Renewable Energy Options and Reducing Emissions from Deforestation and Forest Degradation (REDD+) Using Geoinfo - Mozambique Case Study

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General information

- **Area**   ~ 801 590 Sq km;

- **Population** ~ 27.216.000 (2017 census projection);

- **Economy** – Agro-based (cashew nuts, cotton);
    - **Resources**: Water, Wood Products, Shrimps, Natural Gas, Coal, Hydro-energy;

- **Tropical climate** with two seasons:
    - wet season from October to March, and
    - dry season from April to September;

- **Institution responsible for Forest:** National Directorate of Forestry
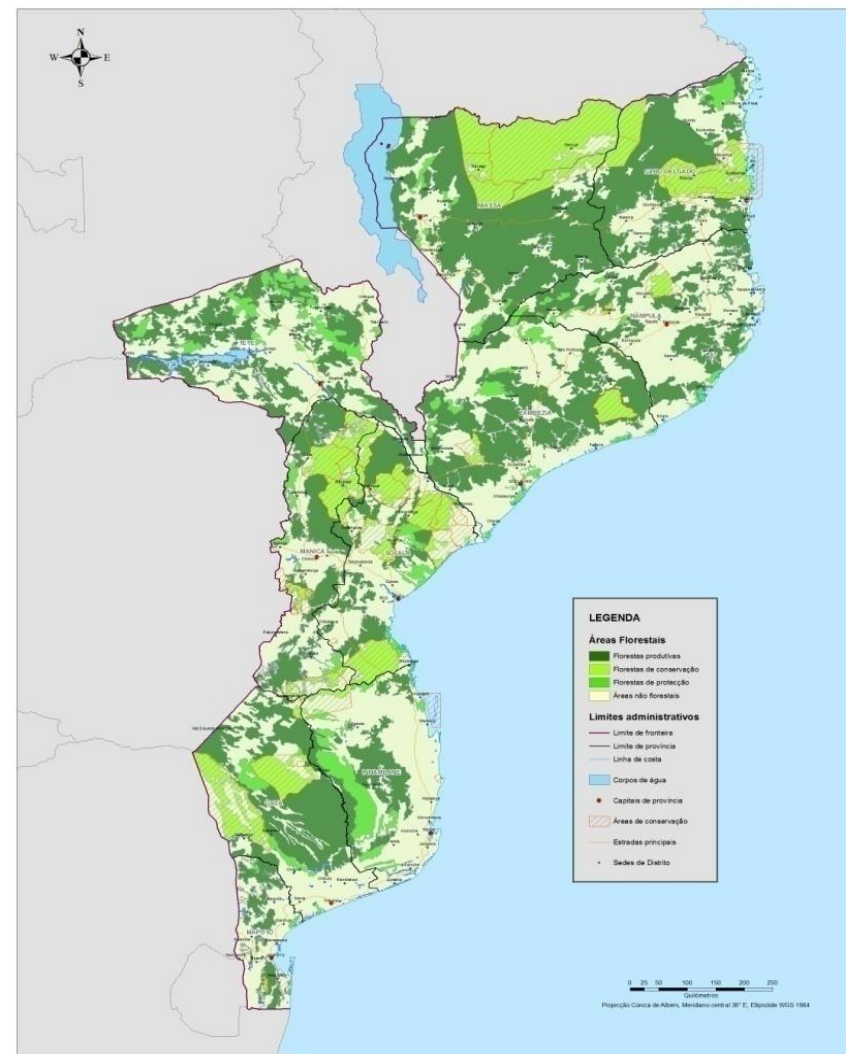   under Ministry Land, Environment and Rural Development.

COBERTURA FLORESTAL

Forest resources

- **Forest cover and other woodland:** 54.8 millions ha (70% of the country)

- **Forest cover**: 40.1 million ha;

- **Potential area of timber production:** 26.9 millions ha;

- **Deforestation rate:** 0.58%/year (219.000 ha per year), (AIFM2007);

Scope of the study

Objective:

- The objective of the case study is to analyse alternative, sustainable and renewable energy development options for Mozambique **alternative** to the major use of wood based energy in both <u>urban</u> and <u>rural areas</u> which cause significant GHG emissions by deforestation and forest degradation;

Expected Results:

- Potential REDD+ effect by introduction of alternatives energy to firewood and charcoal demand;
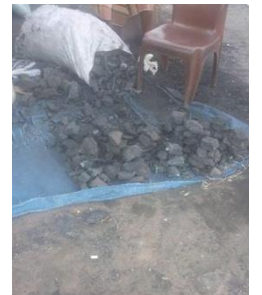
What is REDD+

- **Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries** (**REDD+**);

- 2005 :Started Negotiation under UNFCCC;

- 2015 : Paris agreement Article 5 and 17 UNFCCC COP decisions on methodologies;

- Countries incorporate REDD+ in NDC, for Results based Payments (GCF and others);

- Countries must submit the information on the FREL/FRL, Safeguards (social and environmental), Forest Monitoring;

Methodological approach

- The analysis of steps initially developed as the Woodfuel Integrated

- Supply/Demand Overview Mapping (2013);

- Calculations and results.
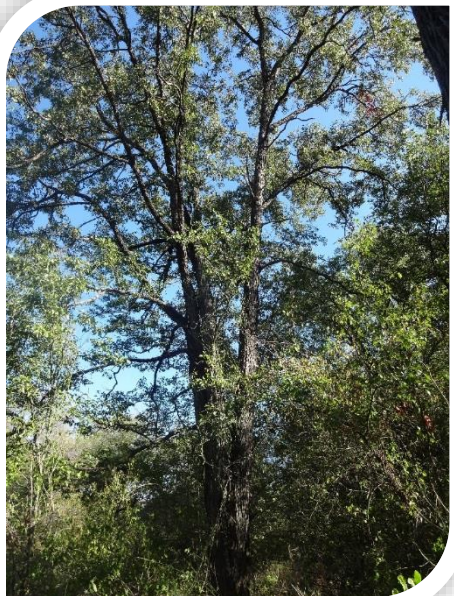
Wood Energy is one of the Largest Drivers of Deforestation

- Introduction of RE can be a potential REDD+ activity;

- However, it is not known much how to find RE as REDD+ option;

Wood demand

1. Estimation of per-capita consumption in rural and urban areas;

2. Analysis of demographic projection & estimation of 2013 situation;

3. Creation of population distribution density and accessibility maps;

4. Creation of woody biomass consumption map from the energy demand;

Analysis of Wood Energy Demand

Demand

- **Estimation of per-capita consumption in rural and urban areas based in projection of population of 2013;**

- **Convert the consumption value in Tons and PJ;**

- **Evaluation of the demand per province, and the rate to deforestation where available;**

Annual Demand of Wood Energy (2013)

Province	Demand (PJ)
Niassa	17.85
C. Delgado	21.62
Nampula	56.83
Zambézia	53.98
Tete	27.47
Manica	20.71
Sofala	22.16
Inhambane	16.54
Gaza	15.94
Maputo	0.00

Total: 284.61 PJ/Year

Legend
Fuelwood Demand (Peta Jouls)
Low
mod-Low
Medium
mod-High
High

NIASSA 17.85
CABO DELGADO 21.62
NAMPULA 56.83
ZAMBEZIA 53.98
TETE 27.47
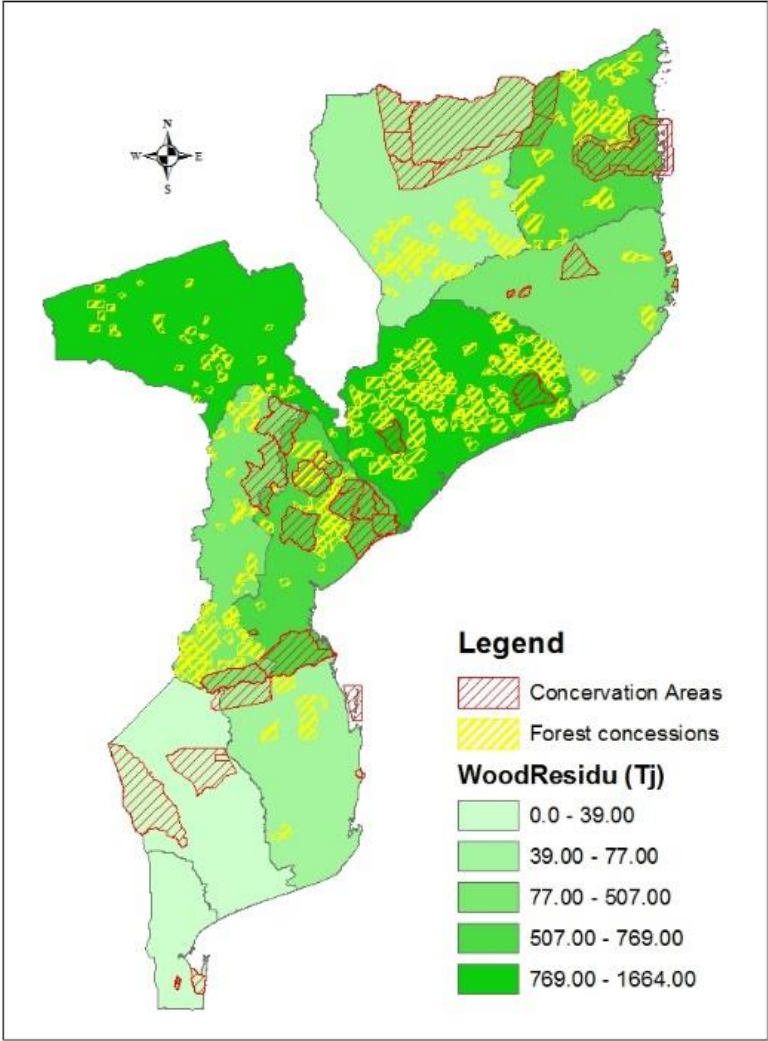MANICA 20.71
SOFALA 22.16
INHAMBANE 16.54
GAZA 15.94
MAPUTO 31.5
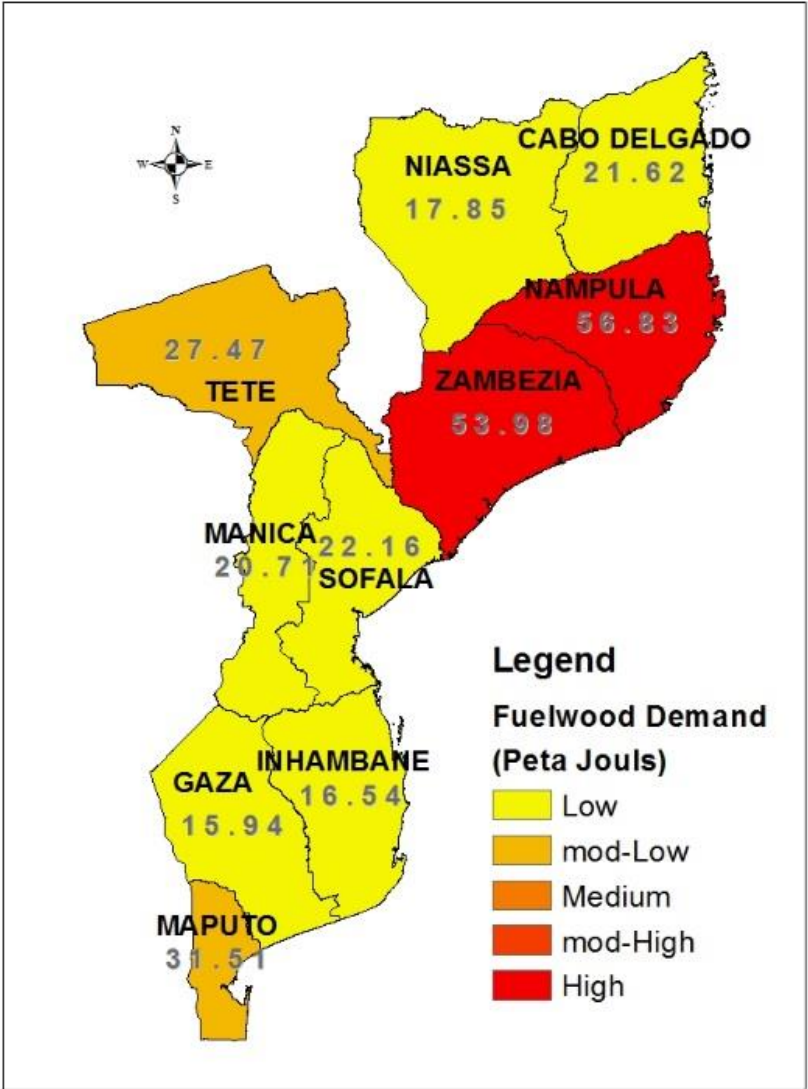
Wood Residue

Province	Wood Residue (TJ)
Niassa	53
C. Delgado	694
Nampula	269
Zambézia	1664
Tete	1267
Manica	507
Sofala	769
Inhambane	77
Gaza	39
Maputo	0

Legend

Concervation Areas

Forest concessions

WoodResidu (Tj)

0.0 - 39.00

39.00 - 77.00

77.00 - 507.00

507.00 - 769.00

769.00 - 1664.00

Supply of Wood Harvest and Processing Residues Potential

Province	Wood Residue (TJ)
Niassa	53
C. Delgado	694
Nampula	269
Zambézia	1664
Tete	1267
Manica	507
Sofala	769
Inhambane	77
Gaza	39
Maputo	0

Total:
5.34
PJ/Year

NIASSA1

CABO DELGADO 12.99

TETE 23.73

NAMPULA 5.04

ZAMBEZIA 31.16

SOFALA 14.39

MANICA 9.5

INHAMBANE 1.45

GAZA 0.73

0 MAPUTO

Legend
Supply of Wood Residue
(Mega jouls)
Low
mod-Low
Medium
mod-High
High
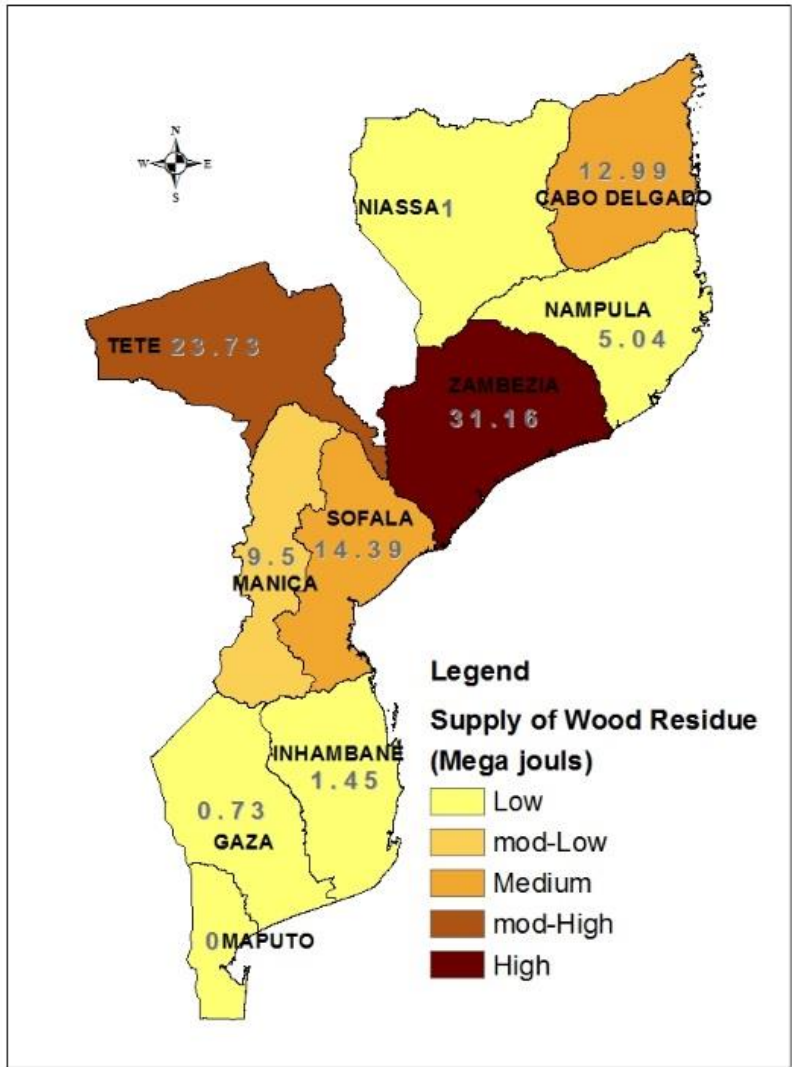
Potential supply based on currently available RE

- Bioenergy potential (190PJ) = Residues from Agriculture (191PJ) + Residues from Forestry (5PJ) – Biomass Needs for Animal Feed (7PJ)

(IRENA Africa 5 analysis based on FAO Stat, 2010)

(condition for analysis)
- 25% of agro-harvest residue
- 90% of potential processing residue
- 30% of wood-harvest residue

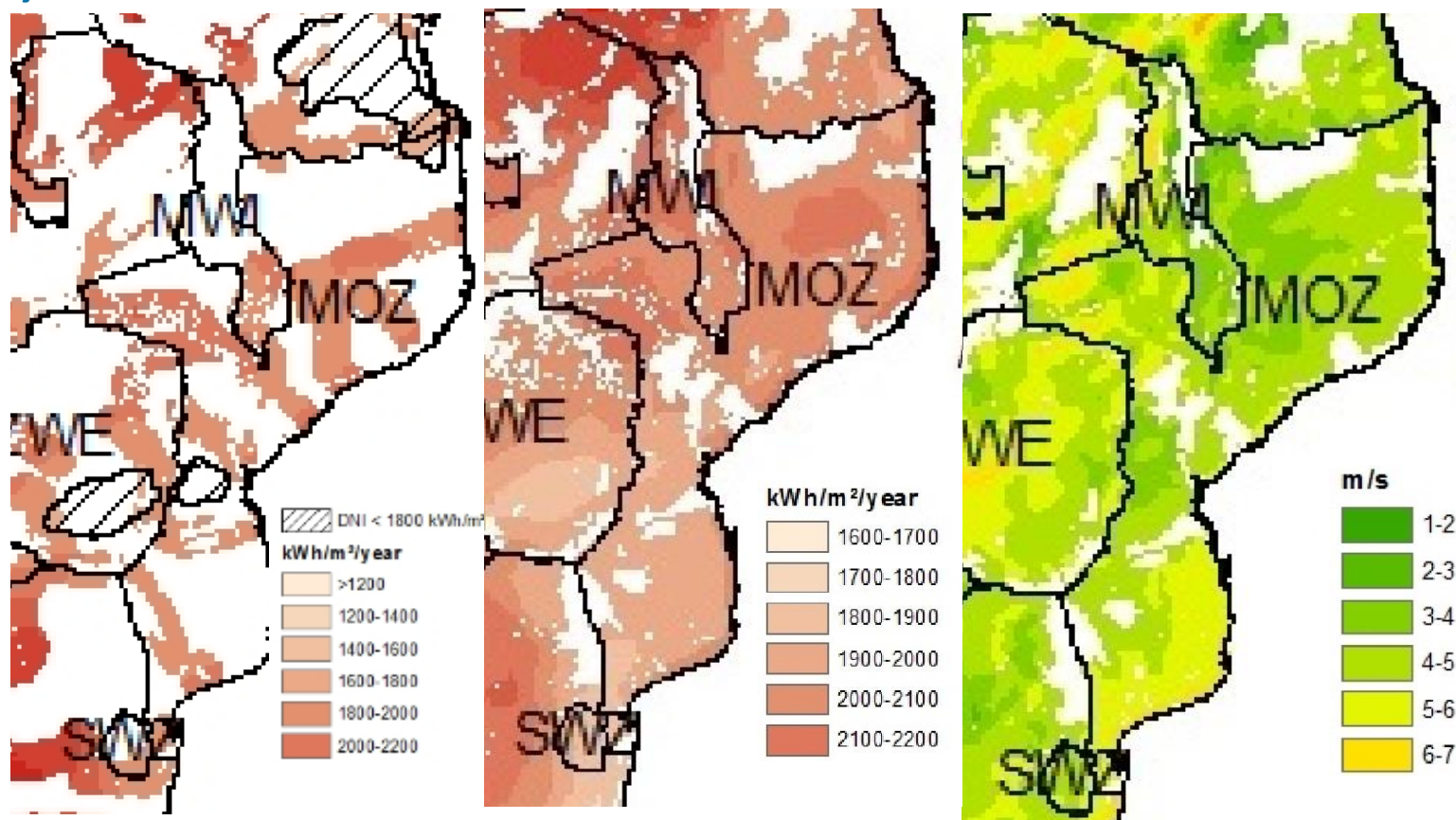# Alternative Energy – Solar CSP, Solar PV and Wind Potential

Solar CSP	Solar PV	Wind
TWh	TWh	TWh
9123	21846	19252
PJ	PJ	PJ
32842	78644	69307

- Exclude river basin, protected areas(all RETS)
- Exclude slope > than 21 % - **CSP**
- Exclude slope > than 45 % - **PV**
- Exclude agriculture area for Solars;
- Exclude forested area;

                    (IRENA analysis)

Agriculture & pasture land – future food security and ecosystem based needs?

Potential from Hydropower Expansion Plan

- Hydropower production total: 43.20 PJ
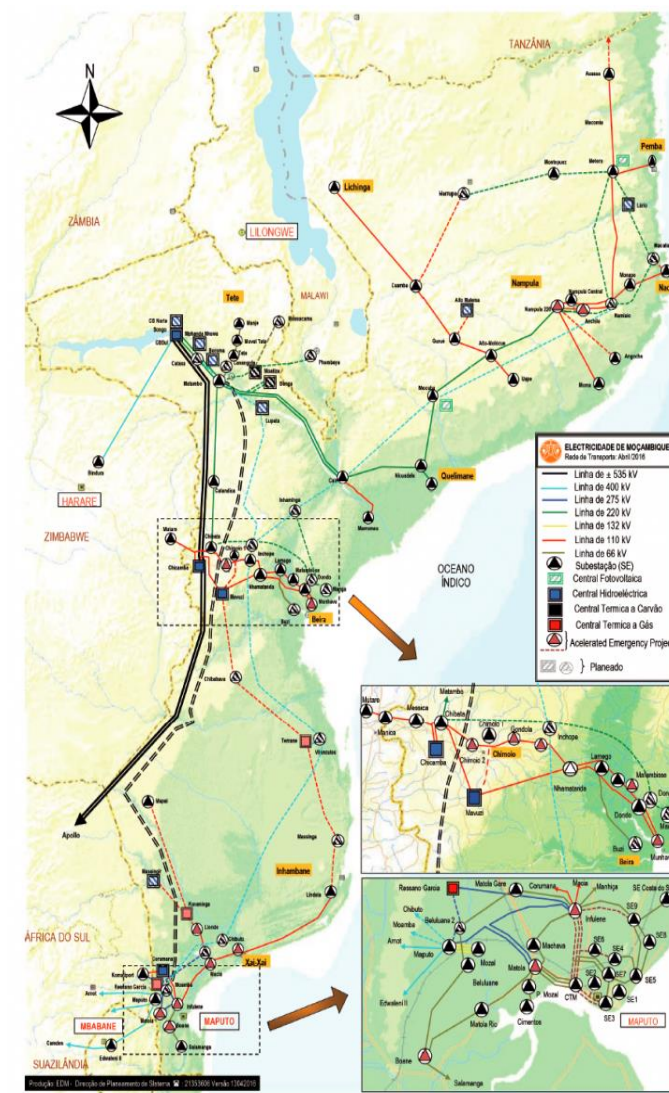
Current domestic supply: 12.17PJ

export: 31.03 PJ

(Cahora Bassa dam 2013)

On going expansion
2500 MW to 12000 MW
(4.8 holds)

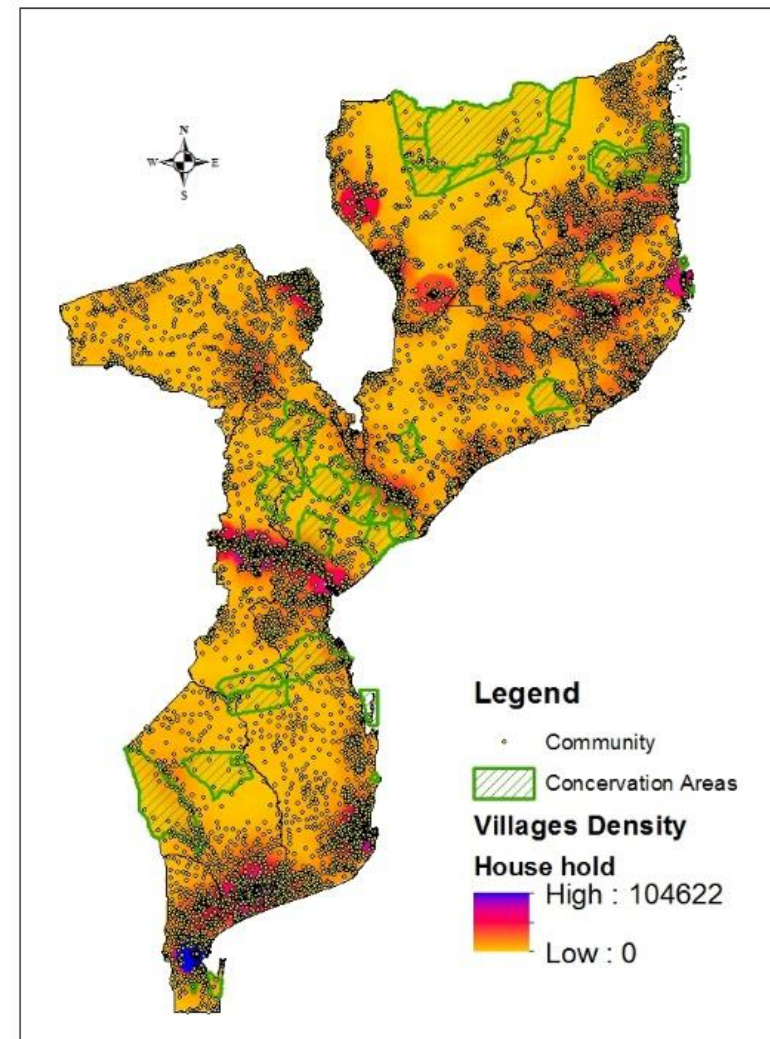- Future Hydropower potential: 207.36 PJ / year

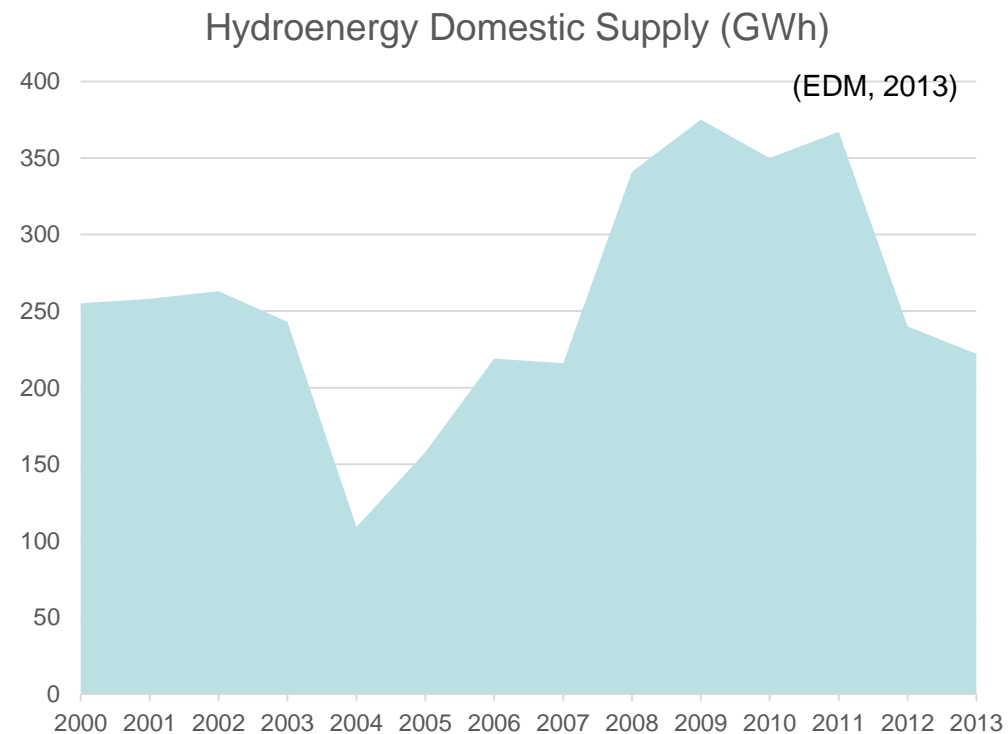# People are Using All Land Except for Protected Areas

Physical accessibility
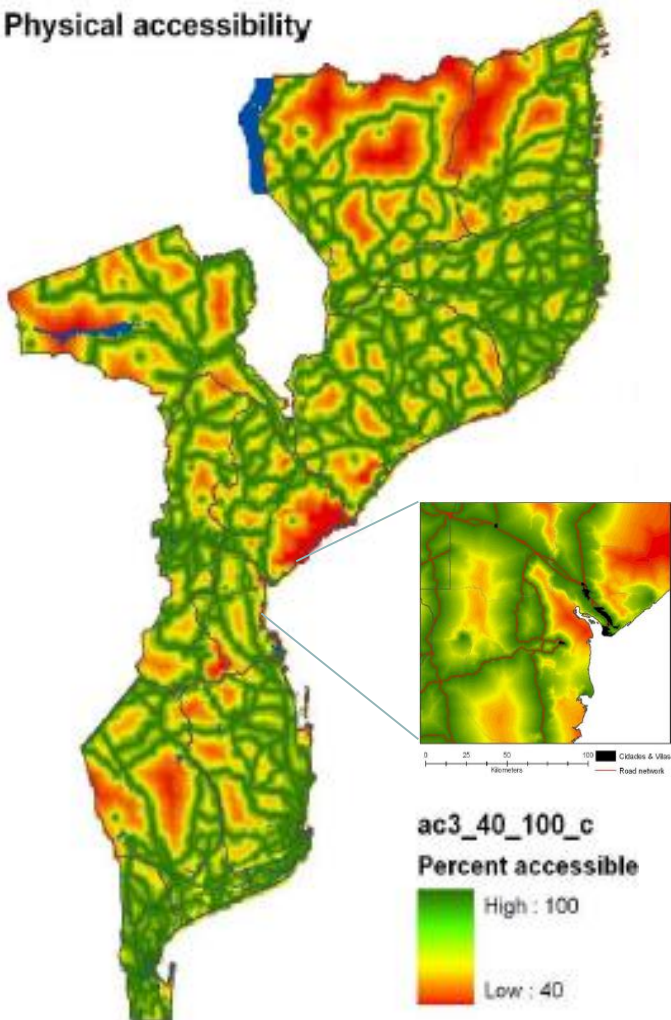
- Shifting Cultivation and Livestock Grazing;
- Biomass is precious resource for sustainable yield;
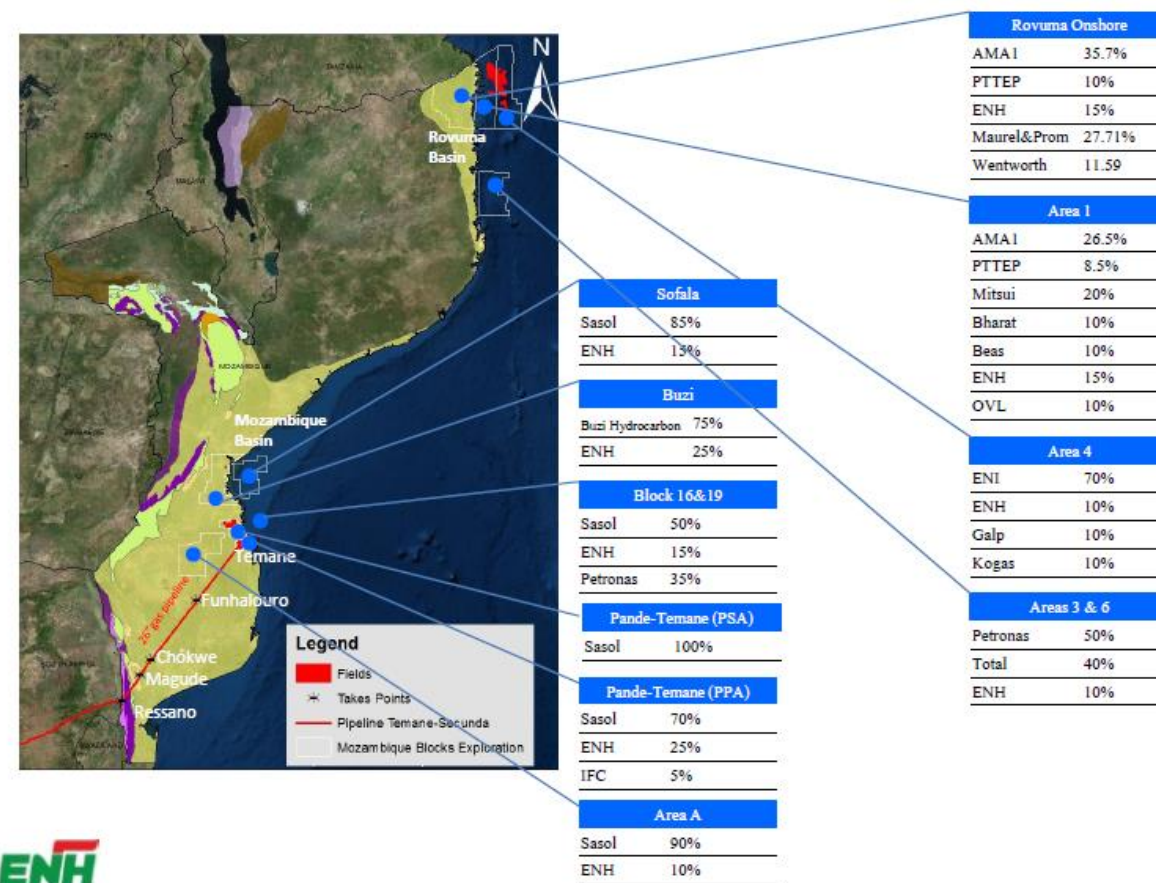- Frequent flood and drought;

ac3_40_100_c
Percent accessible
High : 100
Low : 40

Legend
· Community
Concervation Areas
Villages Density
House hold
High : 104622
Low : 0

Fluctuation of Hydroenergy supply

Hydroenergy Domestic Supply (GWh)
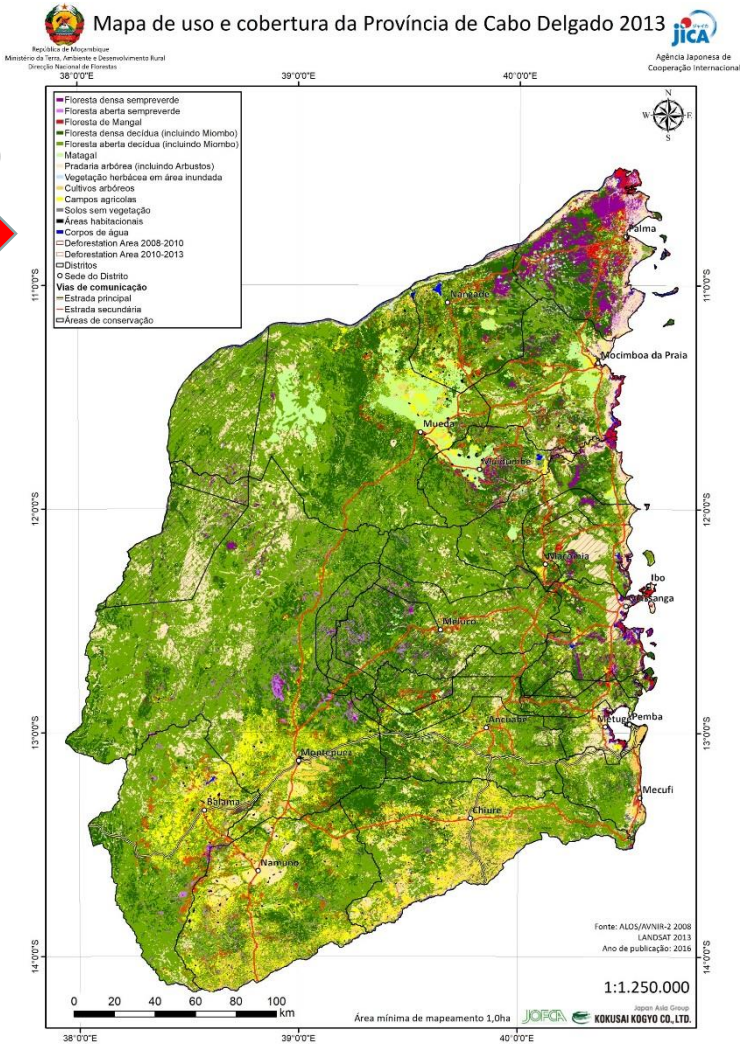
(EDM, 2013)

Potential from Natural Gas Exploitation

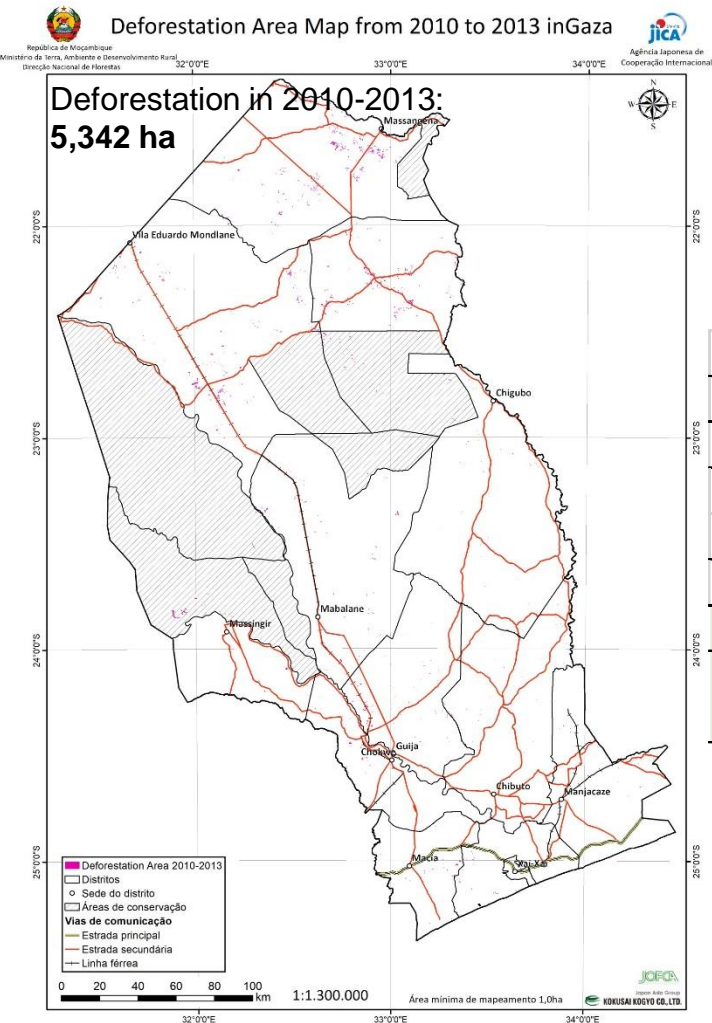- 5,507 billion m3 in Inhambane and Rovuma deposit (Number one in Africa)
- 410 PJ

Aug 2014

Land Cover Map of Cabo Delgado and Gaza Provinces
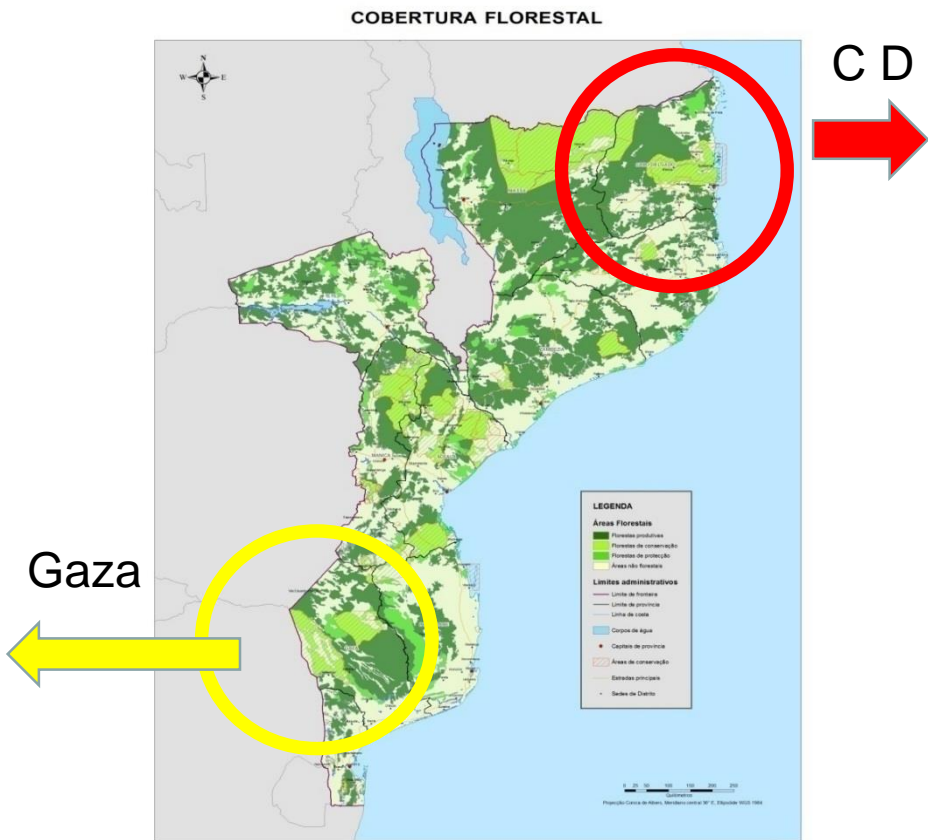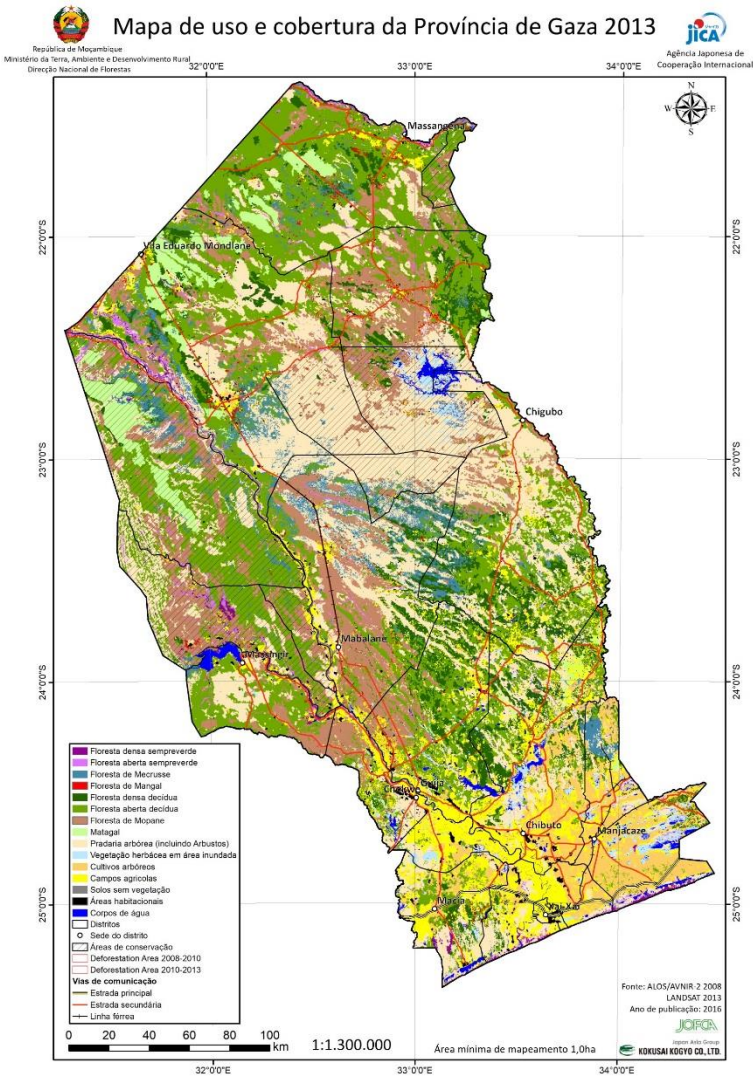
Analysis of the REDD+ Effect by Alternative Energy Deployment

Deforestation Area Map from 2010 to 2013 inGaza

Deforestation in 2010-2013:
5,342 ha

Deforestation Area Map from 2010 to 2013 in Cabo Delgado

Deforestation in 2010-2013:
35,453 ha

If current energy demand is fulfilled by natural gas, how much REDD+ effects is expected on emission from the LUC.

GHG Emission Petential If Wood Fuel is Replaced by Natural Gas				
	PJ	**GJ**	**KgCO2**	**CO2ton**
Total	284.61	284,610,000	16,507,380,000	16,507,380
Cabo Del.	21.62	21,624,232	1,254,205,436	1,254,205
Gaza	15.94	15,937,177	924,356,295	924,356
GHG Emission from Deforestation (DINAF-JICA, 2017)				
2010-2013				**CO2ton**
Cabo Del.				1,485,013
Gaza				594,232

Natural Gas
GHG emission: 58 CO2ton/KG
(U Berkley)
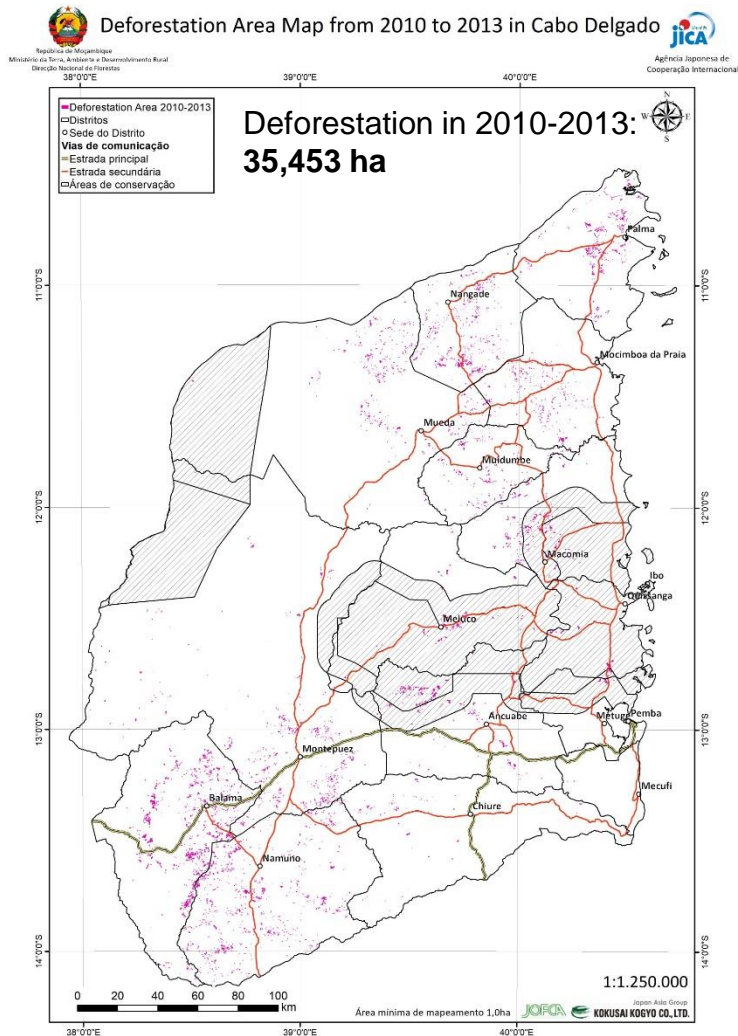
Additional alternative vs current scenarios of fuelwood trade

Low-income population

- Majority of household in urban areas can not bye one bag of charcoal at a time (1200 Mt = **19.55 USD**);

- Small amount of charcoal to supply cooking energy for almost one or two days (0.33 USD; **0.81USD**);
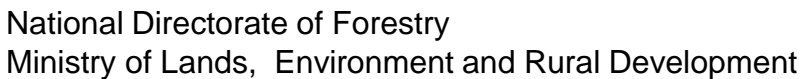

61.38 Mt	1 USD
20 Mt	0.325839
50 Mt	0.814598
500Mt	8.145976
1200 Mt	19.55034

Program of energy for cooking in urban areas :

- Need of <u>development and implement massively program </u> of **smaller Gas cylinder (3 kg**) and **one-burner stove** to assist population in suburban areas taking into account their economical capability (e.g. initial loan).

- One full smaller cylinder of **3 kg** of LP Gas purchased can be used per household within **10.6 days** (3kg=2.7 USD).

- **(11Kg LPG=8.7 USD)**

This kind of program need to be implemented as package (subsidized cylinder and one-burner stove)

Conclusion

	Charcoal demand				
	284 PJ/year				
	Bioenergy	Solar CSP	Solar PV	Wind	Hydro total production in 2012
		TWh	TWh	TWh	TWh
		9,122.73	21,845.57	19,252.00	12.00
	PJ	PJ	PJ	PJ	PJ
	191	32,841.83	78,644.04	69,307.20	43.20
	Agroresidue (25% hervest, 90% production) + Wood residue (30% harvest) - Animal Feed				
Limiting factors	Development of processing industry is a key	Land demand	Land demand	Weather	Precipitation
	REDD+ effect				
	Combination of various RE while meets the social and environmental safeguard on land use is the key				

Thank You