 2017)

Yet, there are significant barriers to active private sector participation in the off-grid sector. The renewable energy industry has identified financial and political/regulatory risks as the most significant barriers for the deployment of renewable energy projects (EIU 2011). The lack of a predictable and reliable long-term market for renewable energy solutions increases investment risks in Mozambique. The lack of a coherent policy towards the deployment of off-grid renewable energy undermines active private sector participation. The lack of a regulatory framework, that supports cost-effective remuneration and reduces the possibility of retroactive change, increases uncertainty and creates disincentives for private investment. Among others, uniform and subsidized tariffs structures, high VAT and import taxes on solar products and supporting equipment inhibits promoting off-grid power. Finally, current licensing procedures represent a significant administrative burden further increasing uncertainty.

These barriers are often complex and interlinked. Therefore, a systematic approach to policymaking is required to overcome them and support the development of a functioning off-grid private sector.

4.2.1. Strengthen regulatory certainty

The Government of Mozambique is recommended to strengthen regulator certainty in the electricity sector, particularly concerning provisions for off-grid electricity. This includes increasing policy

[36] Strategy for New and Renewable Energy Development (EDENR) 2011-2025, Five-year plan (2015-2019), Programme for Reduction of Absolute Poverty (PARPA II/III), and annual Economic and Social Plan (PES, for 2015, 2016, 2017) all state the role of solar PV and private sector participation in for achieving off-grid energy access and/or rural economic development.

coherence and developing operational plans, clarifying the roles and responsibilities among government institutions related to renewable energy, establishing/strengthening an independent regulator, creating a tariff system that allows to cover operational costs and provides a return on investments, and reforming taxes and import duties related to renewable energy equipment.

Increase policy coherence and developing operational plans

There are several central GoM/MITADER guidelines for electricity that are currently under revision and will have direct implications for the role of the private sector in deploying off-grid electricity from renewable sources in rural areas. These are:

- National Electrification Strategy
- Electricity Law
- Electricity Master Plan

However, these strategies and plans appear to be focused on grid extension and provide little clarification on the government's vision for off-grid electricity. These plans do not critically evaluate the feasibility of the current target of 100% electrification by 2030, given the high investment costs. This means that uncertainty around grid extension plans persists, undermining the attractiveness of investing into off-grid renewables. For example, a central element of the recently drafted NES has been the expansion of the electricity grid, without specifying any target, plan, policy, and regulations for off-grid power generation.

Furthermore, while the National Electricity Law is expected to provide the recent created Energy Regulatory Authority (ARENE) with a mandate to set tariffs, license projects, and develop regulations (World Bank 2017a, 13), it is unclear whether this mandate will include off-grid electricity.

There are plans and documents in preparation, that are meant to clarify Mozambique's policies regarding off-grid electrification. These include:

- The Rural Electrification Master Plan;
- Tariff Regime for New and Renewable Energies (REFIT);
- The Energy Compact – a commitment between MIREME and key development partners that is expected to mitigate the barriers for off-grid renewable energy projects.

However, since off-grid electrification is largely absent from overarching strategies, there is a risk of pertaining the current incoherence between policies. Such inconsistency should be avoided as it creates uncertainty and increases the risk associated with investments.

For example, a detailed and predictable rural electrification master plan, such as in Kenya, can minimize the risks of grid arrival to off-grid power sites and enable firms to plan their investments, especially for micro- and mini-grids. Yet, while proposed grid extension plans are available from EdM, the status and construction timelines are not published, creating uncertainty for potential firms and financiers (GGGI 2017).

Assign clear roles and responsibilities

It is recommended for the GoM to clarify the roles and responsibilities of the multiple government branches involved in off-grid electrification. This is crucial for creating an environmental of regulatory certainty.

It is commonly agreed that the development of off-grid renewable energy to improve agricultural productivity and rural livelihoods requires improved coordination among multiple actors at several levels, including within and between ministries, as well as between the government, the private sector and development partners (World Bank 2017a, ALER 2017, GGGI 2017, in-country interviews in Mozambique, October/November 2017).

However, it is questionable whether the new plans and strategies will bring such clarity to the mandates of different government entities. Under the revised provisions, EdM maintains its mandate to run the national grid and set the national power tariffs (under the supervision of directorates in the Ministry of Energy). The public utility company is the primary actor driving the national electrification agenda, but its mandate does not include the off-grid sector. Similarly, in its current form, the NES allows for FUNAE to maintain multiple roles as developer and implementer of off-grid electrification projects. However, FUNAE's original role as a fund to promote off-grid electrification will be taken over by a newly established Electrification Fund.

In its current form, the NES lacks clarity and detail in respect to off-grid sector coordination. The NES introduces an Electrification Fund to coordinate the entire electricity sector, including off-grid projects. However, FUNAE remains the only entity with the authority to propose off-grid projects and to develop them, while EdM is assigned to take over responsibility for the physical infrastructure once it is commissioned (World Bank 2017a, 21). The role assigned to the private sector continues to be limited to "participate as contractor building assets" and to "operate assets outsourced by EdM" (World Bank 2017a, 21).

In the NES proposal, following MIREME planning, the Electrification Fund will decide which EdM and FUNAE project proposals will be funded and implemented; EdM and FUNAE will prepare projects and submit them to the Electrification Fund that reviews, prioritize and approve projects, and makes funds available. EdM and FUNAE will then execute the approved projects (World Bank 2017a).

While the attempt for improved coordination between EdM and FUNAE is commendable, the NES does not address the need for coordination with other ministries (besides the participation of representatives of MEF and MITADER in the Board of Directors of the Electrification Fund) and leaves little space for the private sector. Therefore, a coordinating entity should be given a broader mandate,[37] including:

- Raising the off-grid agenda across all ministries and agencies; for example, through a dedicated focal point for off-grid electrification in each of the relevant agencies;
- Convening of working groups of interagency officials, each developing solutions for addressing the existing barriers to the deployment of renewables for off-grid electrification in its area of expertise; and
- Organizing knowledge sharing sessions across key agencies/ministries on relevant aspects that need to be considered for the deployment of off-grid renewables, technology, costs, and regional success stories.

It is recommended to maintain EdM's focus on grid extension and management. However, it is fundamental that grid extension plans are communicated clearly and coordinated with any plans and incentive schemes for off-grid investment.

It is further recommended to make it the primary role of FUNAE to mobilize and disburse funds, and oversee national off-grid programs, instead of being simultaneously promoter, regulator, finance provider, implementer and manager. Thereby, private sector participation would be extended beyond the supply and installation of systems under public contracts.

Finally, the roles of MIREME, FUNAE and other governmental entities on different levels (e.g. municipalities) during the approval process for installing and operating off-grid infrastructure need to be clarified.

[37] Different proposals for the composition and layout of such a coordinating body exist. See World Bank 2017a, GGGI 2017, ALER 2017.

Simplify licensing

It is recommended for the Government of Mozambique to establish a clear and consistent licensing process for off-grid electrification. This should include regulatory provisions on the integration of off-grid infrastructure into an expanded national grid.

Off-grid projects are subject either to regulations that are not applied consistently (stand-alone systems) or regulations that are tightly regulated by complex procedures (mini-grids). Legal provisions on mini-grids and stand-alone systems currently fall under the Public-Private Partnership Law (2011) and the Electricity Law (2007). The latter gives EdM the mandate to manage the electricity grid and specifies that at the local level the private sector can generate and distribute electricity (e.g. through micro and mini-grids).

> There is a lot of interest by the private sector to develop solar and renewable energy projects. They have to go through the ministry [MIREME] and it takes a year to conclude the process, as there are so many requests.
>
> (In-country interview)

However, inadequate and unclear regulation means that private-sector led mini-grids are subject to the same regulations governing application to utility-scale electricity projects. Therefore, obtaining permission to build and operate a mini grid is a drawn-out process, involving multiples government agencies.[38] The complexity in obtaining a permission makes it virtually impossible for small private businesses or communities to build and operate their own projects, rather than going through FUNAE.

Stand-alone solar kits fall under *permanent electrical installations that generate electricity and with electrical lines that do not extend beyond the property where they are installed* (category 5). They are subject to a license and annual inspections by MIREME.[39] However, although these regulations have been in place since 2007, they are not applied consistently (BERF 2016, 29).

It is recommended to simply the process of obtaining approval for installing and operating mini-grids. In this context, it is recommended to move away from the need to go through the complex process for obtaining a concessions agreement towards a process that is more akin to obtaining a license for stand-alone installations.

[38] An investor has to apply for a concession, which is granted by MIREME for projects above 1 MVA or the relevant municipality for projects of less than 1 MVA. Concessions in the electricity sector are granted in public tenders. Tender bids must specify the technical and financial details of the project and provide evidence regarding the qualifications of the applicant. As part of the tender process, CNELEC (future ARENE, see 3.1.4 Establish an independent regulator) issues an opinion on the subject. Projects that imply the acquisition of land use rights (DUAT) require public consultation and can require an Environmental Impact Assessment (EIA). Once these steps have been successfully concluded, a decision by MIREME or the relevant municipality must be issued within 15 days. Such a decision's effectiveness may be subject to conditions, such as expropriation or the granting of land use rights. It should be noted that a common framework for municipalities to issue concessions does not exist, and, given the small number of investments in this area, capacity and understanding of mini grid setup and viability is almost non-existent in rural areas (BERF 2016, 29-30).

[39] The request for a license requires the applicant to include a detail plan of the installation and the technical description of each component, as well as a description of the use.

Establish an independent regulator

It is recommended for the Government of Mozambique to establish an independent regulatory authority. An independent regulator with a clear mandate and the authority to enforce legal provisions is essential to attract private sector investment for the expansion of off-grid renewable energy. In order to achieve the agreed goal of increasing access to electricity, the regulator needs the mandate to impose obligations through licensing, permitting, accrediting, approvals, inspections, fines and other legal instruments.

By separating the regulatory function from policy setting and fiscal policy, a regulator is expected to mitigate market failures at minimum costs as it can:

- Resist pressures to lower or increase prices at the expense of recovering costs and system maintenance;
- Avoid short-term opportunism linked to political and economic cycles;
- Promote competition by signaling to investors that rules are set and will be followed without undue preferential treatment of any market participants;
- Assure the protection of the interests of producers and consumers;
- Ensure efficient and profitable services by setting prices which reflect costs; and
- Monitor and enforce quality standards that preserve incentives for long-term performance while maximizing efficiency (OECD 2016).

Currently, MIREME through the National Directorate of Electrical Energy regulates the power sector. At the same time, both EdM and FUNAE have taken over functions that should rather fall under an independent regulator, such as setting mandatory electricity tariffs that apply to the entire sector.

ARENE is being operationalized as a regulator with the stated aim of promoting free competition in energy services. It is intended for ARENE to have the mandate to set tariffs for all fuels, including off-grid electricity generation. However, currently no timeline is available for its establishment and the NES in its current form is vague on ARENE's role (GGGI 2017, 8). Therefore, it is essential for the final version of the NES to clarify ARENE's role and provide it with a strong mandate.

Prior to the creation of ARENE, there has been no independent regulatory body with executive powers.[40] Therefore the recent creation of ARENE is a positive development. Nonetheless, this step will only be truly effective for market development and private sector participation if ARENE is provided with the necessary authority and backed by necessary political reforms to liberalize and unbundle the electricity market. (ALER 2017, 146).

Establish a more flexible tariff system

It is recommended for the GoM to introduce a tariff system for off-grid projects that allows to effectively cover investment and operational costs. It is widely agreed that setting appropriate tariffs and subsidies is an essential factor to ensure that projects are sustainable over the medium- and long-term (Cuamba et al. 2014, GGGI 2017).

Currently, Mozambique employs a uniform tariff structure for all power projects. EdM establishes national tariff rates that are tiered by consumption and customer type, and fixed regardless of location (World Bank 2017a, 28). National tariff rates are subsidized and do not reflect actual cost of power generation,

[40] ARENE's predecessor, the National Electricity Council (CNELEC), mostly served as an advisory body to the Council of Ministers (GGGI 2017). According to the Electricity Law (that as mentioned is under revision) CNELEC was meant to "inform on" revision to electricity tariffs proposed by EdM. However, significant revisions of tariffs since 2014 happened without any public statement from CNELEC (CIP 2017).

transmission and distribution. Electricity tariffs in Mozambique are among the lowest in the world (BERF 2016, 8).

To mitigate its weak financial situation,[41] EdM has significantly increased the tariff rates in recent years.[42] Nevertheless, the tariff for low consumption consumers, such as those in off-grid areas, remains unchanged at about MZN 1/kWh (US¢1.6/kWh). EdM's operations continue to be heavily dependent on donor support, and such support continues to be directed towards refinancing its loans and improving its revenue collection and grid maintenance capabilities (GGGI 2017).

Local mini-grids are obliged to charge the national tariff rates, which are insufficient to cover the operation and maintenance costs, let alone provide a return on investment (AfDB, 2017).[43] FUNAE generally charges the national tariff to consumers. However, in some cases, it charges a flat tariff, independent of actual consumption. While this flat tariff is usually higher than the national tariff, it still does not reflect actual costs (World Bank 2017a, 28).

There is a clear tension between heavily subsidizing electricity as a way to fulfil the official government objective of providing universal and affordable access to electricity and promoting private sector participation which requires a deregulated market, free of distortions. (BERF 2016, 12). The rationale behind the system of low uniform tariffs is to provide affordable electricity as a universal service and a means to reduce poverty. Given the low spending power, with a large of the population in rural areas living on less than USD 2 per day, providing electricity at affordable prices is a challenge that needs to be addressed. However, the current policy comes at the price of a distorted electricity market, which leaves little room for private sector activity, and a badly maintained electricity infrastructure which is ultimately to the detriment of consumers. Recent increases in tariffs[44] and the explicit mentioning in GoM documents of the importance to involve the private sector in the energy sector are examples for this tension.

This tension is likely to persist in the revised NES and other relevant plans for the electricity sector. While the NES proposal recognizes that the approach of uniform tariffs may not be the most financially sound, it suggests maintaining the current system (World Bank 2017a, 28). At the same time, there are several policy documents under preparation which are meant to clarify the off-grid tariff regime, but which might be at odds with the NES, such as the Tariff Regime for New and Renewable Energies (REFIT) and the draft regulation on isolated networks (Licensing of mini-grid power projects) (ALER 2017, 62).

In essence, tariffs must maintain the balance between commercial viability of the electricity system and be affordable to consumers. First, if more private sector participation is to be achieved in order to increase

[41] EdM's financial woes are largely due to low tariffs and large areas. Its operating income is not enough to meet debt payment and interest costs. Analysis done prior to the debt crisis indicates that EdM's financial viability will not improve until end of the decade, even with 25% increase over 2015 tariff (World Bank 2015). EdM's current arrears – including from large foreign customers and state agencies –have been tripling each year between 2013 and 2016 to more than USD150 million (GGGI 2017).

[42] In Nov 2016, EdM increased tariffs by 27%-40% for first time in more than 5 years. In August 2017, it revised tariff levels again by about 30%, which was welcomed by IMF. With this, domestic consumers up to 300 kWh now pay MZN 6.95 per kWh. Nevertheless, tariffs for consumers using less than 125 kWh, the likely category of rural off-grid household customers, is virtually unchanged for at least last 6 years, and stands at MZN 1.075 per kWh (USD 0.02 per kWh).

[43] From the two off grid options, i.e. autonomous standalone systems and mini-grids, only mini-grids can be subject of tariff models, as autonomous/standalone systems are supposed to be purchased and operated directly by the individual owner.

[44] EDM recently approved in August 2017 new tariffs corresponding to a 35% increased. As mentioned the social tariff did not suffer any increase, to protect the most vulnerable consumers. In November 2015 EDM had already approved a 40% tariff rise (ALER 2017, 53).

the population's access to electricity, off-grid tariffs must at least cover the system's operating and maintenance costs and allow for a minimum return on the initial investment (Cuamba et al. 2014).

Second, subsidies – directed towards consumers or producers – are a means to guarantee affordability where needed. This can either translate into subsidies for private mini-grid operators to make investments more attractive, or into subsidies for lower tier consumers, in a segmented market and through less distortive mechanism than universal tariffs, such as voucher systems (BERF 2016,39).

In Mozambique, FUNAE projects are essentially subsidized through grants from donor agencies and with some contributions from GoM. However, currently there is no subsidy or incentive program to attract private sector participation in the off-grid electricity sector.

Remove VAT taxes and customs duties

It is recommended for the Government of Mozambique to remove VAT taxes and customs duties and other import costs on solar power equipment. This will substantially reduce end-user costs, stimulate demand, increase the competitiveness of solar power solutions compared to other technologies, encourage greater involvement by the private sector, and allow for reduced electricity costs for final consumers. (ALER 2017, DFID 2016, GGGI 2017)

VAT, customs duties and other import costs represent a significant barrier to the stronger engagement of private sector in solar power off-grid electrification (ALER, 2017, DFID 2016, GGGI 2017). In Mozambique, all renewable energy equipment, including equipment for solar power, is charged at 17% VAT. Import tariffs vary according to the categories of products, but for most renewable energy equipment the rate is 7.5% (ALER 2017, 171),[45] regardless of their application such as for agriculture (e.g. water pumping for irrigation), even though agricultural equipment is generally exempt from such duties (GGGI 2017, 9). When 'facilitation' fees are considered, these charges add 30-40% to the total cost of installation (GGGI 2017, 9).

While equipment for grid electrification under the authority of EdM benefits from reduce VAT and import duties, such preferential treatment does not exist for equipment for off-grid electrification (DFID, 2016). In response, a combined initiative between MIREME. Universities, the private sector and EnDev was established to lobby for tax reductions. An outcome of this initiative is a study on the costs and benefits of removal of VAT and import duties on solar photovoltaic lanterns, solar home systems and improved cookstoves (DFID 2016).

The study concluded that the fiscal loss of the tax exemptions (foregone VAT and import duty revenue) of USD 1.1 million over the 10-year exemption period is more than offset by fiscal benefits of USD 7.6 million. These benefits include increases in business taxes and VAT received on income spent by employees in the sector.[46] The net fiscal benefit is compounded by a much larger benefit for households, being estimated at over USD 40 million over the 10-year period. Financial savings at the household level

[45] Current values of import duties vary from 0% on imports from SADC countries to up to 20% for imports from the rest of the world, with an average (based on 2013 trade data) of about 5% (DFID 2016, 5). For instance, static converters: 5%; portable electrical lamps designed to function by their own source of energy: 20%; non-electrical lamps and lighting fittings, n.e.s.: 20%; photovoltaic system controller not exceeding 1000V: 7.5%; photosensitive semiconductor devices, including photovoltaic cells whether or not assembled or made up into panels; light emitting diodes (excl. photovoltaic generator): 7.5%. (DFID 2016, 5)

[46] It should be noted that the estimate of $6.5 million fiscal net benefit is rather conservative as it does not include the impact on economic growth through increased levels of activity from time savings and productivity improvements at the household level, increased opening hours for small businesses as well as growth in the household energy supply chain.

arise from meeting basic energy needs at a lower cost than before (USD 14 million per year by 2026), as well as additional income from newly created jobs (DFID, 2016).[47] Table 3 provides an overview of the estimated benefits over a 10-year period.

Table 3 Fiscal impact, national and household benefits of the tax exemption policy

Impact USD millions (2017-2026)	Without new policy	With new policy
Fiscal loss	0.0	-1.1
Fiscal gain	0.7	7.6
Net fiscal benefit	0.7	6.5
Household savings	4.4	41.5

Source: DFID 2016

It is recommended that any reduction or removal of VAT and import duties on equipment for off-grid renewable energy are linked to the equipment's quality standards (ALER 2017, 171). Enforcing such quality standards for products entering the national market and linking them to preferential treatment would prevent the adoption of sub-standard equipment as a result of reducing taxes and fees. In turn, this helps minimize the risk of negative consumer perception and price expectations from cheaper and inferior technologies at the expense of businesses offering quality (and higher priced) products. (ALER 2017, 171, GGGI 2017)

Currently, there are no quality standards for renewable energy equipment entering the country. In order to establish quality standards, adequate local testing facilities are required.[48] To enforce such standards, the National Inspectorate for Economic Activities (INAE) requires strengthening to identify and target sub-standard products. (BERF 2016, GGGI 2017)

4.2.2 Improve access to finance and investment

In order to support off-grid renewable energy, it is recommended for the Government of Mozambique to improve access to finance for private investors. There are several measures the GoM can take to facilitate access to finance. These include, reducing capital controls, improving access to local finance, and opening up access to international funds for private off-grid ventures.

Investment in renewable energy is very low in Mozambique. Between 2009 and 2014, investment in clean energy totaled USD 2.2 million, compared to USD 12.2 billion in South Africa and USD 100 million in Rwanda (SEforALL Africa Hub 2017 in ALER 2017, 148-149).[49] Nearly all that investment consists of funding or loans from donors, with negligible amounts coming from the private sector.

To attract more private investment from abroad, it is recommended for the GoM to relax regulations on capital control. Capital from foreign investors plays an important role in other African countries to scale

[47] The report estimates 2,170 additional jobs by 2026, providing income of around $4 million per year.

[48] Eduardo Mondlane University (UEM) and the Institution Industrial de Maputo (IIM) have testing facilities for pico-solar and solar home systems, respectively. However, these are not equipped to administer a full-scale quality standards program.

[49] There is no definition of "clean energy" in either the ALER report nor in the SEforALL Africa Hub site. However, a considerable share of what is considered clean energy should consist of renewable energy.

up off-grid ventures. However, in Mozambique, there are currently restrictions on the import and export of capital with lengthy procedures, considerable costs, and bureaucratic hurdles. Having less restrictive capital controls can help Mozambique to bring in more foreign private investment into the sector.[50]

Beyond attracting more foreign capital, the GoM should also encourage more local investment. For that purpose, high lending costs and limited/unsuited financial services need to be addressed.

First, lending costs are high in Mozambique. Interest rates for commercial loans amount to about 30% (ALER 2017, 147). In addition, local banks often require 100% collateral for commercial loans. Lending conditions might be even harsher for renewable off-grid projects as they are perceived as high risk by local banks.[51] The low-income status and the limited availability to risk-profile data for off-grid customers makes access to credit even more challenging. PAYG business models have been successfully applied, in countries like Kenya, Tanzania and Uganda. They allow poor customers to acquire solar PV systems with a small upfront payment and a leasing model. Access to local capital to provide such consumer lease finance and required working capital is critical in a nascent market like Mozambique (GGGI 2017).

Second, for the time being, the local lending sector is not equipped to cater to the needs of off-grid renewable ventures (BERF 2016, 48). Local banks lack adequate human resource to deal with areas outside their core business. This results in high transaction costs in the off-grid sector (USD 10 for pico-products to USD 250 for mini-grids, GGGI 2017). Additionally, the commonly applied payback period of about two years does not match the requirements for off-grid project loans. Experience elsewhere in sub-Saharan Africa has shown that companies selling solar home or pico-solar systems are likely to be start-up ventures aiming for rapid growth with short funding cycles. They often reinvest their proceeds into further growth, requiring several funding cycles (BNEF and Lighting Global 2016).

Micro-lending could be developed as a viable alternative to commercial bank loans and PAYG models. For example, in Bangladesh off-grid solar has expanded rapidly with the help of microfinance where companies can use cash sales in the absence of PAYG arrangements. However, microfinance is at an early stage in Mozambique and does currently not represent an alternative. Interest rates from microfinance institutions are high at 50-60% and no known lending by existing microfinance institutions has taken place to the off-grid solar sector (GGGI 2017).

Furthermore, donor funding could be made available to absorb part of the risks and the costs associated with lending to the off-grid renewable energy. Therefore, to address the issue of high lending rates, it is recommended for the GoM to strengthen FUNAE's role as a national fund to mobilize and disburse low-cost finance to off-grid projects led by the private-sector.

FUNAE was set up as the rural electrification fund to pool donor resources and national contributions for off-grid projects. However, it has largely taken on the role to design, implement and operate projects with donor grants. It is suggested for FUNAE to focus on its initially envisioned role, leaving more space for the private sector to develop and operate actual projects. Working with local banks, it is recommended for FUNAE to provide low-cost loans, loan guarantees, and other financing support to off-grid ventures. By blending commercial loans with concessional loans and grants (e.g. from the Global

[50] A small step in this direction could consist of helping investors in the Solar PV sector subscribe to the MIGA investment protection insurance (BERF 2016, 49). The insurance's transfer restriction coverage protects against losses arising from an investor's inability to convert local currency into foreign exchange for transfer outside the host country. The coverage also insures against excessive foreign exchange delays caused by the host government's actions. See MIGA (2007). However, the insurance only mitigates the effects of current restrictions on capital movements. A better solution to increase investor confidence would be to relax the current restrictions.

[51] Interviews with farmers in Chokwe district revealed that commercial bank interest rates for loans to replace diesel powered water pumps to solar powered ones could amount to 40-50%.

Climate Fund), FUNAE would be able to reduce the risk associated with private off-grid projects and reduce the cost of lending.

FUNAE can draw on experiences from existing initiatives in Mozambique and on lessons learned in other countries. The BRILHO[52] program funded by DFID is an example for providing such loans to off-grid firms (GGGI 2017). Examples in the region include loans from TIB Development Bank to off-grid projects in Tanzania supported by the World Bank and FONERWA in Rwanda (ibid.).

Additionally, Results Based Financing (RBF)[53] could present a means to mitigate the risks associated with loans for off-grid projects, (SNV, 2016). RBF has been applied successfully to stimulate business opportunities in the solar PV sector in a number of sub-Saharan countries. In Tanzania, for example, RBF has not only provided financial incentives to start or upscale market operations but has also helped leverage third party financing resulting in a substantial uptake of solar deployment through engagement with new and existing solar companies in Tanzania´s Lake Zone. (BERF 2016, 49-50).

Finally, revenues from extractive industries represent another potential source of finance for off-grid renewables. Allocating a small share of those revenues (e.g. through a levy) would increase available funds considerably. However, it remains to be seen whether the positive projections, such as for natural gas projects, will materialize. In the past, high aspirations for the natural gas sector did not translate into project development (AfDB, OECD and UNDP 2016, Deloitte 2016). Projected price recoveries for LNG from the depressed levels witnessed in recent years might support project development and open up the opportunity to use some of the revue for enhancing renewable energy.

> Investment in extractive industries is necessary and Mozambique will follow this path, but why not use the revenues from gas and petroleum to invest in renewable energies? The large oil and gas multinationals are investing in renewable energy. Why not follow their example and use the revenues from natural resources to invest in renewables?
>
> (In-country interview)

[52] A USD 45 million project (2016-2022) to expand market access of off-grid renewable energy products and related services to rural communities and businesses in Mozambique. One of the focus areas is to promote technological solutions, such as mobile phone-based pay as you go systems, to overcome the problem for households of high up-front capital costs of the equipment. BRILHO provides support to government and non-state energy providers (private sector and NGOs) and is expected to leverage an additional USD 45 million of investment from the private sector (DFID 2016, 4).

[53] The fundamental idea is that payments to a service provider are made contingent on the delivery of a pre-agreed result, with achievement of the result being subject to independent verification.

5. Natural Assets

The Government of Mozambique places emphasis both on the development of the country's significant natural resources and on environmental protection. In its position, as both a biologically-diverse and at the same time low income country, Mozambique needs to find ways to reconcile economic development with protection of its natural assets on which agriculture and forestry depend (World Bank-IDA 2017, 1). Ensuring the conservation of the country's natural resource base is critical for sustainable development.

Mozambique is endowed with a large amount of natural assets such as arable land, forests, fisheries, wildlife, water and mineral resources. The country is home to important biodiversity hotspots with high levels of endemism such as Maputaland (coastal forests in southern Mozambique), the humid evergreen montane forests in central Mozambique, and the coastal dry forests of northern Mozambique. Other ecosystems include mopane forests in the semi-arid regions (in the valleys of the Limpopo and Zambezi rivers). Mozambique also has East and Southern Africa's largest mangrove forest, and the second largest mangrove area in Africa, at around 357,000 ha. (MITADER, 2017, 5).

Mozambique's substantial natural capital includes rich flora, with 5,500 plant species (of which 250 are endemic) and terrestrial fauna with 740 species of birds, 80 species of reptiles and amphibians (of which 28 are endemic), and 3,000 species of insects. Mozambique also has important concentrations of whale sharks and manta rays, and the only viable population of dugongs in the entire western Indian Ocean (Biofound 2018). Among the 14 ecological regions that exist in Mozambique, seven are regarded as of global importance (Biofound 2018).

However, Mozambique's natural assets are being rapidly depleted.

Wildlife: 366 Mozambique species are listed in the IUCN red list of threatened species as belonging to the 4 most threatened categories and 2381 species belong to the category of "least concern".

Arable land: The country has 36 million ha of arable land but more than two fifth of the land is degraded (European Space Agency 2011) and another fifth of the land is undergoing active degradation due to

agricultural encroachment and unsustainable use of biomass for cooking and lighting (i.e. fuelwood) (IFAD 2017). Erosion is pervasive, particularly in the coastal zone. Palalane et al. (2016, 1) point out that coastal erosion due to natural causes is compounded by human activity, characterized by a lack of planning or poor planning for coastal developments. As a result, high coastal retreat rates exceeding 1 meter per year have been observed in some places, compared to 0.4 meters per year due to natural causes (ibid.).

Fisheries: Unsustainable fishing practices, overfishing and destructive fishing techniques in coastal waters have contributed to declining fish catches and degraded ecosystems in many nearshore areas, ultimately threatening local livelihoods. Pereira et al. (2014, 10) conclude that almost all fisheries are overexploited, with overexploited fish stocks accounting for 75% of total fish stocks. An assessment that reviewed 34 species of small pelagic, demersal fish and crustaceans showed that 60% of these species are either heavily exploited or overexploited (IIP 2011). Beyond reducing Mozambique's biodiversity, such overfishing undermines livelihoods and incomes as these species contribute approximately two thirds of the total artisanal production.

Water: Both the quantity and quality of water are of concern in Mozambique. Since 2014 levels of rainfall in the Umbeluzi Basin, that supplies Maputo and other cities and rural areas in the southern region with water, have been below the historical average. The Pequenos Libombos dam in the south of the country remained at only 28% of its full capacity, affecting water supply in the cities of Maputo, Matola, and Boane, as well as irrigation systems along the Umbeluzi River. As a result, restrictions in water consumption have been put in place in the affected areas.[54] Water scarcity is compounded by low water quality. Sedimentation levels are high (approximately 30% at the Pequenos Libombos dam) caused by deforestation, farming and extractive industry activities upstream (FEWS NET 2018).

Mineral resources: Mozambique possesses substantial non-renewable resources such as heavy mineral sands (titanium, ilmenite, rutile and zircon), precious and semi-precious stones, gold, uranium, tantalite, bauxite and limestone, among others. The mining of gold and gems is still dominated by artisanal mines, employing approximately 20,000 people. These mines pose the greatest environmental and social risks (AfDB 2015). Mercury, which is used to recover fine powdery gold through an amalgamation process, is a major environmental concern. While mercury vapors are very toxic and pose the highest risk to the operator, during panning and washing, mercury also finds its way into the water supply and ultimately into the food chain. In addition, arsenic, cadmium, chrome, copper, lead and nickel are often found in association with gold deposits. During the extraction process, these heavy metals may be released, polluting surface and groundwater. For example, in Manica district, high levels of arsenic, copper and nickel have been found in gold deposits (Dondeyne et al. 2009).

Forests: More than half of Mozambique's land area (approximately 45 million hectares) is covered with extensive natural forests, consisting mostly of miombo woodlands.[55] About half of these natural forests (almost 27 million hectares) are considered productive forests with potential for commercial timber

[54] The Mozambique's National Directorate of Water Supply and Sanitation announced recently (15 February 2018) restrictions on water supply. Since 2014 the levels of rainfall in the Umbeluzi Basin (that supply Maputo and other cities and rural areas in the southern region) have been below the historical average (Club of Mozambique 2018a).

[55] Miombo is a term used to describe the vegetation belt that covers great parts of Central, Southern and Eastern Africa. Miombo forests can be classified based on mean annual rainfall as dry and wet, where the wet Miombo is characterized by annual rainfall above 1000 mm, canopy height higher than 15 m, and high diverse floristic composition, while the drier Miombo is the opposite. It is generally characterized by the presence of three tree genera from the Fabaceae family, subfamily Caesalpinioideae: Brachystegia, Julbernardia, and Isoberlinia. The Miombo woodlands are poor sites but have high plant diversity (Mate et al. 2014, 538).

production and generally located outside of protected areas (BERF 2017; Marzoli 2007; FAO 2010). Over 13 million hectares of forest land are located in conservation areas (MITADER 2017).[56]

Mozambique has around 7 million ha available for the establishment of forest plantations. However, if accessibility, current land use (e.g., small farmer or commercial agriculture), land tenure rights of local communities, and fulfilling the criteria for forest certification are considered, land availability for forest plantations drops to around 3.5 million ha (BERF 2017; Ministério da Agricultura 2009).

5.1. The Central Role of Forests

It is hard to overstate the importance of the role that forests play in Mozambique. First, forests provide essential ecosystem services from carbon sequestration and storage, to soil fertility, water quality and regulation (World Bank-IDA 2017, 53). Mozambique's forests are also an important habitat for a variety of herbivores and carnivores, including large terrestrial mammals, some of which are endangered and endemic to Mozambique (World Bank-IDA 2017, 12).

Second, forests play an important role in mitigating and adapting to the adverse impacts of climate change (World Bank 2016a, v). Regarding mitigation, forests constitute important reservoirs of above- and below-ground carbon and have significant potential as a carbon sink (EtcTerra 2016). The total above- and below-ground carbon stock in Mozambique is estimated at more than 4 billion tCO_2 (World Bank-IDA 2017). Between 2000 and 2015, forest conversion resulted in greenhouse gas emissions of about 35 million tCO_2 equivalent every year (FAO 2017).[57] Concerning adaptation, forests reduce the probability and effect of natural disasters, as has been documented in the Licungo watershed. Hence, well-managed forests can increase local communities' resilience to climate risks (World Bank-IDA 2017, 12).

Third, forests also play an important role in Mozambique's economy and the livelihoods of the country's rural population. The forest sector contributes about 3% to 4% to GDP (MITADER 2016a, 12).[58] Besides containing high value timber species (for export, construction, furniture, among other uses) and lower value timber (fuel wood), forests provide a variety of goods such as non-timber forest products. However, Mozambique's forest sector is underdeveloped, with only 60,000 hectares of commercial forest plantations. According to the National Reforestation Plan (Ministério da Agricultura 2009), the GoM aims to expand commercial forest plantations considerably, to one million hectares by 2030 (UT-REDD and MITADER 2016).

Few forest plantations are managed by smallholders in Mozambique. Instead, approximately 10 large companies control the majority of established plantations. However, the USD 70 million invested in these projects has led to the creation of only about 3,000 jobs (UNIQUE 2015). This figure is far below the 250,000 jobs envisioned in the National Reforestation Strategy (Ministério da Agricultura 2009).[59] For the time being, plantations provide few employment opportunities for local residents. Most of the jobs created are seasonal and companies increasingly adopt mechanized work, requiring fewer but more

[56] The remaining gap of 5 million hectares is the result of figures coming from different sources, referring to different years and using different definition of forests. See, recommendation below, *Define different types of forests*.

[57] Compared to 8,427kt of CO_2e emissions from the burning of fossil fuels and the manufacture of cement in 2014 (World Bank 2018b).

[58] This excludes the informal sector and local consumption as they are not reflected in the national accounts.

[59] This figure is based on a ratio of one worker per 4 hectares of planted area. UNIQUE (2015) points out that this is considerably higher than the global average of one worker per 20 hectares planted.

skilled workers, who are often not available locally (UNIQUE 2015, Bleyer et al. 2015, Sitoe and Sá-Nogueira 2017).[60]

Finally, fuelwood and charcoal made from wood extracted from forests are critical for household energy needs, with more than 70 percent of the population depending on them for cooking. Non-timber forest products serve as a source of food and medicine and contribute to household income.[61]

5.2. Forests Cover Loss

While figures on forest cover loss differ, the annual deforestation rate is high. Estimates range from 140,000 ha to nearly 220,000 ha of natural forests being lost every year.[62] Deforestation affects many of Mozambique's other natural assets (as described above). It leads to a reduction in biodiversity, soil erosion (directly affecting agricultural production), lower water quality as a result of sedimentation, increased GHG emissions due to loss of carbon stock in living biomass, and undermines sources of income related with fishing, tourism, timber and other forest products (Castel-Branco 2017, 488). Forest loss and illegal logging also reduces much-needed government revenues,[63] while associated loss in wildlife and biodiversity undermines the potential for revenues from nature-based tourism (World Bank-IDA 2017).

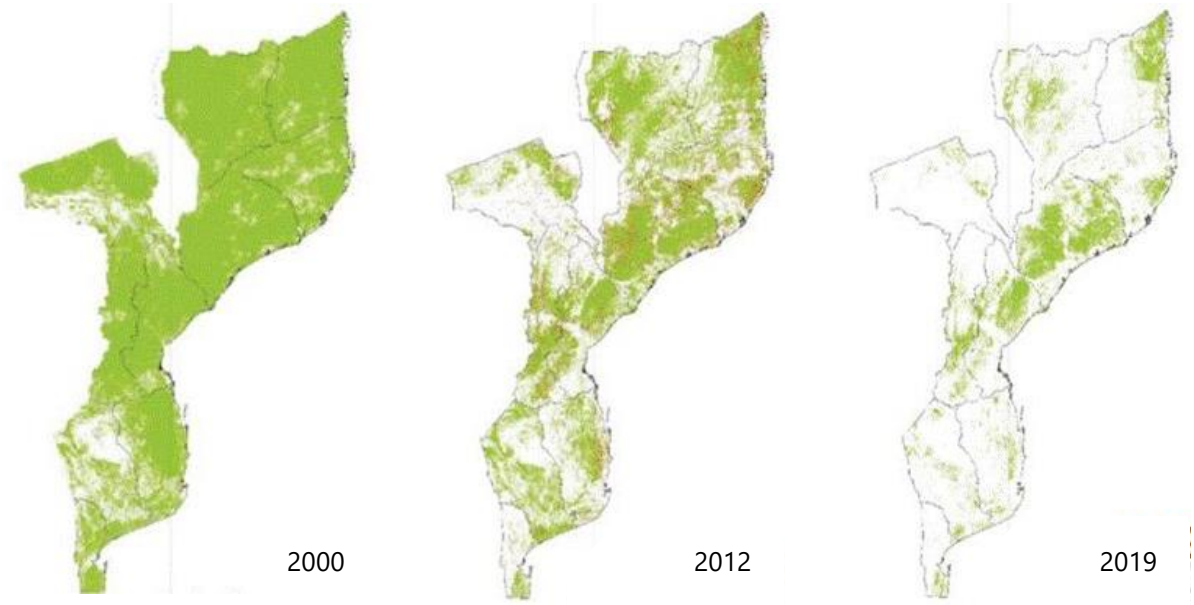
[60] A recent survey conducted in a major forest plantation in Mozambique (Portucel) concludes that most of the jobs created are seasonal and only 10% are full-time jobs (Sitoe and Sá-Nogueira 2017, 27).

[61] Hedge and Bull (2011) estimate that, in some areas, for example in the Gorongosa district, miombo woodlands contribute approximately 19 percent of household cash income and 40 percent of household subsistence (non-cash) income.

[62] Aquino and Fonseca (2017) report annual deforestation rates between 0.23% and 0.35%. MITADER (2017a) refers to similar losses of 138,000 hectares per year (0.31%). However, BERF (2017) and MITADER (2018) refer to a rate nearly twice as high at 0.58%, corresponding to about 220,000 hectares per year. According to FAO (2014) "*[d]ifferent forest area estimation initiatives in Mozambique provide dissimilar data, misleading discussions on forest changes. Due to the different forest definitions used in subsequent forest inventories, the extent of forest cover has been reported differently in various sources. It is not possible to identify whether this discrepancy is due to real changes or classification errors. The extent of forests cover was estimated of 20 million hectares in 1990 (Saket 1994). However, current estimate of forest cover is 40 million hectares (Marzoli 2007)".* Furthermore, forest degradation is widespread, albeit not measured systematically (UNIQUE 2016).

[63] Forgone tax revenues were estimated at US$540 million between 2003 and 2013 from unreported wood exports (mostly logs), mainly to Asian markets (World Bank-IDA 2017)

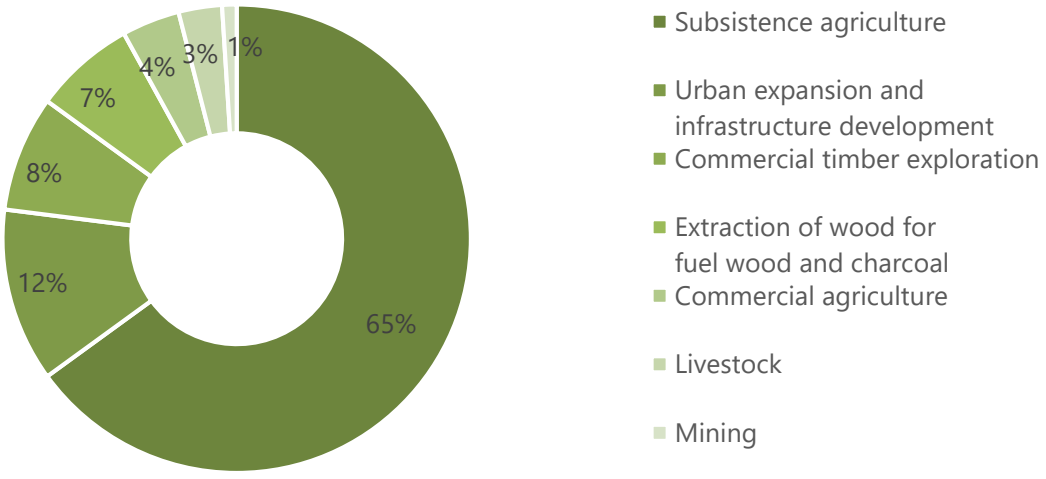
Figure 11 Deforestation in Mozambique



Source MITADER 2016b. Illustration for 2019 is based on projections.

Conversion of forests to agricultural land as a result of itinerant subsistence practices is the dominant driver of deforestation (shifting cultivation, often resulting in uncontrolled spreading of fires), accounting for about two thirds of forest cover loss. Commercial agricultural expansion represents a considerably smaller fraction of deforestation at about 4% (MITADER 2016a). Other prominent drivers of deforestation include urban expansion and infrastructure development (12%), unsustainable commercial timber exploration (8%) and extraction of wood to be used as a fuel for cooking and lighting as well as for the production of charcoal (7%) (CEAGRE and WINROCK 2016; BERF 2017: 8-9).

Figure 12 Drivers of Deforestation in Mozambique



Source CEAGRE and WINROCK 2016

In summary, current rates of deforestation are unsustainable, both from an economic and an environmental perspective (Sitoe and Sá-Nogueira 2017, 2). Deforestation is mainly caused by current agriculture and forest management practices, which also contribute to low levels of agricultural productivity, land and forest degradation, and devaluation of natural capital. Protecting forest landscapes will help communities to secure access to resources they depend on, enhance incomes,

improve rural livelihoods and reduce poverty (UNIQUE 2016). Sustainable agriculture practices and sustainable forest management can translate into profitable agri- and forest businesses, provide benefits to local communities and generate revenues for the state (ibid.).

The following recommendations are aimed at promoting this objective and addressing the different drivers of deforestation.

5.3. Forest Conservation

Define forests consistently considering user rights.

There are more than 800 definitions of forests worldwide. Most of them follow threshold parameters such as minimum area, minimum tree height; and minimum percentage of crown coverage (Falcão and Noa 2016). In Mozambique, forests are defined as "lands with trees with the potential to reach a height of 3 m at maturity, a canopy cover equal or greater than 30%, and that occupy at least 1 ha" (Falcão and Noa 2016, MITADER 2018). The definition continues noting that "[t]his includes temporarily cleared forest areas and areas where the continuity of land use would exceed the thresholds of the definition of forest, or trees capable of reaching these limits in situ" (ibid.). A consistent definition that clearly distinguishes between different categories of forests – considering their use – is missing.

Distinguishing between different types of forest is essential to assess the forest sector, design and track conservation efforts, determine use, determine the mitigation potential for GHG emissions, assess opportunities and constraints for commercial use, develop legislation for forest management, and divide responsibilities between different government branches involved in forest management. Terms such as natural forest, conservation forest, protected forest, productive forest, plantation forest are used in the literature on Mozambique's forest sector. While some of the terms are used interchangeably, others imply a distinctiveness. In either case, clear definitions are lacking.[64]

The lack of a coherent forest definition, distinguishing between different forest types, renders forest inventories largely useless, as the extent of forest cover has been reported differently in various sources and over time. This has led to high uncertainty regarding levels of deforestation. The lack of a clear distinction between forest use makes it impossible to identify whether this discrepancy is due to real changes or changes in classification (FAO 2014).

The lack of a clear definition undermines conservation efforts. Without a consistent distinction between forests based on their use or user rights, protected areas cannot be properly delineated, rendering the enforcement of existing legislation both difficult and arbitrary. This blurs the line between legal and illegal economic activities in forests. Encroachment into areas that are aimed to be preserved is the likely result (World Bank 2017d).

[64] Compare, BERF (2017), Falcão and Noa (2016), MITADER (2018), World Bank (2017b). For example, the Forest and Wildlife Law (República de Moçambique 1999) divides forests in three categories: (1) conservation forests, consisting of plant formations located in protection zones and subject to special management arrangements; (2) productive forests, constituted by plant formations of high forest potential, located outside of protection zones; and (3) multi-use forests: consisting of plant formations located outside protected areas and with low forest potential. The 2007 National Forest Inventory (Marzoli 2007) includes the category of protective forests (florestas de protecção) defined as forests protecting the soil (areas with slopes, mountainous areas) and water (riverbanks, mangroves). Ministério da Agricultura (2009) refers to conservation plantations as "plantations with emphasis on the protection of fragile ecosystems (coastal dunes, river basins, mountain areas, mangroves), biodiversity conservation, forest rehabilitation and environmental preservation". MITADER (2018) defines forests on the basis of land use and land cover, including forest plantations defined as "having exotic species, including pines and eucalyptus".

In turn, absent a clear distinction between forests types, it is equally challenging to determine which forests can be used commercially. This complicates land use planning and has hampered investments in the planted forest sector (World Bank 2016a, 70). Most of the land available for plantations is covered with miombo vegetation in different stages of degradation. Miombo woodland, the most common forest type in Mozambique, has a canopy cover ranging from relatively open to dense. While there is no clear definition, any land that is cleared from natural vegetation is likely to be classified as conversion of natural forests (World Bank 2016a. 15-16).[65] As a result, companies are exposed to high reputational risk, as the conversion of natural forests is incompatible with forest certification standards (World Bank. 2016a). A clear definition of the different types of forests will facilitate meeting the requirements that many consumer countries impose regarding the origin of wood and wood product imports, allowing to reduce investment risks. (World Bank. 2016a, 15).

Finally, a clear definition of different forests types is needed to clarify the roles of different government branches within the forestry sector. First, MITADER is responsible for natural forests and supervising a number of reforestation activities, including community-based and conservation plantations.[66] Second, MASA regulates plantation forest that can involve natural forests, with the National Directorate of Agriculture and Silviculture being in charge of agroforest plantations (UNIQUE 2015).

Clear division of roles and avoiding redundancy is also essential within single ministries. Within MITADER, three key departments are responsible for the forestry sector. The National Directorate of Land (DINAT) serves as the regulatory authority, charged with holding and organizing the national land cadaster records. Furthermore, it processes and approves applications for large-scale land use projects of over 1000 hectares (such as many plantation forests).[67] The National Directorate of Forests (DINAF) is responsible for policymaking, legal and regulatory provisions, establishing norms for licensing, promotion of processing activities, and promotion of community participation in the management of natural resources. The National Agency for Environmental Quality Control (AQUA) is responsible for law enforcement in forestry sector, which was under the auspices of DINAF and DINAT until 2016 (Macqueen and Falcão 2017).

The government's national agro-ecological zoning process illustrates this need for clear definition of different forest types. The zoning process will classify and map areas suitable for productive forests (World Bank 2016a, 71). However, in that exercise, productive forests are defined as "*forests that are managed to optimize the sustainable harvest of forest products*". This definition includes a range of forest types, such as commercial plantations, smallholder woodlots, and natural forests. Without having proper definitions in place, uncertainty around regulation, user rights, and administrative authority will remain.

Support agroforestry to extend cultivation periods and to reduce the spread and negative environmental impact of itinerant agriculture

Conversion of forests to agricultural land as a result of itinerant cultivation practices is the dominant driver of deforestation, accounting for about two thirds of forest cover loss in Mozambique (CEAGRE

[65] Past forest inventories used a 10% canopy cover as the threshold between forest and non-forest, resulting in extensive areas having been mapped as forests (World Bank 2016a. 15-16).

[66] One of the pillars in MITADER's REDD+ strategy includes "the restoration of forest plantations in order to establish a favorable environment for increasing forest plantations and forest businesses" (Kaechele, 2017).

[67] This occurs under Mozambique's land tenure system (DUAT) which provides the state with the authority to allocate land concessions to commercial businesses. While the DUAT does not confer full ownership, it is a renewable long-term user right, comparable to a lease (World Bank 2008).

and WINROCK, 2016). Agroforestry systems[68] are a means to improve yields and enhance food security for subsistence farmers, while reducing the spread of itinerant cultivation and as a result decreasing deforestation. Trees can be planted and managed to address local demand for fuel wood, fruits as a source of nutrition, and other non-timber products. At the same time, planted trees contribute to higher agricultural productivity by promoting ecosystem services, such as enhancing organic matter in the soil, retaining water, and providing a habitat for pollinator agents. Due to increased yields and slower soil degradation, the frequency of shifting cultivation is reduced. As a result, there is less need to clear forests for agriculture (World Bank-IDA. 2017, 53).

There are several initiatives that have successfully introduced agroforestry in Mozambique and provide valuable lessons on scaling up the approach. For example, the Mozambique Forest Investment Project (MozFIP, 2017-2022), funded by the World Bank, has been launched with the aim of promoting agroforestry systems on approximately 1,500 hectares. MozFIP targets individual smallholder producers as well as informal and formal producer groups (including associations and cooperatives) with the goal of reaching approximately 3,000 producers by 2022. Through the initiative, beneficiaries are provided technical assistance and agroforestry inputs, such as seeds, tree seedlings, tools and fuel. Nurseries identified near agroforestry clusters receive technical assistance to ensure that they meet the needs of the project beneficiaries (World Bank-IDA. 2017, 52-53).

The project is estimated to increase crop yields considerably, with a growth in crop gross margins of 20%.[69] This is equivalent to an estimated net present value of USD 0.7 million over 50 years at 6 percent discount rate (World Bank-IDA 2017, 100). The benefits of the additional carbon sequestration related to the initiative's agroforestry activities are estimated to amount to approximately USD 1 million (World Bank-IDA 2017, 100).[70]

Strengthening value chains and improving market access for commercial farmers have been identified as critical complementary elements to agroforestry initiatives to improve rural incomes and foster sustainability (UT-REDD and MITADER 2016). For this reason, MozFIP provides technical assistance to beneficiaries to facilitate market access (World Bank-IDA 2017, 53).

Past experiences have identified several elements that are crucial for disseminating and scaling up agroforestry initiatives. First, suitable approaches should be developed in participation with local farmers, to test and adjust equipment, technologies and practices. Second, trainings provided by farmers and farmer-to-farmer exchange visits have proven successful in disseminating the practice

[68] Agroforestry refers to the use of trees as part of agricultural landscapes as they interact with crops, livestock, wildlife and humans. In this context, trees provide products and services. Tree products include fruits, nuts, oils, beverages, gums, resins, latex, flavours, leaves for food and nutrition, fodder for livestock, timber, fuel wood, and medicines. Trees also provide a wide range of ecosystem services such as being a host to edible insects and pollinators, carbon capture, shelter from wind and sun, modifying micro-climates, nitrogen fixation, increased soil carbon, erosion control, refugia for biodiversity, and regulation of water, including groundwater recharge. (ICRAF 2018).

[69] The project targets small-scale farmers who are generally engaged in low gross margin activities in Cabo Delgado. To estimate the benefits, smallholders were modeled to grow maize, sesame, beans and cassava. Short-cycle eucalyptus gross margins were assumed to be applicable to the tree crops in the agroforestry system due to lack of financial information on other species. Under the project, extension services and agroforestry are means to support farmers transition to higher value crops such as sesame, soya, beans and tree crops. Annual crop gross margins are estimated to increase by 20 percent. This estimate is found to be in line with international benchmarks for productivity improvements through agroforestry. (World Bank-IDA 2017, 100)

[70] This estimate is based on a market value of USD 5.5 per ton of CO_2 equivalent (World Bank-IDA 2017, 99).

beyond a project's initial beneficiaries (CARE 2017, Linyunga 2004). Finally, the positive impact of agroforestry on yields and resilience can be enhanced by combining it with other modern agriculture practices, such as climate smart agriculture which aims at using water more efficiently among others (UT-REDD and MITADER 2016).

Support small-scale irrigation schemes.

Lack of irrigation is one of the factors contributing to low agricultural productivity and depletion of soils in Mozambique. Currently, about 90,000 to 120,000 hectares are irrigated (FAO 2016a, Sousa et al 2017).[71] Estimates for the potential area that could benefit from irrigation vary considerably. Sousa et al (2017) estimate that about 3 million hectares are suitable for irrigation. However, considering not only technical factors[72] but also commercial viability, World Bank (2016b) estimates the potential for irrigation fifteen times lower at approximately 200,000 hectares.[73] It is recommended to rely on the more rigorous assessment accounting for commercial viability and specifically looking at the potential of small-scale irrigation to select suitable sites, estimate the scope for appropriate interventions, assessing the number of beneficiaries, and ultimately help estimate costs and impact compared to other interventions (such as agroforestry).

Independent of the potential area suitable for irrigation, it is recommended that any interventions to focus on small-scale irrigation projects. Community-based small-scale irrigation projects in drylands have a higher potential to be successful than large-scale irrigation schemes due to present demanding economic, institutional, and technical conditions (World Bank 2016b).

First, the level of investment required for small-scale irrigation schemes is considerably lower at about USD 4,500 per hectare than for large-scale projects at about USD 14,000 to USD 28,000 per hectare (World Bank 2016b). Nevertheless, smallholder farmers are generally unable to afford irrigation. As a result, most small-scale irrigation projects rely on government and donor support. Currently, business models to support farmers to invest in small-scale irrigation do not exist (Pittocket al. 2017, 846).

Second, Pittock et al. (2017) concluded that irrigation projects face considerable institutional barriers such as poorly functioning markets, regulatory uncertainty, and lack of technical know-how. Sousa et al. (2017) point out that aligning cropping strategies more closely with demand would significantly improve profitability of irrigation systems. Small-scale irrigation systems face similar institutional as larger systems.

For example, covering Mozambique, Zimbabwe and Tanzania, Pittock et al. (2017) point out that irrigation associations need to be strengthened. Associations are often too weak to perform basic functions such as maintaining infrastructure, organizing collective purchases of services,[74] and scheduling production throughout the year to maximize returns. Being unable to ensure adequate water supply has resulted in water theft, inequitable water distribution within schemes and conflicts between

[71] Of the 90,000 hectares of irrigated land, about 20,000 hectares is in southern Mozambique, of which about 4,000 hectares are located in Maputo Province (Sousa et al. 2017, 706)

[72] Technical factors include the availability of arable land and water resources.

[73] World Bank (2016b) identified 94,000 ha suitable for small scale irrigation and 99,000 ha for large scale irrigation. Practices for improving water management in rainfed environments were not included. The assessment excluded barrages, run-of-the-river, and pump schemes. Irrigation potential associated with schemes that simply divert river water (such as Gezira) or that rely on pumping from the river (such as Kenana) were not included, as they are mostly associated with large, multipurpose reservoirs. The construction of such reservoirs is generally driven by considerations other than irrigation, so that irrigation services are in effect a by-product of the larger infrastructure investment.

[74] This includes ordering agricultural inputs and transport services in bulk to lower costs.

farmers, lack of participation in maintenance work and refusal of farmers to pay water fees; all of which has further eroded trust in the associations and undermined their role (Mwamakamba et al. 2017, Pittock et al. 2017). A prominent reason for their weakness is that irrigation associations are given the responsibility but lack the authority to collect fees. This lack of authority is compounded by an unclear division of responsibilities for maintenance. For example, regarding water distribution infrastructure, it is unclear where the responsibilities of irrigation associations for headworks ends and where farmers' individual responsibility for tanks, canals and pipes begins.

The adoption of the Legal Framework of the Irrigators Associations in 2015 was a first step to address this situation. The framework was meant to clarify the rights and obligations of irrigation associations, including their responsibilities for the irrigation infrastructure, development of business plans, and collection of member fees to ensure operation and maintenance of the systems. However, while pilot schemes have been implemented under the framework, little is known in how far the framework was able to resolve the underlying problems (Mwamakamba et al. 2017).

Finally, irrigation schemes are complex systems that require multiple, different and complementary interventions to increase productivity and sustainability. While small-scale irrigation schemes reduce the complexity to some degree, it cannot be avoided entirely. Therefore, investment is needed in hardware as much as in people (Pittock et al. 2017). Therefore, as with other recommendations in this report, training farmers and improving extension services are critical enablers for outcomes to be realized.

Effectively managed small-scale irrigation schemes can enable farmers to farm year-round, increase cropping, and diversify crops. As a result, small-scale irrigation would allow local communities to improve productivity, increase food security, raise incomes, and ultimately decrease the pressure to convert forest areas (IRENA 2016b, Sousa et al. 2017). Small scale irrigation schemes exist in different parts of Mozambique and could be expanded with technical support and funding (Hanlon 2017). These schemes generally serve small-scale irrigator associations and cooperatives with plot sizes ranging from 0.5 to 10 hectares, mostly relying on furrow or surface irrigation (Sousa et al. 2017). [75].

A prominent example is the Sustainable Irrigation Development Project (2011-2018) funded by the GoM, the World Bank and Government of Japan with a total investment of USD 90 million.[76] The project rehabilitates and expands irrigation schemes in the central provinces of Manica, Sofala, and Zambézia to help farmers grow rice and vegetables. When completed, the project will have irrigated more than 3,000 hectares to the direct benefit of more than 6,000 people (World Bank 2017e).[77]

To reap the benefits of higher productivity brought by irrigation, storage facilities, post-harvest handling practices and market linkages need to be improved (Pittocket al. 2017, 846, Sousa et al. 2017) Given market conditions and the price volatility of some crops, such as tomatoes and cabbages, increasing productivity of these crops will not necessarily increase profitability. Therefore, farmers need to be more integrated in the value chain and their access to markets needs to be improved, both physically through transportation and commercially through access to information (Sousa et al. 2017).

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[75] In addition, two types of large-scale irrigation schemes exist, either constructed by the government or by private companies. Private companies generally manage the systems constructed by the government and are responsible for maintenance of the infrastructure as well as water distribution. Farmers are responsible only for maintaining the canals that convey water to their plots and paying for water service (Sousa et al. 2017, 706).

[76] Of the USD 90 million, about USD 41 million were spent on irrigation systems and support infrastructure. Institutional capacity building and participatory irrigation management, cost-sharing grant for market-led development of production and value chains, as well as project management and coordination absorbed the rest of the budget.

[77] Of these 3,000 hectares 1,700 hectares are dedicated to rice production, 800 hectares to horticulture, and 500 hectares to contract production.

Introduce certification as a means to access more lucrative markets for timber.

Forest certification is an important non-state regulatory tool. It is "*a process through which transnational networks of diverse actors set and enforce standards for the management of forests around the world*" (Meidinger 2003). Certification is a tool for importing countries and businesses that demand sustainable production and guaranteed provenance. The Forest Stewardship Council, the Programme for the Endorsement of Forest Certification, and the International Tropical Timber Organization are organizations with developed and widely endorsed forest certification schemes.

Currently, Mozambican timber exports are highly dependent on the Chinese market, with more than 80% of all Mozambican wood exports going to China in 2015 (World Bank 2018c). Existing business models are unsustainable over the longer term. Currently, non-Chinese forest operators rarely, if at all, export directly to China. Instead, operators sell logs to Chinese owned companies who process and export timber and timber products. Decisions by producers on what and when to harvest are driven solely by customer requirements and do not take into account the actual sustainable production capacity of their forests (UNIQUE 2016).

Large forest plantation companies have expressed interest in becoming certified under internationally recognized standards of sustainable forest management. Internationally recognized and endorsed forest certification is a key element in gaining access to high value timber export markets. It is fundamental to raise awareness among producers that certification will provide access to new markets and earn higher prices for their products, while making their business model more sustainable (UNIQUE 2016). Certification has become an efficient tool in companies' reputational management. Furthermore, certification could help firms to attract investment as it guarantees financiers – who are not necessarily familiar with the forest sector – that the plantations are responsibly managed and carry a lower economic risk (World Bank 2016a).

National and private certification schemes are to be viewed with caution. First, the costs of implementing and monitoring certification are high. Second, national or private certification schemes are likely to lack international endorsement and, as a result preclude access to international markets that demand sustainable management of forests. Examples from South East Asia show that national schemes face severe obstacles in obtaining international endorsement as standards differ (Durst et al. 2006, Global Forest Atlas 2018). For example, several nationally certified forests, such as those under the Malaysian Timber Certification Scheme (MTCS), have been criticized for unclear environmental and social protection standards (Global Forest Atlas 2018).

Adherence to international certification schemes is also a precondition to access global carbon funds through the REDD+ scheme. Furthermore, certification provides opportunities for improved governance and transparency, for strengthening forest laws and regulations, and to attract technical assistance for sustainable forest management. In this context, Macqueen and Falcão (2017), among others, recommend that certification should be accompanied by incentives related to law enforcement (e.g. timber tracking, training of forest law-enforcement officers, customs officers and judiciary) and training operators in sustainable forest management (e.g. strengthening extension services, providing regular training courses in sustainable forest management).

Several conditions need to be fulfilled for certification schemes to be successful. These include (1) putting in place a clear definition distinguishing different types of forest by their use (see recommendation above), (2) strengthening the technical capacity to monitor and enforce regulations, and (3) enhance enforcement. These conditions are examined in detail below.

First, any certification scheme requires a clear definition distinguishing between different types of forests, based on compliance with verifiable certification standards. Such distinctions are the foundation for verifying the origin of timber and timber products, monitor sustainable practices, and ensure compliance with certification standards (World Bank 2016a, 15).

Second, implementing certification together with the necessary standards, regulations, monitoring and enforcement requires sufficient technical capacity. Modern forest management requires knowledge in

biology, ecology, economics, markets regulations, and policies. Moreover, it necessitates keeping abreast of evolving technologies in the sector, such as the use of high resolution satellite imagery to guide forest management and support law enforcement efforts. Currently, such capacity is low in Mozambique (World Bank 2017f). Legally anchoring certification can be a means to garner local political support and mobilize resources from donors to improve existing and build new capacities.

Third, enforcement remains an issue. MITADER adopted several provisions to address challenges in the forest sector, including a participatory audit of all forest concessions, the suspension of new requests for exploration areas, a ban on log exports, the updating of forest policies and regulations, and a project called "Floresta em Pé" (Standing Forest), which aims to promote sustainable integrated rural development though conservation and sustainable management of forests (MITADER 2017). However, a greater effort in law enforcement is needed (BERF 2017, 15). For instance, the ban on log exports for all native species, launched in January 2017, has faced several challenges since its inauguration, such as lack of enforcement personnel and corruption. Several trucks and containers containing logs of native species have been seized since, suggesting that the ban is porous.[78]

A first step in addressing the gaps in enforcement would be to equip the newly formed enforcement agency the National Agency for Environmental Quality Control (AQUA), with a modern internet-based data system that could monitor real-time flows of timber and prevent easy circumvention or bribery at law-enforcement checkpoints (Macqueen and Falcão 2017).

Support sustainable production and use of fuel wood and charcoal

Extraction of wood for fuel wood and charcoal is another important driver of deforestation in Mozambique, responsible for about 7% of forest cover loss in the country (CEAGRE and WINROCK, 2016). In 2008, about 15 million tons of fuel wood and charcoal were consumed per year, the third highest amount among countries in Africa (Sitoe et al. 2008, World Bank 2017c). Considering population growth, in 2018, more than 19 million tons of fuel wood are likely consumed per year.[79] Furthermore, substituting unsustainable sources of charcoal would sequester an annual 530,000 t CO_2e (World Bank 2017c, 72).[80] Therefore, making the production, processing and use of fuel wood and charcoal more sustainable is an important means to address deforestation and climate change mitigation (CEAGRE and WINROCK, 2016).

First, the National Reforestation Strategy (Government of Mozambique 2009) recognizes biomass production for energy use as one of the potential areas for investments within the domestic market. However, the lack of sustainable forest management means that currently nearly all (more than 90 percent) of the consumed biomass is produced from open access, unmanaged, natural forests. At the same time, Mozambique´s charcoal value chain remains largely informal. Such informal and unregulated extraction of wood as a fuel source is unsustainable. It also undermines any attempts at sustainable commercial production as commercial production is not cost competitive (World Bank 2016a, 8). Formalizing the production of fuelwood and charcoal is essential to reduce its role as a driver of

[78] MITADER Minister Celso Correia (Club of Mozambique 2018b, quoting Mozambique Television, TVM) said that both, community leaders and MITADER officials have been involved in facilitating illegal timber exports. The Minister added that this year, twelve MITADER officials involved in smuggling of timber were identified and arrested.

[79] This estimate is based on a population growth of about 2.5% per year between 2008 and 2018 (World Bank 2017b).

[80] For comparison, the establishment of planted forests and substituting other materials with harvested wood products would sequester an additional 1.8 million tons of CO_2e per year. Substitution refers to harvested wood products displacing products of equal utility but higher emission factors. (World Bank 2017c, 72).

deforestation. This would allow for planted forests to sustainably supply fuel wood and reduce the pressure on natural forests (World Bank 2017c, 71). For that purpose, licenses for charcoal production need to be accompanied by a formal register that captures the amounts of wood extracted to produce charcoal (World Bank-IDA 2017, 53).

However, formalizing and commercializing fuelwood and charcoal production will increase the price for those fuels. In particular rural households are currently relying on (almost) cost-free fuelwood as their primary source of energy (ALER 2017; GGGI, 2017, World Bank 2016a, 8).[81] Therefore, any attempts to formalize the production of fuelwood and charcoal will need to consider the economic cost for households and communicate the benefit of the change to local communities in order to obtain their buy-in.

The aforementioned MozFIP project on agroforestry includes an element of formalizing the sector, promoting higher efficiency in charcoal production, and thereby reducing deforestation. It promotes charcoal producer organizations to adopt forest management plans. For that purpose, it supports partnerships between producers and private operators in the forest sector to integrate charcoal production into sustainable forest management. In that context, forest associations can be promoted to enable small businesses involved in charcoal production to benefit from economy of scale effects and sustainable forest management practices (World Bank-IDA 2017, 53).

Second, processing wood into charcoal more efficiently can also help reduce deforestation. Recent analysis by civil society organizations in Mozambique show that simple improvements in practices linked to charcoal production, such as the arrangement of wood within kilns and changes in kiln design (using the same traditional material), can produce efficiency gains of as much as 100% (World Bank-IDA 2017, 28). These measures require little to no financial investment but yield considerable improvements in efficiency. Achieving a high adoption rate among charcoal producers is critical. For that purpose, it is essential to identify the most suitable model for technical assistance which allows replication at a large scale (World Bank-IDA 2017, 28).

Third, use renewable energy and clean cooking technologies are options to reduce the use of fuelwood and charcoal. The potential of renewable energy is discussed separately in chapter 4 (See *Promote the Use of Off-Grid Electricity from Renewable Sources*). Clean cooking is addressed in a separate recommendation below.

Support clean cooking technologies to reduce unsustainable use of fuelwood and charcoal.

Access to clean cooking technologies, including improved cookstoves and clean cooking fuels, will reduce deforestation, associated soil erosion and emissions of greenhouse gases and black carbon. Improved cookstoves either use biomass more efficiently or replace it entirely by other fuels, such as LPG and biogas (Loayza and Galimberti 2017, WINROCK 2017).

Total consumption of fuel wood and charcoal was estimated at more than 19 million tons in 2018.[82] This amount is higher than the volume of the permitted annual cut for commercial timber (Sitoe et al. 2012, Loayza and Galimberti 2017). In addition to deforestation, emissions from combustion of unsustainably harvested fuel wood and charcoal in inefficient, traditional cookstoves contribute significantly to global climate change. The burning of both fuels produces significant quantities of emissions that impact the

[81] While fuel wood is nearly cost free, the price of charcoal has rapidly increased over the past years in Mozambique and can absorb up to 25% of a monthly family income (Broto, Macucule and Smith 2017).

[82] This estimate is based on consumption figures of about 15 million tons of fuel wood and charcoal in 2008 and accounting for population growth (Sitoe and Tchaúque 2007, Sitoe et al. 2008, World Bank 2017b, World Bank 2017c).

climate in the short-term, including gases such as methane, carbon monoxide, and nitrous oxides (Global Alliance for Clean Cookstoves 2011).[83]

Beyond reducing deforestation and the repercussions related to it, improved cookstoves are cleaner and safer than traditional cookstoves, reducing indoor air pollution and improving health, particularly of women (Khushk et al. 2005; McCracken et al. 2007; Clougherty 2009, Kuylenstierna 2011). Clean cooking technologies also allow household to reduce expenses on charcoal.

First, use of improved cookstoves reduces indoor air pollution with a direct effect on health and life expectancy. Traditional cookstoves emit a range of pollutants such as fine particulate matter (black carbon, $PM_{2.5}$) and carbon monoxide (CO) that are damaging to health (Khushk et al. 2005; McCracken et al. 2007; Clougherty 2009). For example, residential sources, mainly from cookstoves, account for more than 25% of global black carbon emissions (Bond et al. 2004).

According to WHO (2014), in Africa, 600,000 people a year die from the exposure to indoor air pollution from cooking with inefficient stoves. In Mozambique, exposure to indoor air pollution is the third leading cause of death after malaria and AIDS-related illnesses (Loayza and Galimberti 2017). Exposure to indoor air pollutants has been proven to be linked to acute lower respiratory infections,[84] chronic obstructive pulmonary disease, stroke, ischemic heart disease, cataracts, and lung cancer (WINROCK 2017).

Second, the use of improved cookstoves reduces household expenses on charcoal. In Mozambique, the price of charcoal has rapidly increased over the past years and can absorb up to 25% of a monthly family income. Oil and natural gas represent cheaper alternatives to charcoal, particularly in the wake of the price drop in 2014 (Broto, Macucule and Smith 2017). For example, a study of the costs of different sources of energy, conducted in the city of Beira, revealed that charcoal compared to electricity and gas was the most expensive fuel per energy unit (Egas 2006; Loayza and Galimberti 2017).

Third, the introduction and dissemination of improved cookstoves is an economic opportunity, particularly for women. Selling improved cookstoves creates jobs and empowers women by giving them a source of income. Furthermore, it allows them to gain a higher profile in their communities by raising consciousness about environmental and health issues (Loayza and Galimberti (2017).

Loayza and Galimberti (2017) estimate that over 4 million households, of which 1.2 million are in urban areas and 3.2 million in rural areas, could benefit from using improved cookstoves. However, despite its promising potential, the uptake of improved cookstoves is limited in Mozambique. The Global Tracking Framework (2017) indicates that access to clean cooking fuel and technologies increased from 2% to about 4.5% (or about 300,000 households[85]) in 2014. Results from programs such as GIZ's Energising

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[83] In 2014, emissions from burning biomass amounted to 37,725kt of CO_2, compared to 8,427kt of total CO_2 emissions for the same year (World Bank 2018b). It should be noted that emissions from the burning of biomass are not counted towards the total national emissions, as biomass is considered as a renewable energy source. However, given the unsustainable use of biomass in Mozambique as indicated by the high percentage of forest cover loss, a considerable amount of the emission from burning biomass is not stored in new forests.

The estimate for CO_2 emission from the burning of biomass is based on the following calculation: The total final consumption of biomass as a fuel amounted to 336,828TJ (2014). This amount was converted into kilotons of CO_2, using a conversion factor of 12,000 kg of CO_2/TJ (conversion factor for wood/wood waste, suggested by the IPCC Guidelines for National GHG Inventories).

[84] This includes pneumonia, which is the single leading cause of death in children under five years (WINROCK 2017)

[85] The number of households with access to improved cookstoves was estimated based on the Mozambique's total population of 30 million people divided by an average household size of 5 people and multiplied by 4.5%. It should be noted that this estimate is optimistic, as household sizes in least

Development (GIZ EnDev), which between 2013 and 2016 facilitated sales of 65,000 improved cookstoves, suggest that adoption of clean cooking technologies is accelerating somewhat (DFID 2016). Nevertheless, the share of people with access to clean cooking remains low.

The EnDev program works with several implementing partners by supporting their production and distribution chains, contributing to building and consolidating local know-how and experience rather than directly subsidizing product prices. It offers valuable lessons regarding product marketing, awareness raising, introducing new technologies, establishing and scaling up production facilities, and ensuring compliance with product standards (Loayza and Galimberti 2017).

> The cookstove project entails teaching people how to make them (they are made of clay and easy to make) and they use 60% less wood than a normal stove. Those who learn how to make them can sell them. They are for sale in all the markets in Maputo. Stoves made in 2012 are still being used, they last a long time. There are also used in social centers and in Manhiça there are around 3000 families using them.
>
> (In-country interview)

Affordability remains one of the main challenges in the adoption of improved cookstoves, as many of the beneficiaries are among Mozambique's poorest. Again, lessons learned from the EnDev program are useful in this respect. To increase affordability, commercialization of improved cookstoves was combined with the generation and trade of Certified Emission Reductions (Loayza and Galimberti 2017). This occurs under the Clean Development Mechanism (within the framework of UNFCCC) through initiatives such as the Gold Standard Foundation.[86] In essence, a project's emission reductions are certified and sold through global carbon markets. Selling their Certified Emission Reductions to carbon credit traders makes improved cookstoves affordable for low-income consumers (Loayza and Galimberti 2017). In addition, DFID (2016) recommends removing VAT and import duties on improved cookstoves that meet Global Alliance quality standards as a way to reduce prices and increase dissemination.[87]

When assessing the costs and benefits of improved cooking solutions, the choice of fuel and technology is decisive. Costs and benefits at the household level have to be distinguished from the larger social benefits.[88] Looking at costs and benefits for private households indicates whether households are likely

developed rural areas (those profiting most from improved cookstoves) are likely higher than 5 people.

[86] The Gold Standard Foundation is a standard and certification body with the aim to maximize the impact of climate and development activities. Gold Standard was established in 2003 by WWF and other international NGOs as a best practice standard to ensure projects that reduced carbon emissions under the UN's Clean Development Mechanism (CDM) also delivered on their dual mandate to foster sustainable development. It explicitly recognizes carbon finance "*as an attractive option to help fund improved cookstove initiatives*" (Gold Standard 2016).

[87] The Global Alliance for Clean Cookstoves is an initiative involving governments, companies, UN agencies, and nongovernmental organizations with the goal to foster the adoption of clean cookstoves and fuels in 100 million households by 2020. For that purpose, the initiative seeks to address the market barriers that currently impede the production, deployment, and use of clean cookstoves in developing countries. The development and promotion of emissions and efficiency standards for cookstoves as well as rigorous testing protocols is a crucial element of the alliance's work (Global Alliance for Clean Cookstoves 2011).

[88] Private costs refer to capital costs for cookstove, operation and maintenance costs, fuel costs, learning and promotion program costs. Private benefits consist of fuel costs saved, improved health and time savings. Social benefits refer to improved eco-system services provided by forest, particularly reduced carbon emissions (Jeuland and Tan 2016).

to adopt improved cooking technologies on their own, and which factors are most important to determine whether households will perceive investing in improved cookstoves as beneficial to them. The social perspective evaluates the net benefits for society as a whole, by mitigating the negative externalities generated by use of traditional cookstoves (Jeuland and Tan 2016).

Private net benefits show large variations. Whether they are positive or negative dependents on the extent of households using improved cookstoves, time savings, fuel costs for the chosen technology, and fuel efficiency. Including the social dimension, all technologies and fuel options become more attractive, showing higher net benefits. Nevertheless, due to the prominence of emissions savings in determining social benefits, they remain highly dependent on the choice of technology and fuel (Jeuland and Tan 2016). Cleaner fuels including emission-free solar and low-emission LPG and ethanol virtually eliminate emissions of harmful soot and other toxic gases (Global Alliance for Clean Cookstoves 2011). Therefore, initiatives to promote improved cookstoves should consider the benefits of shifting to cleaner fuels and more efficient technologies, rather than overly focusing on comparatively cheaper biomass-burning solutions.

> Country-specific efforts have been the most effective when a cross-section of ministries, private sector partners, academics, and non-governmental stakeholders have coalesced around a common strategy or campaign with the resources to sustain the advocacy, outreach, and implementation efforts.
>
> (Global Alliance for Clean Cookstoves 2011, 47)

Finally, based on case studies covering 18 projects involving improved cookstoves in 14 African countries (including Mozambique), Kapfudzaruwa (2017), concludes that adequate institutional support is essential for the successful dissemination of clean cooking technologies. This includes adopting and enforcing regulation and quality standards concerning the manufacture and import of improved cookstoves (KCIC 2016). It also means that dissemination and use of improved cookstoves needs to be integrated into broader government policies and activities on health care, education, environment, and energy. Such coordination is important to raise awareness of the technology's advantages among potential beneficiaries and to facilitate needed financial support (Global Alliance for Clean Cookstoves 2011, Kapfudzaruwa 2017).

6. Conclusion

There are many ongoing efforts to plan and implement green growth in Mozambique. However, currently there is no shared understanding of green growth or a clear national agenda. Therefore, the aim of the GGPA process was to identify green growth priorities and recommendations, underfed by an evidence-based assessment and mapped against existing policies. As a result, two main areas have been identified as priorities for green growth in Mozambique. These are renewable energy and the sustainable use of natural assets. For each of these priorities specific recommendations have been developed, building on scientific evidence, successful examples from other countries, considering existing policy documents and technical analysis.

It is highly recommended for the Government of Mozambique to consider these priorities and recommendations not only when establishing the county's green growth agenda, but also in the context of implementing the 2016 REDD+ strategy, achieving the Sustainable Development Goals (SDGs), and delivering on the country's climate change commitments.

First, renewable energy can help to improve electricity access in rural areas. Given the geographical spread of Mozambique and the low population densities in rural areas, increasing access to electricity alone by extending the grid is extremely costly. Off-grid solutions based on renewable fuels offer a cheaper alternative while conserving natural assets and reducing greenhouse gas emissions. The role of the private sector needs to be strengthened in order to take advantage of the opportunities that renewable energy presents for rural development. For that purpose, this report presented specific recommendations on how to strengthen regulatory certainty and simplify licensing procedures to attract investment, strengthen the role of an independent regulator to ensure fair competition and a level playing field, introduce a more flexible tariff system, reform the VAT taxes and customs duties on renewable equipment, and improve access to finance.

Second, in terms of using resources and natural assets more efficiently, the possible applications are manifold. This report focusses on forest conversation given that forests provide essential ecosystem services – from carbon sequestration and storage, to soil fertility, to enhancing water quality and regulation – and play an important role for the livelihoods of Mozambique's rural population. The report encompasses a wide range of recommendations in this area. Forests need to be defined consistently, clearly distinguishing the user rights for different forest types to strengthen conservation efforts and to provide regulatory certainty for legal commercial activities. Agroforestry and small-scale irrigation schemes should be supported to extend cultivation periods and reduce the spread of itinerant agriculture. Certification should be introduced to access more lucrative markets for timber and other forests products, strengthening conservation efforts while increasing income. Similarly, commercializing the extraction and processing of fuel wood can reduce deforestation while creating new sources of income, and clean cooking technologies should be supported to reduce the consumption of fuel wood and charcoal.

Many of these recommendations will directly support the goals set out in Mozambique's National REDD+ Strategy, including reducing deforestation, enhancing the resilience of forests to the adverse impacts of climate change, promoting rural development, reducing CO_2 emissions and increasing carbon stocks (MITADER 2016a). In this context, the GGPA provides several recommendations on how to promote sustainable farming methods to curb shifting cultivation and increase productivity, how to promote access to renewable energy sources and clean cooking technologies as an alternative to fuel

wood and charcoal, and how to support conservation by strengthening forest management and developing livelihood alternatives for rural communities.[89]

In addition to supporting sustainable growth and the improvement of rural communities' livelihoods in Mozambique, this report serves to strengthen the country's global engagement. With the Sustainable Development Goals and the Nationally Determined Contributions (as part of the 2015 Paris Agreement), the Government of Mozambique has committed the country to a number of targets. The recommendations outlined in this report can guide the GoM on how best to actualize some of these commitments.

Specifically, the Sustainable Development Goals are a collection of 17 global goals (with a total number of 169 targets) set by the United Nations. The SDGs cover a broad range of social and economic development issues, including poverty, hunger, health, education, climate change, gender equality, water, sanitation, energy, environment, and social justice (United Nations 2017b). The recommendations in this report directly support the achievement of Goal 8 *Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all*. Beyond that, individual recommendations support a range of targets included in other goals such as increasing access to electricity, reducing the impact of climate change, increasing agricultural productivity, increasing water-use efficiency, increasing the share of renewable energy, developing sustainable and resilient infrastructure, ensuring conservation and sustainable use of ecosystems, and promoting good governance.[90]

Nationally Determined Contributions (NDCs) are at the heart of the Paris Agreement, aiming at limiting global warming to 1.5 to 2 degrees Celsius above pre-industrial levels. NDCs embody efforts by each country to reduce national emissions and adapt to the impacts of climate change (UNFCCC 2018). The Government of Mozambique intends to reduce total greenhouse gas emissions by about 76.5 megatons of CO_2 equivalent in the period from 2020 to 2030 (MITADER 2017). Reducing the spread of itinerant agriculture and improving agricultural productivity, using renewable energy and clean cooking technologies, and introducing forest certification are central means to achieve these goals and discussed in this report.

Ultimately, it should be clear that there is ample potential for green growth in Mozambique. The GGPA assessment revealed that the country's economy not only has a large potential to grow further, but that

[89] All of these elements are highlighted in Mozambique's National REDD+ Strategy (MITADER 2016a).

[90] The following SDG targets are supported by recommendations in this report:

- Provide access to basic services/access to electricity: SDG targets 1.4 and 7.1;
- Reduce the impact of climate change through change in agricultural practices: SDG targets 1.5, 11.5, 13.1 and 13.2;
- Increase agricultural productivity through change in agricultural practices: SDG targets 2.3 and 2.4;
- Increase water-use efficiency through change in agricultural practices and promotion of small-scale irrigation: SDG targets 6.4 and 12.2;
- Increase the share of renewable energy through promoting off-grid renewables and strengthening the role of an independent regulator: SDG target 7.2;
- Promote the private sector to enhance deployment of renewable energy solutions: SDG target 9.3;
- Promote conservation and sustainable use of ecosystems through certification of forest products, commercialization of production and processing of fuel wood, and promotion of clean cooking technologies: SDG targets 12.2, 15.1, 15.2, 15.3, and 15.5;
- Promote good governance through strengthening EAC as an independent regulator: SDG targets 16.5 and 16.6.

this growth can be more resource-efficient, climate resilient, and socially inclusive. To help the GoM act on this potential, this report provides thirteen tailored recommendations.

MITADER will play a central role in advancing Mozambique's green growth agenda and in implementing the recommendations outlined in this report. The ministry can act as a coordinator between different government branches to foster a shared approach for sustainable rural development. In the areas under its auspices, it is in a strong position to strengthen regulatory certainty to promote conservation and attract investment. Beyond attracting finance and technical support from donors for specific initiatives, MITADER can engage with stakeholders (producers, federations, buyers, processors, and financial intermediaries) that have expressed interest in many areas (forest certification, renewable energy) to explore business opportunities.

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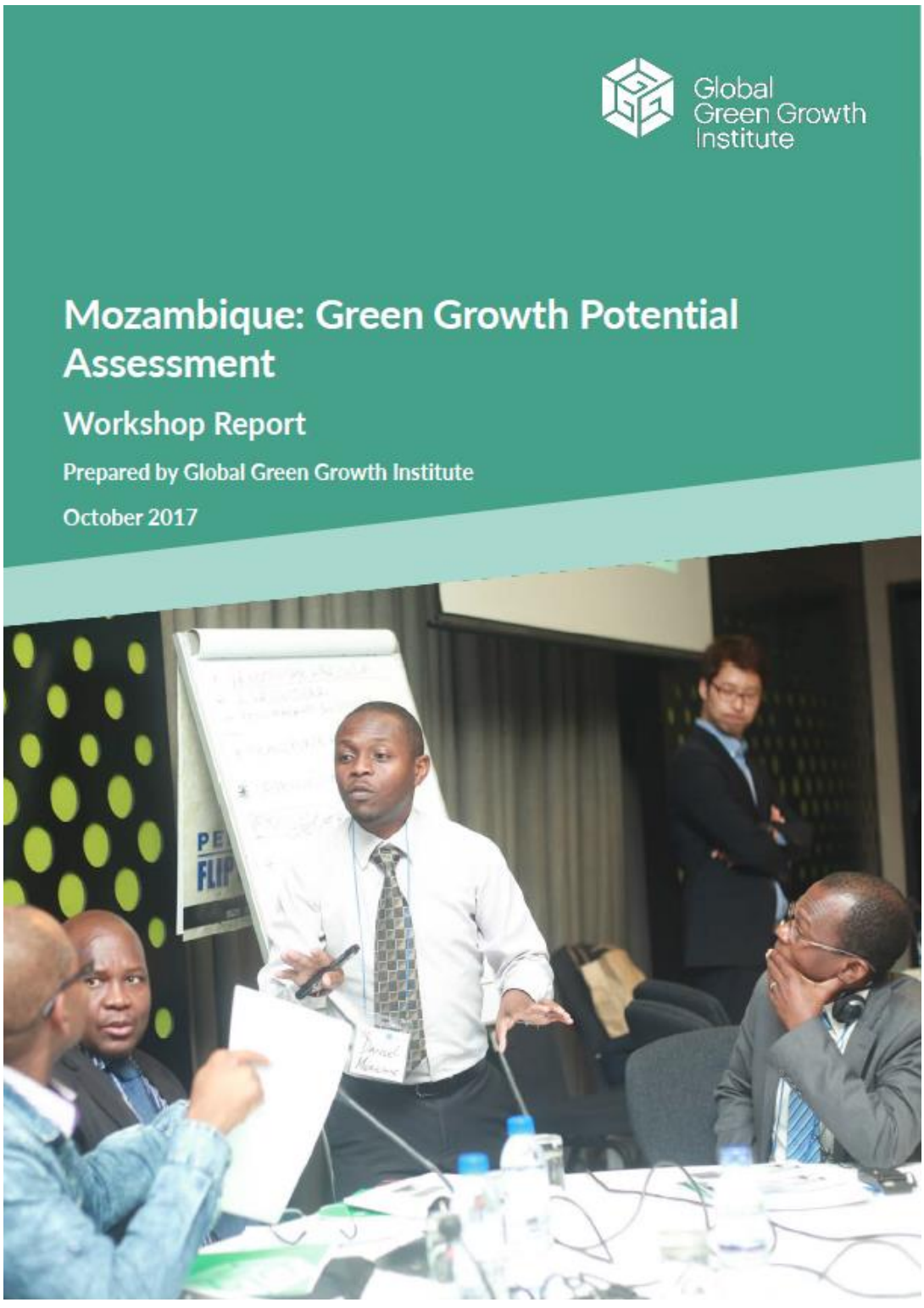
Appendix

Appendix 1 Mozambique: GGPA Workshop Report



Mozambique: Green Growth Potential Assessment

Consultation Workshop Report

Green Growth Potential Assessment (GGPA) Consultation Workshop
Radisson Blue Hotel, Maputo, 11 October 2017

Organized by:
Ministry of Land, Environment and Rural Development (MITADER)
In collaboration with: Global Green Growth Institute (GGGI), Ministry of Economy and Finance (MEF), Ministry of Energy and Mineral Resources (MIREME)

OCTOBER 2017

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EXECUTIVE SUMMARY

A Avaliação do Potencial de Crescimento Verde (APCV) combina a análise de dados e a consulta às partes interessadas, a fim de identificar e priorizar as oportunidades de um país para o crescimento verde. O processo de APCV inclui três etapas: (1) a avaliação preliminar baseada na análise de dados; (2) a validação da avaliação preliminar com consulta às partes interessadas; e (3) a análise por sector com desenvolvimento de recomendações.

Uma parte essencial da APCV consiste em reunir informações de um vasto leque de partes interessadas num workshop interactivo onde se validam e/ou reveem os resultados iniciais da avaliação preliminar. O workshop de consulta da APCV foi realizado a 11 de Outubro de 2017 em Maputo, reunindo cerca de 40 participantes representantes de ministérios e departamentos do Governo de Moçambique (GoM), de organizações parceiras de desenvolvimento, ONGs, instituições académicas e sector privado.

De forma a identificar áreas prioritárias para crescimento verde, os participantes passaram por uma série de rondas de consulta. Em cada ronda foram convidados a escolher até oito prioridades a partir de uma lista que incluía 33 áreas. Entre essas rondas, os participantes receberam informações adicionais dos resultados da análise de dados.

Os participantes identificaram cinco áreas prioritárias para o crescimento verde em Moçambique. Três dessas áreas constituem desafios técnicos ou económicos, e são as seguintes:

- Produtividade agrícola,
- Diminuição dos recursos naturais e
- Energias renováveis

As duas áreas adicionais priorizadas representam desafios e oportunidades transectoriais para o desenvolvimento sustentável. Os participantes consideraram-nas como promotoras de progressos nas três primeiras áreas e do desenvolvimento global de Moçambique. Estas áreas priorizadas são:

- Boa Governação e
- Educação.

Produtividade agrícola: A APCV analisará potenciais intervenções de crescimento verde para aumento da produtividade agrícola. O uso de tecnologias acessíveis, a melhoria dos serviços de extensão e as oportunidades de acesso aos mercados e comercialização, têm um papel fundamental. A análise incidirá sobre as ligações entre a melhoria da produtividade agrícola e outros aspectos do desenvolvimento rural destacados no workshop, tais como a rede de transportes e as energias renováveis fora da rede.

Diminuição dos recursos naturais: a sobre-exploração dos recursos naturais (madeira, lenha, peixes, etc.) causa graves danos ambientais, afectando os meios de subsistência rurais. A utilização mais eficiente dos recursos e a procura de alternativas, reduz os danos ambientais e permite um desenvolvimento rural sustentável. P.e. o uso de energias renováveis reduz o consumo de biomassa e combustíveis fósseis, tais como a lenha e o carvão vegetal.

Energias renováveis: as energias renováveis são uma oportunidade para aumentar a electrificação das áreas rurais, tanto para uso doméstico como produtivo. Fornecer electricidade fora da rede de fontes renováveis foi visto como forma de melhorar os meios de subsistência da população rural, introduzindo opções mais limpas e saudáveis para cozinhar e iluminar. O uso produtivo de energias renováveis foi considerado um meio para o aumento da produtividade agrícola, p.e. através da alimentação de bombas de água e de sistemas de irrigação, permitindo formas adequadas de armazenamento e refrigeração. As energias renováveis foram ainda consideradas como fonte de crescimento económico, possibilitando o incremento do processamento e de outras actividades de valor acrescentado.

Boa governação e educação: ambas as áreas foram seleccionadas como cruciais para o desenvolvimento das outras áreas e sectores. Sublinhou-se que a boa governação é condição essencial para a melhoria das áreas mais técnicas e para fortalecimento do desenvolvimento económico. A educação, para além de envolver todos os níveis de educação formal, inclui, a formação profissional, a educação cívica e a capacitação de funcionários públicos.

As áreas identificadas como prioritárias para crescimento verde, constituem as bases a partir das quais serão realizadas as entrevistas sectoriais e onde incidirá a análise a desenvolver no relatório final da APCV. É parte integrante desta análise o trabalho que o GGGI vai desenvolver com as partes interessadas de forma a contextualizar o crescimento verde e desenvolver recomendações com foco nos planos do GoM para o desenvolvimento rural.

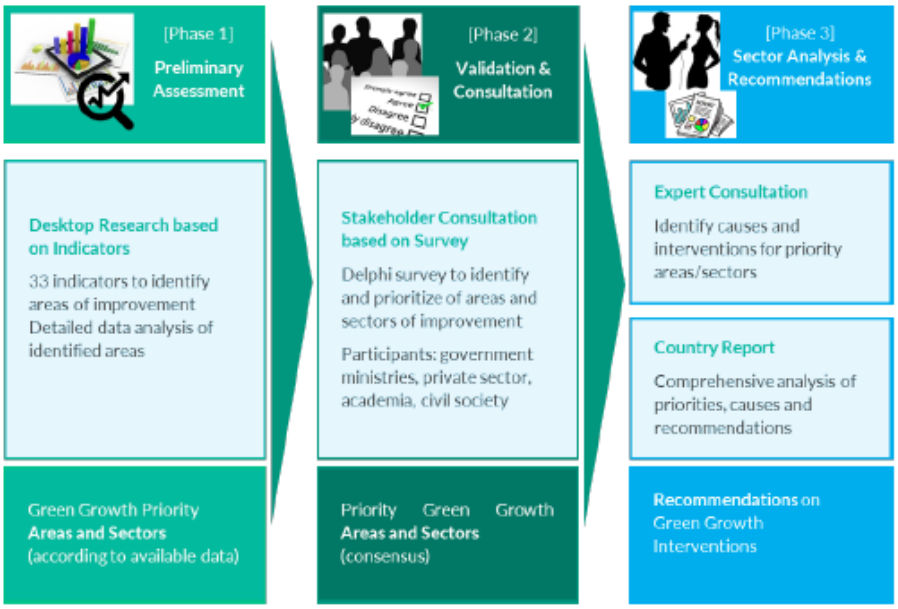
1. BACKGROUND

Although there are many ongoing efforts to plan and implement green growth in Mozambique, there is not a shared understanding of green growth or a clear national agenda. To address these needs, Ministry of Land, Environment and Rural Development (MITADER) has requested the support of GGGI to undertake an evidence-based and results-oriented assessment as the first step in setting its green growth priorities and targets.

As part of this work, GGGI is conducting a national Green Growth Potential Assessment (GGPA). The GGPA will identify green growth interventions offering the greatest potential for improvement. The assessment will also support the implementation of the Green Economy pillar of the 5 Year Plan (2015-2019), the Sustainable Rural Development Program (2015-2030) and other sectoral plans and strategies over the short and mid-term periods. The result will be a set of recommendations to guide national, sectoral and sub-sectoral planning as well as investment activities toward a transformational green growth pathway.

The GGPA is a diagnostic tool which consists of a combination of data analysis and stakeholder consultation in order to identify and prioritize a country's opportunities for green growth. The GGPA process consists of the following three stages: (1) preliminary assessment based on data analysis; (2) validation of the preliminary assessment and consultation with stakeholders; and (3) sector analysis and the development of recommendations (Figure 1). This design aims to ensure that the assessment process is systematic, objective, and participatory.

Figure 1 Overview of the GGPA Process



2. CONSULTATION WORKSHOP OBJECTIVES AND METHODOLOGY

An essential part of the GGPA is to gather input from a broad range of stakeholders through an interactive Delphi-based workshop. This workshop serves to validate and/or revise the initial findings from the preliminary assessment. Presenting the results of the data analysis, coupled with a systematic participatory process, is essential to ensure broad stakeholder consensus on green growth priorities. The consultation process also serves to compensate for any lack of relevant data and ensures the alignment of GGPA results with existing policies.

The GGPA consultation workshop was held on 11 October 2017 in Maputo with about 40 participants representing different ministries and departments of the Government of Mozambique (GoM) as well as representatives from developing partners, NGOs, academic institutions and the private sector (The list of the participants and the workshop agenda are provided in Appendix A2). A final list of priority areas and related sectors was defined after the workshop

The workshop was organized by the Ministry of Land, Environment and Rural Development (MITADER), in collaboration with the Ministry of Economy and Finance (MEF), Ministry of Energy and Mineral Resources (MIREME), and the Global Green Growth Institute (GGGI).

Participation of a broad range of relevant stakeholders from government ministries, academic partners, the private sector and development partners was essential to ensure broad representation of distinct sectors to determine the green growth priorities.

A sequence of voting and discussion (Delphi method) led by GGGI, representatives of the GoM and Maputo University, was used to identify green growth priorities in Mozambique. Participants actively participated throughout the workshop in discussions and interactive consultations. This process was aided by using an electronic voting system at different stages of the workshop to systematically gather participants' input.

The identified green growth priority areas serve as the basis for the sector interviews and analysis leading up to the GGPA final report. As part of this analysis, GGGI will work with stakeholders to contextualize green growth and develop recommendations with a focus on GoM plans for rural development. The following chapter presents the consensus building steps and agreed priority areas.

Figure 2 Plenary Session and Group Discussions During Consultation Workshop

3. WORKSHOP PROCEEDINGS AND RESULTS

3.1 Consultation

To identify green growth priorities, the workshop program altered between presenting the results of the data analysis and asking participants for their feedback in several interactive voting rounds.

3.1.1 GGPA Methodology

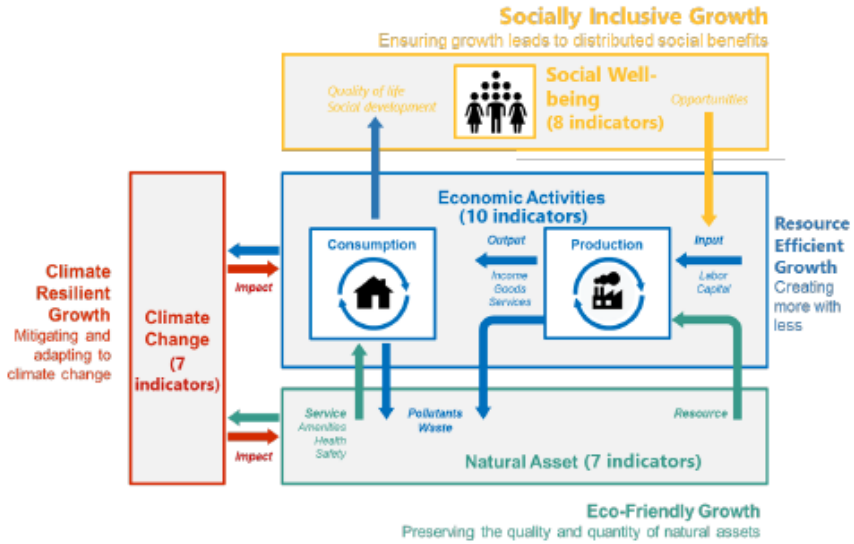
Jan Stelter, GGGI Senior Analyst, introduced the Green Growth Potential Assessment methodology, explaining that the GGPA is a diagnostic tool that combines data analysis with stakeholder consultation to identify areas where green growth solutions provide the greatest potential for supporting a country's development. He explained the assessment process and the workshop objectives. As part of his explanations, Mr. Stelter asked participants to choose three out of the following aspects that they associate with green growth:

1. Economic growth;
2. Environmental protection;
3. Health and well-being;
4. Climate change;
5. Poverty reduction;
6. Investment;
7. Technology and innovation;
8. Efficient use of resources.

The majority of participants associate green growth with environmental protection (59%) and economic growth (56%), followed by efficient use of resources (44%).

Based on participants' understanding of green growth, Mr. Stelter made the link to the conceptual framework of how indicators for the data analysis were chosen and which aspects of green growth they attempt to reflect. Key aspects selected by participants are reflected in the theoretical framework, covering resource-efficient growth, eco-friendly growth, climate-resilient growth, and socially inclusive growth (Figure 3).

Figure 3 Conceptual Framework for GGPA Indicators



3.1.2 Identification of Green Growth Priorities

In order to identify priority areas for green growth, participants went through a series of consultation rounds. In each round, participants were asked to choose up to eight priorities out of a list of 33 areas. These consultation rounds were supported by an electronic voting system. Between these rounds, participants were provided with further information on the results of the data analysis.

Prior to the first consultation round, Mozambique's performance on 33 indicators (representing the areas participants were asked to select from) was compared to neighboring countries (Malawi, Tanzania and Zambia) as well as the group of the Low-Income Countries. A list of the indicators with details on their definition and sources is provided in Appendix A1.

Prior to the second consultation round, participants received additional context and more detailed information on the areas they had prioritized during the first consultation round as well as those areas they showed high potential for green growth interventions based on the data analysis.

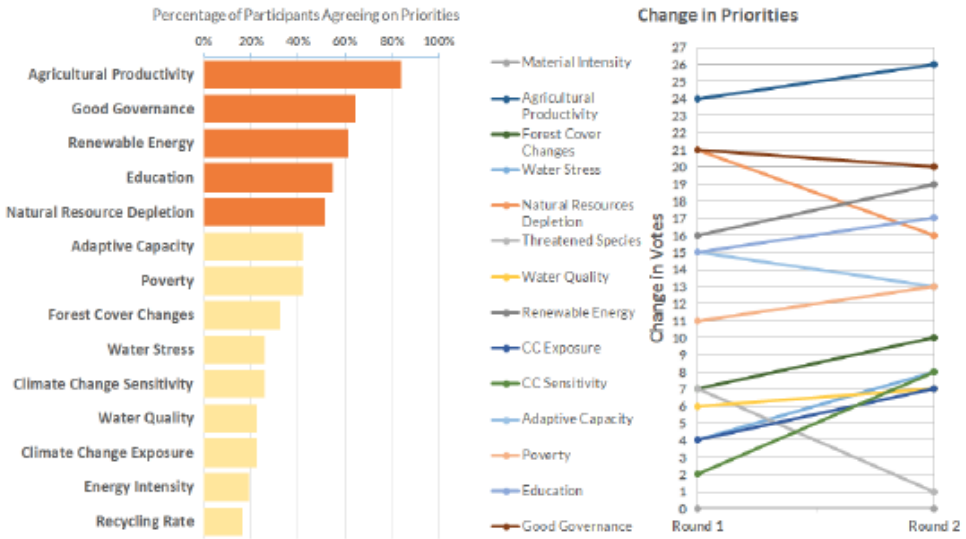
Participants identified five priority areas for green growth in Mozambique (Figure 5). Three of these areas can be described as technical or economic challenges. These areas are:

- Agricultural productivity,
- Natural resource depletion, and
- Renewable energy.

The two additional areas represent cross sectoral challenges and opportunities for sustainable development. Participants regarded them as enablers to advances in the first three areas, but also to general progress in the development of Mozambique. These enablers are:

- Good governance, and
- Education.

Figure 4 Priority Areas Identified by Participants



The selected priorities remained remarkably stable between multiple consultation rounds. Three of the selected five priorities witnessed an increase in the number of votes during the workshop, including agricultural productivity (+2), renewable energy (+3 votes) and education (+2 votes). This reflects higher consensus among participants that the selected areas reflect indeed green growth priorities. Both, good governance (-1) and natural resource depletion (-5) experienced drops in the number of votes. However, changes in forest cover (+3)

and fish socks (+2) saw votes going up, with participants explicitly pointing out that they see both areas as part of natural resource depletion.

It is noteworthy that issues connected to climate change remained prominent throughout the workshop. Taken together, exposure, sensitivity and adaptive capacity to climate change increased by a combined number of 6 votes.

The top five priorities captured 54% of the votes at the end of the workshop. Considering areas that will be addressed in the final analysis but are not among the top five priorities (e.g. poverty, gender inequality and the different aspects of vulnerability to climate change), the assessment will cover over 75% of the areas participants regarded as priorities.

3.1.3 Break-Out Group Discussions

After lunch, participants were divided into four breakout groups. Each of these groups was led by an experienced representative of the GoM, Maputo University, or GGGI. All four groups were asked to complete two tasks:

1. Based on the priorities proposed by the plenary, please select three priority areas for green growth.
2. Please select three sectors that are related to the priority areas your group agreed on.

The results of the group discussions largely confirmed the results of the priority areas selected in the plenary. In total, breakout groups named six priority areas for green growth, including:

- Agricultural productivity, due to the high importance of agriculture for rural livelihoods and Mozambique's economy;
- Natural resource depletion including forests (timber), overfishing, degradation of coastal areas;
- Renewable energy, as an opportunity to increase electrification in rural areas, both for household electrification and productive use, such as water pumps, irrigation systems, storage and cooling, as well as a source of economic growth, including processing and other value-adding activities;
- Adaptive capacity to the adverse impacts of climate change. The use of renewable energy was largely seen as a means to strengthen adaptive capacity. Beyond that, participants mentioned the need to make the country's transportation network more resilient to the impacts of climate change;
- All groups explicitly mentioned good governance and education as necessary enablers for progress in other areas.

Selecting the sectors that are most related (in the context of Mozambique) to the priority areas mainly served to further narrow down the issues and inform the next stage of the assessment process involving interviews with technical experts from different ministries, development partners, academia, civil society and the private sector. In a final plenary consultation round, participants were asked to select relevant sectors for all five priority areas (Table 1).

More details on the selected priorities are provided in Chapter 3.2 'Interpreting the Results', while the discussion results of individual breakout groups are presented in Appendix A3.

Table 1 Selected Growth Priority Areas and Related Sectors by Percentage of Participants

Priority Area / Related Sectors	Agricultural Productivity	Depletion of Natural Resources	Renewable Energy	Education	Good Governance
Agriculture	90%	48%	14%	14%	5%
Forestry & Land Use	62%	71%	29%	14%	10%
Fisheries	19%	24%	0%	0%	0%
Economy & Finance	10%	5%	10%	57%	90%
Industry & Commerce	5%	0%	52%	0%	10%
Energy & Mineral Resources	10%	24%	86%	5%	10%
Transport & Communication	10%	0%	0%	5%	0%
Public Works & Water Resources	14%	19%	43%	5%	10%
Education & Vocational Training	19%	19%	19%	86%	57%
Public Administration	0%	5%	10%	57%	90%
Rural Development	43%	48%	29%	24%	10%

*Highlighted cells suggest area and sector are strongly related (One quarter of participants regarded the area and sector as related).

3.2 Interpreting the Results

The five priorities identified in the GGPA workshop largely align with the social and economic development priorities identified in Mozambique's Five-Year Plan for 2015-2019. The priorities identified in the plan are:

1. Strengthening national unity, peace and sovereignty;
2. Developing human and social capital;
3. Promoting employment, productivity and competitiveness;
4. Developing social and economic infrastructure, and
5. Sustainable and transparent management of natural resources and the environment.

Each of the five priorities is supported by three pillars, namely:

1. Ensuring democratic rule of law, good governance and decentralization;
2. Promoting a balanced and sustainable macroeconomic environment;
3. Strengthening international cooperation.

Improving Agricultural Productivity

Participants agreed that enhancing agricultural productivity as a green growth priority. This is in line with the Five-Year Plans objectives 2-4.

First, agriculture is central to rural livelihoods due to the high share of subsistence agriculture in Mozambique. Second, the agriculture sector is also an important pillar of the country's economy, employing about 75% of the workforce and accounting for 25% of GDP.

The GGPA analysis will look into potential green growth interventions for increasing agricultural productivity. In this context, the use of affordable technologies, improvement of extension services and opportunities to enhance market access and commercialization will play a prominent role.

Furthermore, the analysis will look at the strong link between improving agricultural productivity and other aspects of rural development that were highlighted during the workshop, such as

the transport network (rural roads) as well as off-grid renewable energy.

Reducing the Depletion of Natural Resources

First, workshop participants explicitly pointed out their concern that (over-)exploitation of natural resources will increase in the coming years. In their opinion over-exploitation of natural resources (including timber, fuel wood, fish stocks, etc.) causes severe harm to the environment and undermines rural livelihoods, in particular. Therefore, using resources more efficiently or finding alternatives to the resources currently used would reduce environmental damage and allow for a sustainable rural development. Participants pointed out the link to the use of renewable energy. Using renewable energy would allow to reduce consumption of biomass and fossil fuels, such as fuel wood and charcoal.

Second, participants voiced their concern that earnings from natural resources do not benefit the larger population. In this context, moving away from economic activities that rely on resource extraction and increase the share of value-adding activities in rural areas was seen as a means to spur economic growth, create jobs and reduce poverty.

Reducing the depletion of natural resources is closely aligned with priorities 3 and 5 of the current Five-Year Plan.

Improving Productivity and Rural Livelihoods Through Renewable Energy

Renewable energy, as an opportunity to increase electrification in rural areas, both for household electrification and productive use. Providing off-grid electricity from renewable sources was seen as a means to improve the livelihoods of the rural population by introducing cleaner and healthier options for cooking and lighting.

Productive use of renewable energy was seen as a potential means to increase agricultural productivity, for example, by powering water pumps, support irrigation systems, allow for proper storage and cooling. Renewable energy was also regarded as a source of economic growth, allowing for more processing and other value-adding activities in rural areas.

The use of renewable energy was regarded as a means to strengthen the adaptive capacity to the adverse impacts of climate change.

The discussion of renewable energy in the final GGPA analysis aligns closely with priorities 3-5 of the current Five-Year Plan.

Good Governance and Education As Critical Enablers

Participants regarded good governance as an enabler for progress in other areas and sectors. Participants pointed out repeatedly that good governance is essential for improvement in more technical issues and for strengthening economic development.

Similar to good governance, participants pointed out that education is an enabler for development in other areas and sectors. Participants consistently highlighted that education involves all levels of formal education, but also includes vocational training, civic education campaigns as well as capacity building for civil servants.

The promotion of education is in line with priority 2 of the current Five-Year Plan. Discussing both, education and good governance as enablers for progress in other areas of development reflects the perception of good governance as a supporting pillar for all five priorities set out in the Five-Year Plan.

4. PHASE 3: SECTOR ANALYSIS

First, the sector analysis will be based on existing policy documents relevant to priority areas identified. The final report will build on these documents, identifying how green growth can support the identified goals and initiatives. Second, the report will propose and highlight specific initiatives and interventions based on the assessment.

For this purpose, a series of interviews with technical experts in Mozambique is crucial. GGGI together with MITADER will identify relevant experts from ministries, the private sector, academia, and development partners. The interviews and consultations will be conducted over the course of October and November 2017.

Figure 5 Schematic of Analytical Framework for GGPA Final Report

Appendix 2 GGPA Indicators

Theme	Sub-theme	Area	Indicator	Unit	Description	Source
Resource- Efficient Growth	**Energy Efficiency**	Energy Intensity	Energy Intensity of the Economy	MJ / unit GDP	Energy Intensity indicates of how much energy is used to produce one unit of economic output. It is the ratio between total primary energy supply (TPES) and GDP. TPES is defined as energy production plus energy imports, minus energy exports, minus international bunkers, minus stock changes. GDP is measured at purchasing power parity. (GDP: 2011 USD PPP) http://data.worldbank.org/indicator/EG.EGY.PRIM.PP.KD	WB
		Electricity Losses Loss	Transmission and Distribution Losses of Electricity	% of output	Electricity losses refer to transmission and distribution losses. This includes both technical and non-technical losses. Technical losses are caused by physical characteristics of the grid and the electricity-generating system. The amount of losses is mainly dependent on the size of the country (length of power lines), voltage of transmission and distribution and quality of network. Transmission and distribution losses comprises all losses due to transport and distribution of electrical energy, including losses in overhead transmission lines and distribution networks as well as losses in transformers which are not considered as integral parts of the power plants. Non-technical losses mainly refer to electricity theft. http://data.worldbank.org/indicator/EG.ELC.LOSS.ZS	
	Resource Productivity	Material Intensity	Material Intensity	kg of domestic consumption / unit GDP	Material intensity refers to the quantity of material used to produce goods and services. It is the ratio between GDP and the total amount of domestically extracted/produced materials (construction/industrial minerals, metal, ores, fossil fuels and biomass). It does not account for any amounts of imported and exported materials. http://www.materialflows.net/data/datadownload (flow type "Extraction" flow sub-type "Used" reference parameter "Per GDP", GDP in constant 2005 USD)	SERI
		Waste Generation	Municipal Solid Waste Generation Intensity	kg of waste / unit GDP	Municipal solid waste is defined as the waste produced by households. It further includes similar waste generated by commerce, offices and public institutions. The indicator is defined as the ratio between GDP (at constant 2010 USD) and the amount of municipal solid waste collected by or on behalf of municipal authorities and disposed of through the waste management system. The indicator does not capture any informal waste collection. http://www.atlas.d-waste.com/ (for municipal solid waste generation) http://data.worldbank.org/indicator/NY.GDP.MKTP.KD (for GDP)	Dwaste, WB

		Waste Recycling	Recycling Rate of Solid Waste	% of waste generated	Recycling rate of municipal solid waste refers to the amount of Municipal Solid Waste (MSW) recycled as a proportion of total MSW generated and collected within the formal waste sector. http://www.atlas.d-waste.com/	Dwaste
		Water Productivity	Water Productivity	GDP/ m^3 of freshwater withdrawal	Water productivity indicates how water intense a country's economy. It is defined as GDP (in constant 2010 USD) divided by the total annual freshwater withdrawal. http://data.worldbank.org/indicator/ER.GDP.FWTL.M3.KD	WB
		Land-use Productivity (Agricultural)	Agricultural Land Productivity	Unit GDP / km^2	Agricultural land productivity is defined as agricultural production divided by total area of arable land under permanent crops, and under permanent pastures. The economic value of agricultural output has been calculated by multiplying gross production in physical terms by output prices at the farm gate. Since intermediate uses within the agricultural sector (seed and feed) have not been subtracted from production data, this value of production aggregate refers to the notion of "gross production". http://faostat3.fao.org/download/Q/QV/E (gross production value constant 2004-2006) http://data.worldbank.org/indicator/AG.LND.AGRI.K2 (for further description of agricultural land)	FAO WB
	Other Productivity Factors	Labor Productivity	Labor Productivity	GDP / worker	Labor productivity is defined as the total volume of output (measured in terms of Gross Domestic Product, GDP) produced per unit of labor (measured in terms of the number of employed persons) during a given time reference period. The economically active population comprises all persons of either sex, ages 15 and older who furnish the supply of labor for the production of economic goods and services as defined by the United Nations System of National Accounts during a specified time-reference period. http://www.ilo.org/global/statistics-and-databases/research-and-databases/kilm/lang--en/index.htm https://stats.oecd.org/glossary/detail.asp?ID=730 Indicator: Output per worker (GDP constant 2005 USD)	ILO
		Logistics Performance	Logistics Performance Index	1 – 5 (higher scores indicate	Logistic performance measures countries' performance in six areas that capture the most important aspects of the current logistics environment (efficiency of customs clearance process, quality of trade- and transport-related infrastructure, ease of arranging competitively priced shipments, quality of logistics services, ability to track and trace consignments, as well as frequency with which shipments reach the consignee within the scheduled time).	WB

				better performance)	http://data.worldbank.org/indicator/LP.LPI.OVRL.XQ http://siteresources.worldbank.org/INTLAC/Resources/ConnectingtoCompete.pdf	
		Technology	Technological Readiness	1 – 7 (higher scores indicate higher readiness)	Technological readiness is a proxy to measure the agility with which an economy adopts existing technologies to enhance the productivity of its industries, with specific emphasis on its capacity to fully leverage information and communication technologies (ICTs) in daily activities and production processes for increased efficiency and enabling innovation for competitiveness. Whether the technology used has or has not been developed within national borders is irrelevant for its ability to enhance productivity. The central point is that the firms operating in the country need to have access to advanced products and blueprints and the ability to absorb and use them. Among the main sources of foreign technology, FDI often plays a key role, especially for countries at a less advanced stage of technological development The index covers the following areas: (1) technological adoption (availability of latest technologies, firm-level technology absorption, FDI and technology transfer), and (2) ICT use (internet users, broadband internet subscriptions, internet bandwidth, mobile broadband subscriptions, mobile telephone subscriptions, fixed telephone lines). http://www3.weforum.org/docs/gcr/2015-2016/Global_Competitiveness_Report_2015-2016.pdf	WEF

Eco-Efficient Growth	**Quantity of Natural Assets**	Fishing Pressure	Coastal Shelf Fishing Pressure	tonnes / km^2	Coastal shelf fishing pressure is defined as the total catch from trawling and dredging equipment divided by the total area of a country's exclusive economic zone. http://epi.yale.edu/sites/default/files/2016EPI_Raw_Data_0.xls	EPI
		Forest Cover Changes	Changes in Forest Cover	annual change (%)	Changes in forest cover capture the annual percent change in forest cover between 2005 and 2015. Forests are defined as land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10%, or trees able to reach these thresholds in situ. Areas that are predominantly under agricultural or urban land use is not included. http://faostat3.fao.org/download/R/RL/E	FAO
		Water Consumption	Water Stress	0 – 5 (higher scores indicate greater competition among users)	The baseline water stress index measures water stress is defined as the ratio between total annual water withdrawals (municipal, industrial, and agricultural) and total renewable supply. The index is based on a scale ranging 0 to 5. The index serves as a proxy for the level of competition among users and depletion of the resource. Focusing on competition and depletion makes this indicator an effective way to measure the hydrological context at the catchment scale. http://www.wri.org/sites/default/files/aqueduct_coutnry_rankings_010914.pdf	WRI
		Natural Resource Depletion	Natural Resource Depletion	% of GNI	Natural resource depletion is defined as the sum of net forest depletion, fossil fuel depletion, and mineral depletion, as a percentage of gross national income (GNI). Net forest depletion is unit resource rents times the excess of round wood harvest over natural growth. Fossil fuel depletion is the ratio of the value of the stock of fossil fuel resources to the remaining reserve lifetime (capped at 25 years). It covers coal, crude oil, and natural gas. Mineral depletion is the ratio of the value of the stock of mineral resources to the remaining reserve lifetime (capped at 25 years). It covers tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate. http://data.worldbank.org/indicator/NY.ADJ.DRES.GN.ZS	WB
	Quality of Natural Assets	Endangered Species	Threatened Species	Number of threated species in a country/ number of threated species worldwide	This indicator serves as a proxy for measuring biodiversity and environmental conservation efforts. The indicator is defined as the number of threatened species, as defined by IUCN, in a country divided by the number of threatened species worldwide.	IUCN

					http://cmsdocs.s3.amazonaws.com/summarystats/2016-3_Summary_Stats_Page_Documents/2016_3_RL_Stats_Table_5.pdf http://cmsdocs.s3.amazonaws.com/summarystats/2016-3_Summary_Stats_Page_Documents/2016_3_RL_Stats_Table_6a.pdf http://cmsdocs.s3.amazonaws.com/summarystats/2016-3_Summary_Stats_Page_Documents/2016_3_RL_Stats_Table_6b.pdf	
		Water Quality	Water Quality Index	0 – 100 (higher scores indicate higher quality)	The Water Quality Index uses three parameters to determine the water quality of a country's fresh water bodies, measuring nutrient levels (Dissolved Oxygen, Total Nitrogen, and Total Phosphorus) and two parameters measuring water chemistry (pH and Conductivity). http://www.epi.yale.edu/files/2010epi_data.xls	EPI
		Soil Quality	Trends in Soil Health Index	0 – 50 (higher scores indicate better soil health)	The Trends in Soil Health Index measures the physical part related to loss of soil mass and structure; and the long-term chemical well-being of the soil in terms of nutrients and absence of toxicities built up. http://www.fao.org/nr/lada/index.php?option=com_docman&task=doc_download&gid=773&lang=en	FAO
		Air Quality	Population-Weighted Exposure to $PM_{2.5}$	µg / m^3	The indicator measures the average exposure to $PM_{2.5}$, particles less than 2.5 micrometers in diameter. Three-year rolling population-weighted average of the $PM_{2.5}$ values are used to calculate indicators for national annual average exposure to $PM_{2.5}$ in micrograms per cubic meter. Population-weighted average exposure values are calculated using population data from the Global Rural Urban Mapping Project (2011) database. http://epi.yale.edu/sites/default/files/2016EPI_Raw_Data_0.xls	EPI

Climate- Resilient Growth	**Climate Change Mitigation**	CO_2 Emissions	CO_2 Emission Trend	annual growth rate (%)	The CO_2 emission trend captures a country's annual growth rate in national emissions of CO_2 over the latest five years available. http://data.worldbank.org/indicator/EN.ATM.CO2E.KT	WB
		Carbon Intensity	Carbon Intensity	$kgCO_2$ / unit GDP	Carbon intensity is defined as the amount of carbon dioxide emissions (stemming from the burning of fossil fuels and the manufacture of cement) per unit of gross domestic production (GDP in constant 2010 USD). http://data.worldbank.org/indicator/NY.GDP.MKTP.KD (for GDP) http://data.worldbank.org/indicator/EN.ATM.CO2E.KT (for CO_2)	
		Renewable Energy	Renewable Energy Production	% of total electricity output	Renewable energy production refers to the share of electricity generated from renewable sources of energy within total electricity generation, including geothermal, solar, tidal, and	
		Carbon Stock Changes	Carbon Stock in Living Forest Biomass	annual change in million tonnes	Annual changes in carbon stock, which is a quantity of carbon contained in a reservoir or system of living forest biomass which has the capacity to accumulate or release carbon. http://www.fao.org/3/a-i4808e.pdf	FAO
	Climate Change Adaptation	Exposure	Climate Change Exposure	0 – 1 (higher scores indicate higher exposure)	Climate change exposure indicates the degree to which a society and its supporting sectors (defined as food, water, health, ecosystem, human habit and infrastructure). is exposed to significant climate change from a biophysical perspective. It is a component of vulnerability independent of socio economic context. Exposure reflects projected impacts for the coming decades and are therefore invariant overtime. http://index.gain.org/ranking/vulnerability/exposure	NDGAIN
		Sensitivity	Climate Change Sensitivity	0 – 1 (higher scores indicate higher sensitivity)	Climate change sensitivity indicates the degree to which a society and its supporting sectors (defined as food, water, health, ecosystem, human habit and infrastructure) are affected by climate related perturbations. The factors increasing sensitivity include the degree of dependency on sectors that are climate-sensitive and proportion of populations sensitive to climate hazard due to factors such as topography and demography. http://index.gain.org/ranking/vulnerability/sensitivity	

		Adaptive Capacity	Adaptive Capacity to Climate Change	0 – 1 (higher scores indicate lower adaptive capacity)	Adaptive capacity to climate change reflects the ability of society and its supporting sectors to adjust in order to reduce potential damage and to respond to the negative consequences of climate events. In ND-GAIN adaptive capacity indicators seek to capture a collection of means, readily deployable to deal with sector-specific climate change impacts. Indicators used for this index include (1) electricity access and (2) disaster preparedness. http://index.gain.org/ranking/vulnerability/capacity	
Socially Inclusive Growth	**Quality of Life**	Poverty	Poverty headcount ratio at $1.90 a day (2011 PPP)	% of population	The poverty headcount ration indicates the percentage of the population living on less than $1.90 day. http://data.worldbank.org/indicator/SI.POV.DDAY	WB
		Hunger	Prevalence of undernourishment	% of population	Prevalence of undernourishment is defined as the percentage of population whose calorific intake is insufficient to meet dietary energy requirements continuously (at least one year). http://data.worldbank.org/indicator/SN.ITK.DEFC.ZS	WB
		Health and Well-being	Healthy Life Expectancy at birth, total	years	The Healthy life expectancy (HLE) is used as a proxy to measure the overall health for a population. The HLE indicates the average equivalent number of years of full health that a newborn could expect to live if they were to pass through life subject to the age-specific death rates and average age-specific levels of health states for a given period. http://apps.who.int/gho/data/view.main.HALEXv	WHO
		Education	Net Primary Enrolment Rate	%	The net primary enrollment rate is defined as the number of children enrolled in primary school who belong to the age group that officially corresponds to primary schooling, divided by the total population of the same age group. http://data.uis.unesco.org/Index.aspx?queryid=145	UNESCO
	Inequality	Gender Inequality	Gender Inequality Index (GII)		The Gender Inequality Index measures gender inequality across three aspects of human development: (1) reproductive health, measured by maternal mortality ratio and adolescent birth rates; (2) empowerment, measured by proportion of parliamentary seats occupied by females and proportion of adult females and males aged 25 years and older with at least	UNDP

				0 – 1 (higher scores indicate greater inequality)	some secondary education; and (3) economic status, expressed as labor market participation and measured by labor force participation rate of female and male populations aged 15 years and older. http://hdr.undp.org/en/composite/GII	
		Income Inequality	GINI Index	0 – 100 (higher scores indicate greater inequality)	The GINI index measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. http://data.worldbank.org/indicator/SI.POV.GINI	WB
	Governance	Good Governance	Corruption Perception Index (CPI)	0 – 100 (higher scores indicate lower levels of corruption)	The Corruption Perception Index scores and ranks countries/territories based on how corrupt a country's public sector is perceived to be. It is a composite index based on a combination of surveys and assessments of corruption, compiled by a variety of reputable institutions. https://www.transparency.org/cpi2015/results	TI
		Public Expenditure	Public Expenditure on Health and Education	% of GDP	Public health expenditure consists of recurrent and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds. Public expenditure on education (current, capital, and transfers) consists of government expenditure for all levels of education, and includes expenditure funded by transfers from international sources to government. http://data.worldbank.org/indicator/SH.XPD.PUBL.ZS (Public health expenditure) http://data.worldbank.org/indicator/SE.XPD.TOTL.GD.ZS (Government expenditure on education)	WB

About the Global Green Growth Institute

The Global Green Growth Institute was founded to support and promote a model of economic growth known as "green growth", which targets key aspects of economic performance such as poverty reduction, job creation, social inclusion and environmental sustainability.

Headquartered in Seoul, Republic of Korea, GGGI also has representation in a number of partner countries.

Member Countries: Australia, Cambodia, Costa Rica, Denmark, Ethiopia, Fiji, Guyana, Hungary, Indonesia, Jordan, Kiribati, Republic of Korea, Mexico, Mongolia, Norway, Papua New Guinea, Paraguay, Philippines, Qatar, Rwanda, Senegal, Thailand, United Arab Emirates, United Kingdom, Vanuatu, Vietnam

Operations: Cambodia, China, Colombia, Ethiopia, Fiji, India, Indonesia, Jordan, Laos, Mexico, Mongolia, Morocco, Mozambique, Myanmar, Nepal, Peru, Philippines, Rwanda, Senegal, Thailand, Uganda, United Arab Emirates, Vanuatu, Vietnam

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