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IMPROVING EFFICIENCY IN FORESTRY OPERATIONS AND FOREST PRODUCT PROCESSING IN KENYA:

A VIABLE REDD+ POLICY AND MEASURE

SUMMARY FOR POLICY MAKERS

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SUMMARY FOR POLICYMAKERS

KEY MESSAGES

Kenya's constitution has set a minimum national tree cover target of 10%. Additionally, the country has demonstrated sustained commitment to anchoring REDD+[1] in its national policy framework and development strategy. In this context, Kenya is in the process of identifying the best ways to address the direct and indirect drivers of deforestation and forest degradation.

Both timber and fuelwood demand are increasing and the challenge ahead is to help public and private plantations to meet future demand in a sustainable way, by reducing the quantity of non-renewable biomass used to bridge the demand shortfall. According to the Kenyan Readiness Preparation Proposal (R-PP), the lack of security of timber supply to the sawmilling industry (i.e. low investment in timber processing technology, poor timber conversion ratios) is a key indirect driver of deforestation and forest degradation (KFS, 2010) as it may contribute to encroachment in forests not destined for timber production. Sustainable utilization of wood resources, including but not limited to enhanced efficiency in processing, is one way for Kenya to potentially achieve a reduction or removal of emissions and hence REDD+ results.

This report analyses whether increased efficiency in forestry operations and forest product processing and utilization are interesting REDD+ policies and measures (PAMs) for the Government of Kenya (GoK) to pursue, with the potential to attract public and/or private investments to enable REDD+ implementation. In particular, the report focuses on the extent to which efficiency improvements could address supply deficiency in the forest sector, thereby reducing pressures on existing forests and related emissions.

To this end, cost estimates and emissions reduction potential were undertaken in the following sectors:

1. Forestry operations (commercial logging)
2. Timber conversion (sawmills)
3. Charcoal production
4. Charcoal and firewood use in cooking stove technology (households)
5. Wood usage in industrial processes

Although wood is a renewable material, it becomes non-renewable when the harvesting rates exceed the ecosystem's production capacity. Thus, for each sector, the fraction of non-renewable biomass (fNRB), which indicates the proportion of biomass used that is not renewable, was a key parameter to estimate the potential emission reductions from deforestation and forest degradation of each of the five sectors. The United Nations Framework Convention on Climate Change (UNFCCC) defines this as the "proportion of total annual (woody) biomass removals that is demonstrably not renewable".

With regards to forestry operations and timber processing from forest plantations in Kenya, while strong socio-economic benefits may be derived from efficiency improvements, there is no evidence that increasing efficiency will help alleviate illegal harvesting pressure on natural forests. According to Kenya Forest Service (KFS), most of the timber produced at national level comes from forest plantations. Small, illegal saw-millers rely mostly on timber from private farms and illegally accessed timber from forest reserves, especially through indiscriminate and uncontrolled selective cutting in forests. Plantation forest products such as pine, cypress and eucalyptus are hardly substitutable with the precious woods illegally harvested in natural forests. Moreover, rare commercial species such as camphor and sandalwood are not only exploited for their precious wood but also for other products (such as bark used in the perfume industry or for medicinal use) and therefore are not affected by increasing the efficiency of forestry operations in pine, cypress and eucalyptus plantations.

1 Reducing Emissions from Deforestation and Forest Degradation (REDD) is a concept to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. "REDD+" goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.

Emission reductions or removals are only expected when investing in enhancing efficiency in charcoal production and fuelwood consumption at household and industrial levels. Investments to improve efficiency in charcoal production (increased supply) and fuelwood consumption (reduced demand) at household and industrial levels are both economically-attractive and have the highest potential to generate REDD+ results, with an estimated emission reduction potential of more than 20 million tons of carbon dioxide equivalent (tCO_2e) per year.

The assessment results support the mitigation activities proposed by the GoK in its Intended Nationally Determined Contribution (INDC) submitted to the UNFCCC in July 2015, including: "Enhancement of energy and resource efficiency across the different sectors" and "Making progress towards achieving a tree cover of at least 10% of the land area of Kenya". The INDC states that Kenya's total greenhouse gas (GHG) emissions were around 73 million tCO_2e in 2010, of which 75% were from the land use, land-use change and forestry (LULUCF) and agriculture sectors. **If Kenya were to implement the measures proposed in this report, the potential reduction of 20 million tCO_2e identified in this study could lead to a reduction of 27% of total GHG emissions** against 2010 numbers.

The assessment, therefore, supports the GoK by shedding light on how stimulating investments in the forest sector can create economic benefits while also reducing pressures on remaining forests. This is particularly the case for dry forests, where 75% of charcoal is sourced and the risk of over-harvesting of non-renewable biomass is higher.

FORESTS: MORE THAN TIMBER

Forests are an important feature of Kenya's landscape, ranging from montane forests (also called 'water towers') in the mountainous areas, to western rainforests, dry forests, and coastal and riverine forests. Forests also have an understated importance to Kenya's economy. While the system of national accounts (SNA), a set of rules that determine a country's Gross Domestic Product (GDP), put the total annual contribution of forests at 1.1% of GDP in 2010, this is a gross underestimation (UNEP, 2012).

Aside from timber and other wood products, forests also provide a range of services that directly or indirectly support other key productive sectors such as energy (water regulation and soil retention for hydroelectric power generation), agriculture (enhancing soil quality, reducing soil erosion) and tourism. A report by the KFS, the Kenya Bureau of Statistics and international partners (UNEP, 2012) revealed that the economic contribution of forests is considerably undervalued. Instead of 1.1% of GDP, the contribution would rise to at least 3.6% of GDP if a broader range of ecosystem services provided by Kenya's montane forests were included. Even this is an underestimate, because this work did not include the other types of forest in the analysis.

There is, therefore, a clearer domestic economic rationale to reduce deforestation rates and increase efforts to rehabilitate degraded forest areas. **The underlying idea behind this study is to assess if efficiency improvements can address the supply deficiency, reduce subsequent pressure on forests and**

therefore be an interesting REDD+ policy or measure to pursue by the Government of Kenya in order to reduce or remove forest carbon emissions.

OPPORTUNITIES FOR EFFICIENCY IMPROVEMENTS

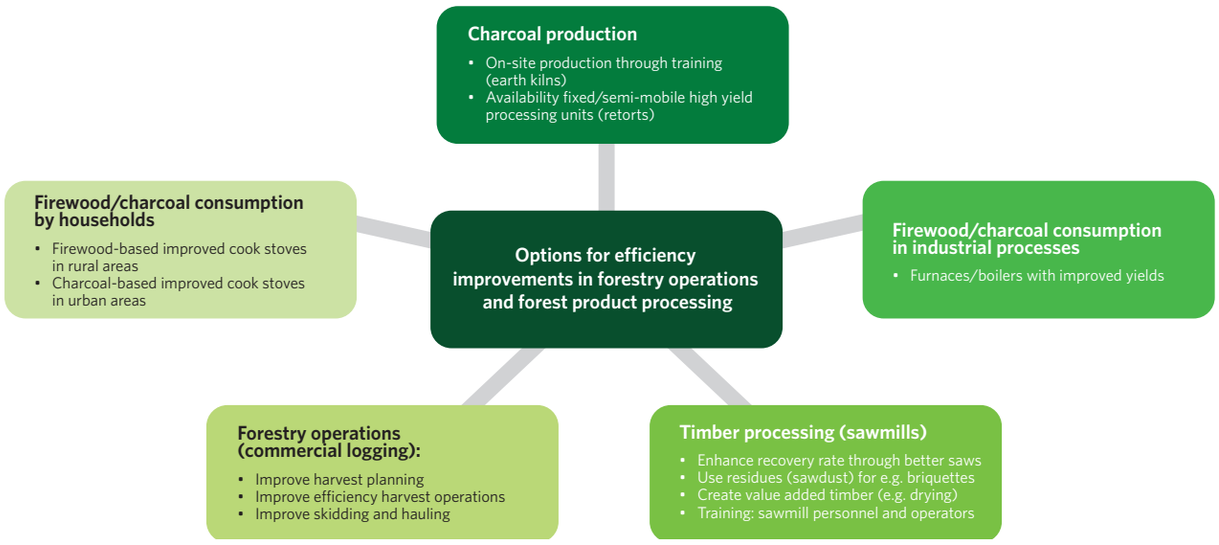
1. **Forestry operations (commercial logging).** There is great potential to improve the quality and quantity of plantation resources in Kenya, both in the public and private realms. In order to ensure adequate wood supply, improved management practices are needed to address the current poor performances of public plantations, while increased investments will be necessary to increase the stocked plantation areas. Improved sawn log quality from appropriately managed plantations is a precondition for investments in more efficient equipment in the timber processing sector to increase the timber processing average recovery rate. Afforestation and reforestation as well as improving plantation management by appropriate silvicultural practices such as thinning, pruning and extension of rotation age, can reduce forest carbon emissions from both public and private plantations. Improving harvesting techniques has the potential to cut logging waste from harvesting volumes by 5%. However, given that there is no evidence that increased rate of recovery from harvesting in forest plantations will decrease the pressure on natural forests for timber production, and given that the non-renewable biomass fraction (fNRB) in public and private plantations is close to zero, these measures are unlikely to generate emission reductions from deforestation and forest degradation. The efficiency measures to enhance forestry operations might have positive socio-economic impacts, though, such as increasing the safety of harvesting operations and harvested timber quality.

2. **Timber conversion (sawmills).** Greater efficiency in timber processing could increase national timber production by about 238,000 m^3 round wood equivalent (RWE) per year. To reach this goal, investments in sawing and drying technologies as well as in vocational training are required. The timber and wood industry is closely linked to the construction sector and the Government of Kenya's 2030 Vision places sawmills, as small and medium enterprises (SMEs), at the heart of the country's development plan. The sector has rebounded from the effects of a 1999-2011 countrywide ban on logging in public forests and developed steadily in recent years, with almost three times the volume of sawn wood produced compared to the level of 1999. However, for the same reasons described above, most of these measures are unlikely to generate emission reductions or removals from deforestation and forest degradation. Promoting the substitution of fuelwood from non-renewable forest sources with briquettes made of recycled sawn wood can lead to a small amount of biomass savings per year (36,000 m^3_{RWE}). Around 111,000 tCO_2e per year of emission reductions from deforestation and degradation are generated. It is reasonable to assume that improved timber production will increase safety and healthcare on working sites, create more value added and jobs in the wood supply chain and contribute to sustainable development of the country.

3. **Charcoal production.** The proposed measures range from basic improvements, such as the training of 100,000 charcoal producers to apply best practices to improve earth kilns, and the construction of 50,000 Casamance kilns (with metal chimneys, as promoted by the Kenya Forestry Research Institute (KEFRI) for several years), to technological substitution such as the use of retort kilns instead of traditional direct-combustion earth kilns. Increasing efficiency in charcoal production can reduce the pressure on forests: instead of using 10 kg of wood to produce 1 kg of charcoal, improved technologies can cut the use of wood down to 3 to 6 kg according to the technology used and best practices applied. Considering the high proportion of non-renewable biomass used to produce charcoal (between 90% and 95%), these measures could lead to 5.7 million m^3_{RWE} of non-renewable biomass savings per year from dry forests, generating about 16.5 million tCO_2e per year of emission reductions from deforestation and forest degradation. Moreover, charcoal production efficiency measures can generate other positive impacts such as the reduction of accidental burning and respiratory problems amongst charcoal producers. These measures can also generate more qualified jobs in the sector. Therefore, improving charcoal production could be an attractive measure for the Kenyan government as part of its National REDD+ Strategy and implementation plan.

4. **Use of charcoal and firewood in cooking stove technology.** The proposed measures target the large-scale adoption of 5 million improved cook stoves in urban and rural areas to replace the current inefficient cooking devices and reduce the demand for fuelwood (firewood and charcoal). Increasing efficiency in the consumption of fuelwood, mainly sourced from natural forests where high levels of non-renewable biomass are estimated, could lead to 960,100 m^3_{RWE} of non-renewable biomass savings per year from natural

FIGURE 1: Investment opportunities to enhance efficiency in the forest sector



forests, generating about 2.4 million tCO_2e per year in terms of emission reductions from deforestation and forest degradation. Moreover, these measures will generate positive impacts such as the reduction of respiratory problems among fuelwood consumers, especially women and children, and can create additional jobs in the cook stove manufacturing sector. These measures are therefore potentially attractive for the Kenyan government as part of its National REDD+ Strategy, generating both emission reductions from deforestation and degradation and positive co-benefits.

5. **Increasing efficiency in wood usage in industrial processes** may represent nearly 1.2 million m^3_{RWE} of non-renewable biomass savings per year, generating more than 2.0 million tCO_2e per year in terms of emission reductions from deforestation and forest degradation. However, more data on fuelwood origin by sector (tea, tobacco, restaurants and kiosks, etc.) is necessary to refine this conclusion. It is yet not clear whether a significant amount of non-renewable biomass from natural forests is used in these industrial processes, or if they rely only on renewable biomass harvested in forest plantations. In the latter case, the potential emission reductions from deforestation and degradation would be much less.

An overview of investment opportunities in the forest product and processing sector is shown in Figure 1.

CONCLUSION

Kenya submitted its INDC to the UNFCCC in July 2015. In the INDC, Kenya pledges to cut its carbon emissions to 30% below business-as-usual (BAU) levels by 2030. The Kenyan government has indicated that, to meet this ambitious target, a number of measures will be required including expanding solar, wind and geothermal power, and bringing national forest cover up to 10% while reducing reliance on wood fuel. The analysis carried out in this project is therefore very relevant in the context of Kenya's INDC, but also to its National Climate Change Response Strategy (2010) and National Climate Change Action Plan (2013).

Table 1 provides an overview of the costs (in terms of annual investment) and benefits (in terms of potential biomass savings and carbon benefits) of efficiency improvements in the five forestry sub-sectors that were analysed given a certain amount of upfront investment. However, only efficiency improvements in charcoal production and fuelwood consumption at household and industrial levels are expected to generate REDD+ results.

These results are relevant as they show that investments in efficiency measures in charcoal production as well as fuelwood consumption at household and industrial levels are: i) viable REDD+ policies to reduce or eliminate net carbon emissions; and ii) could significantly contribute to Kenya's

TABLE 1: Summary cost-efficiency analysis

	Potential biomass savings (m^3_{RWE} per year)	Emission reductions from deforestation and degradation (tCO_2e per year)	Investment* ($/year)
Forestry operations (harvesting)	10,000	n/a	375,000
Timber processing (including briquette production)	238,000	110,838	1,340,000
Charcoal production	5,658,810	16,476,000	15,642,000
Fuelwood consumption at household level	960,100	2,386,000	10,000,000
Fuelwood consumption at industrial level	1,191,000	2,040,000	11,430,000
Total	**8,057,910**	**21,012,838**	**38,787,000**

* For details see Tables 6, 8, 13 and 18.

GHG emission reduction targets; iii) can be cost efficient. In terms of abatement costs, these range from 0.95 $/$tCO_2$-e for efficiency improvements in charcoal production, 4.2-5.6 $/$tCO_2$-e for fuelwood consumption at household and industrial level, to 12.1 $/$tCO_2$-e for efficiency improvement to process timber.

Based on Kenya's 2010 GHG emission level of 73 million tCO_2e per year as stated in the INDC, reducing emissions by 21 million tCO_2e per year, as identified in this report, would go a long way to meeting Kenya's climate goals. Given that the policy options identified in this study are viable from a REDD+ perspective, they offer preliminary reflections that may be strategically relevant to the design of Kenya's National REDD+ Strategy and future REDD+ investment plan.

However, estimated investments needed to increase efficiency and reduce or remove carbon emissions are significant at about $38 million per annum. There is an opportunity for the GoK to identify how to incentivize the private forestry sector to (co-)finance improvements in the way charcoal and fuelwood is used for energy provisioning i.e. what financial (and other economic) incentives need to be provided in order to stimulate private actors to finance such efficiency improvements?

From a regulatory perspective, it is important to understand that productivity improvements could have the unintended consequence of actually enhancing pressures on forests as efficiency improvements can lead to higher incomes, which can perversely incentivize additional encroachment on forests. It is therefore important to identify how financial incentives to stimulate efficiency improvements can be made conditional on private users adhering to relevant social and environmental criteria so that such stimulus measures actually lead to emission reductions or removals.

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