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Quantis

Coordinated Advocacy for biomass friendly governance of the energy sector in Tanzania

Potentials, limitations & impacts of Biomass Energy in Tanzania

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General Goals of the Study

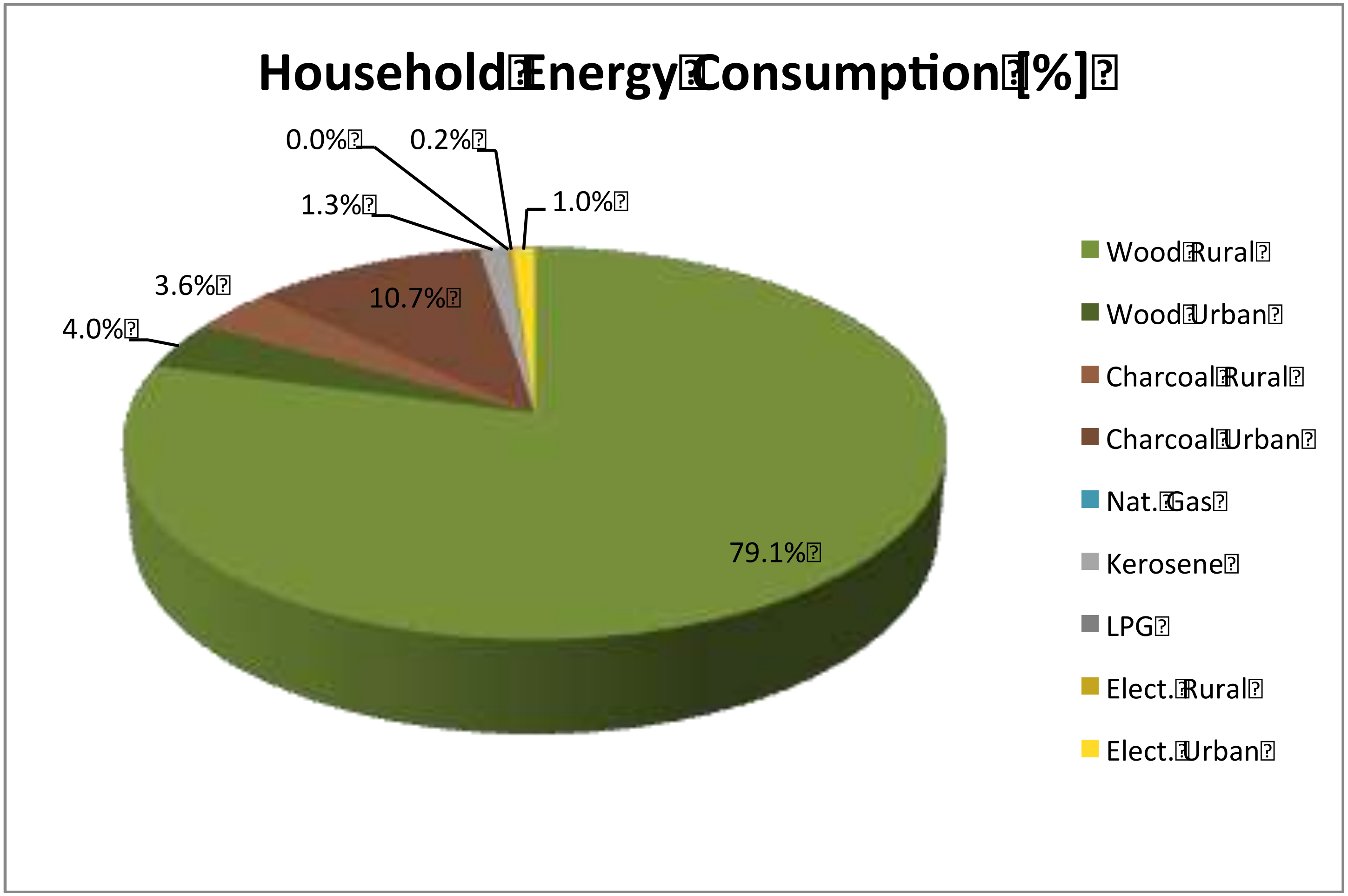
- Identify potentials and systemic constraints to a rational, sustainable and productive biomass energy industry in Tanzania.
- Focus on the five most important biomass energy sources in Tanzania: charcoal, firewood, liquid biofuels, farm residues and biogas

Project steps

1. Demand Assessment
2. Supply Assessment
3. Analyse the GHG Mitigation potential
4. Assess the Local Sustainability

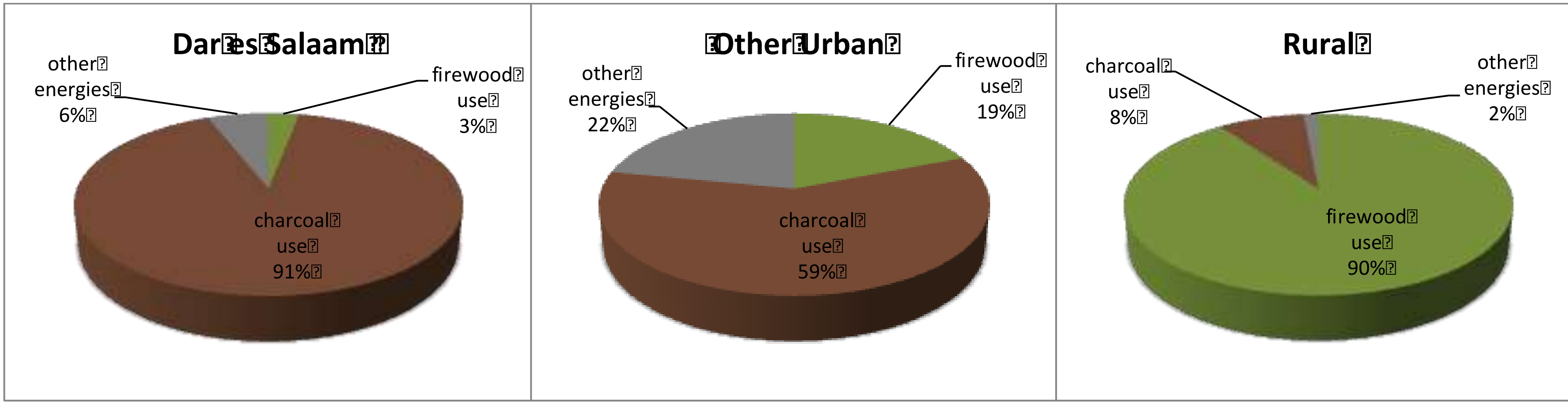

Demand Assessment

Current energy demand in TZ



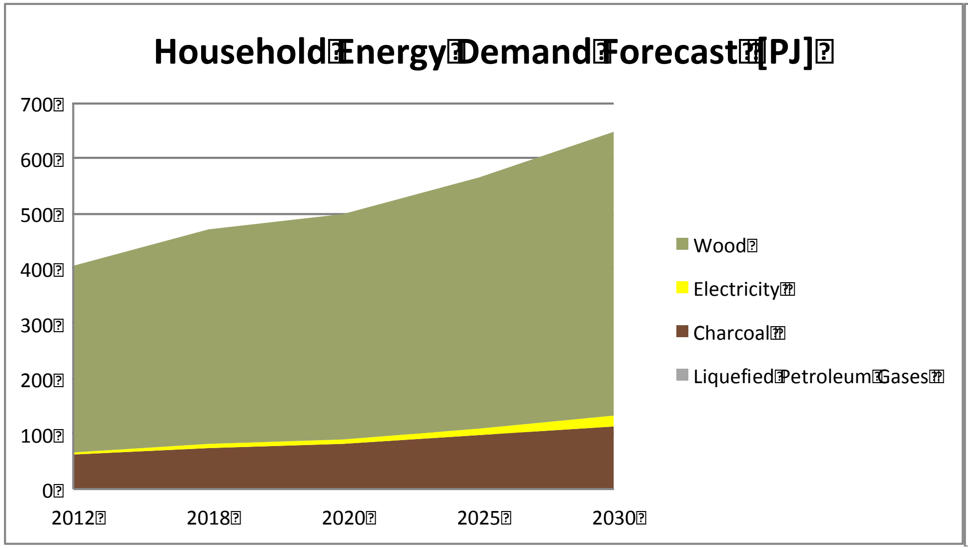
Current household energy consumption by fuel type for 2012 in Tanzania. All numbers in % of total household energy consumption

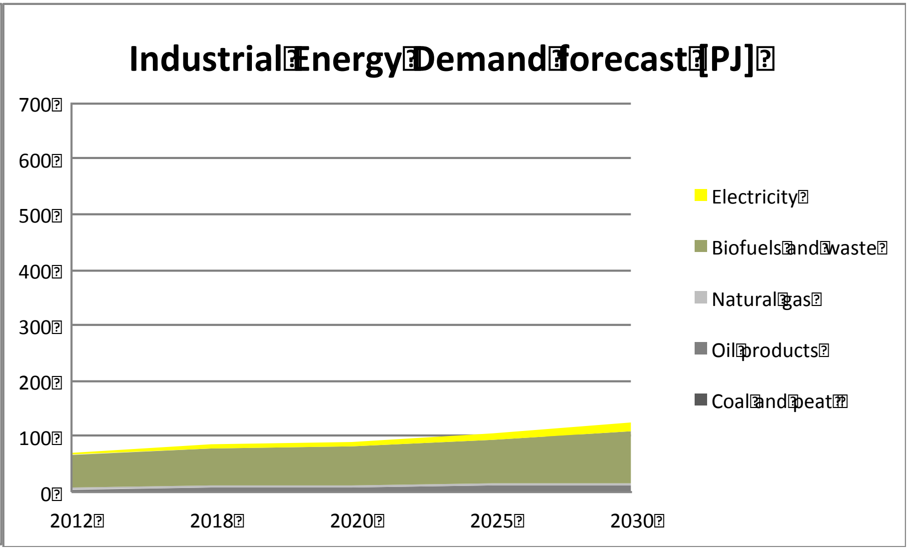
Urban-rural differences



→ charcoal is used in large cities, while firewood is dominating in rural areas and smaller cities where it is locally available

Future trend in Energy Demand





- Due to population growth and expected economic development, the demand for energy will grow in Tanzania over the next 20 years
- Nevertheless, the contribution of the different energy sources will not change significantly
- The demand for biomass-based energy will therefore further increase in the future, for both households and industry


Supply Assessment

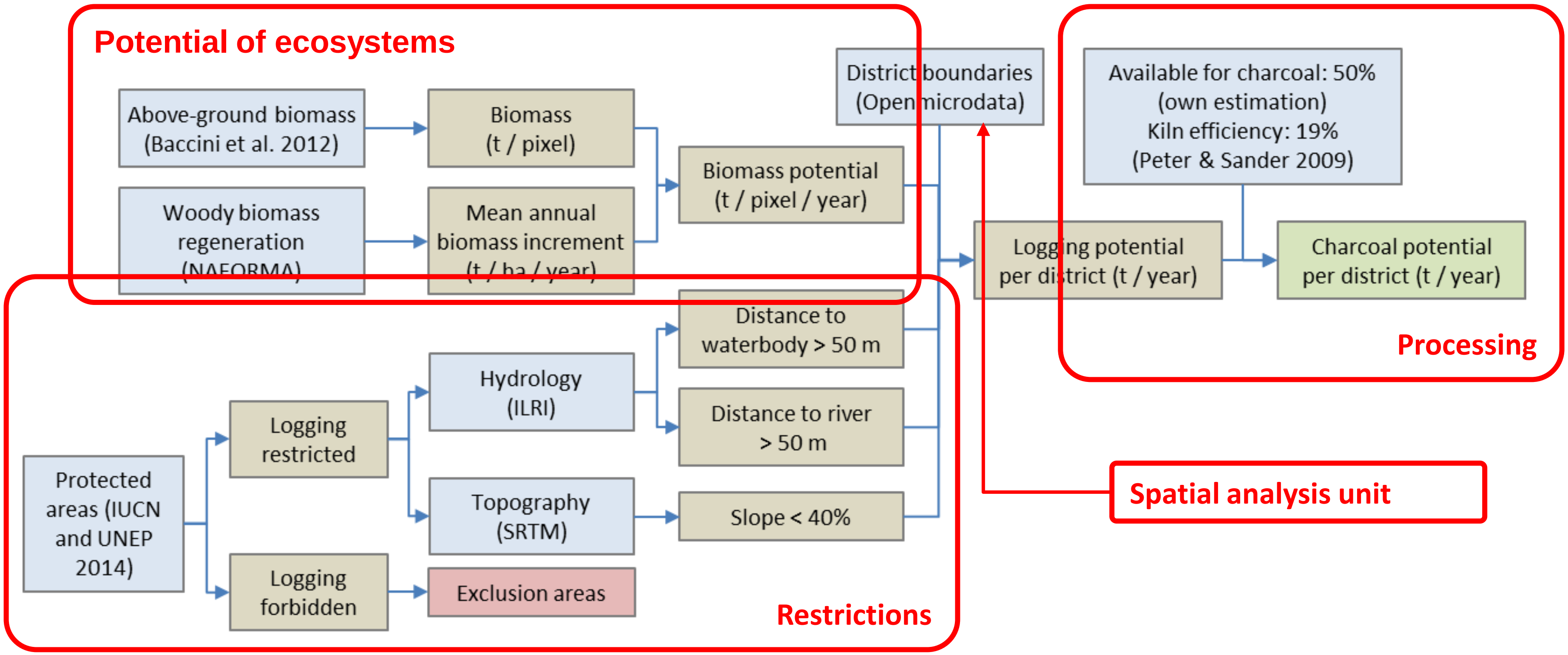
Objectives

1. To design logical models for the processing chains of charcoal, firewood, selected crop residues, selected liquid biofuels and biogas; these models have to take into consideration sustainable resource availability, resource use restrictions and resource to fuel conversion losses.

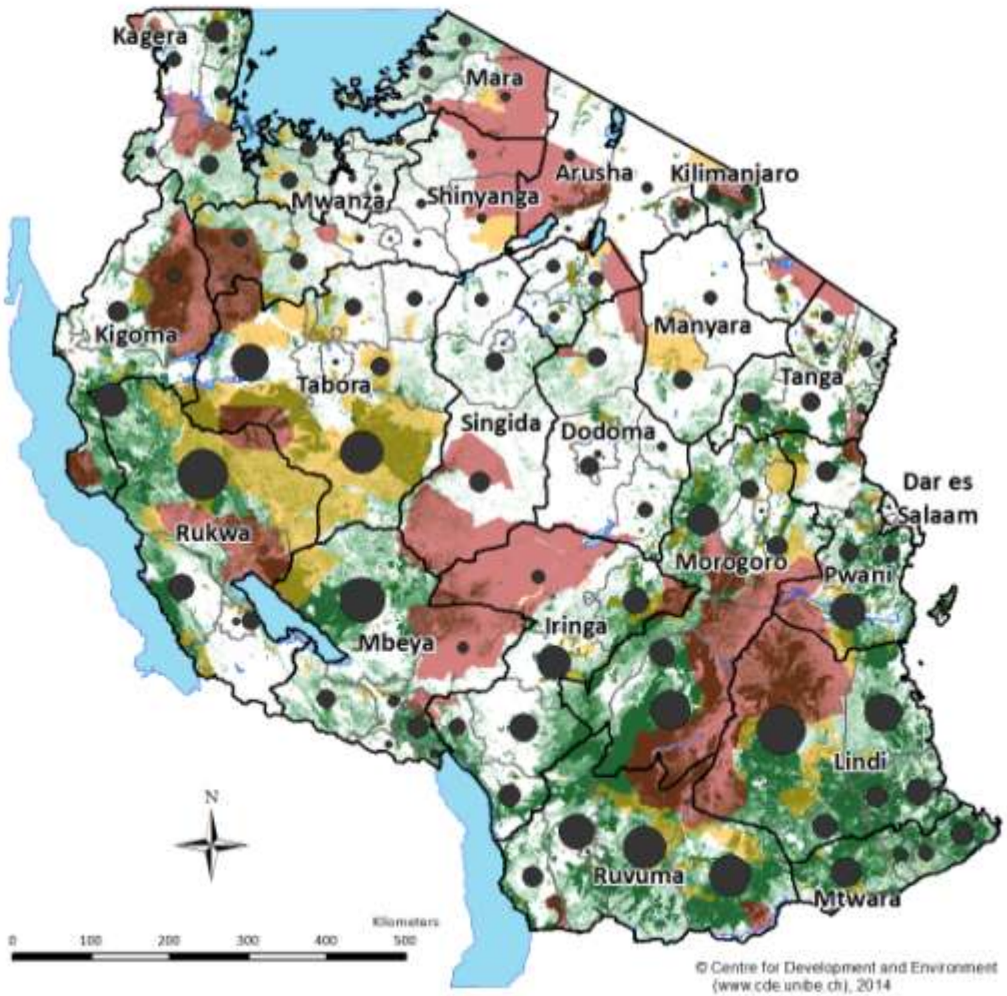
2. To make a quantitative and spatially disaggregated assessment of the production potential of these five biomass-based energy carriers and to present this assessment in maps and tables.

3. To derive relevant observations and conclusions from the modelling results and to present the same in the frame of a final technical report.

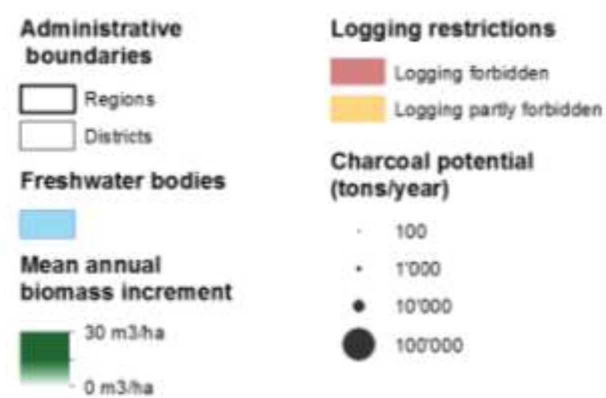
Example of Model: Charcoal



Sustainable Charcoal Production Potential



- 50% of mean annual biomass increment
- ~ 4‘400‘000 tons of charcoal
- ~ 120‘000 TJ
- Limited potential in the North
- In some areas: High biomass regeneration, but important logging restrictions

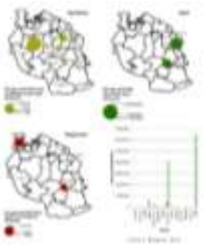


3 Spatial patterns

- **North south pattern**
  - High potential for non-woody biomass energy (biogas and *Jatropha* oil) in the North
  - South rather suitable for the production of firewood and charcoal

> **Peri-urban pattern**
  - Strong concentration of improved cattle production in the surrounding of some major towns indicating that biogas from improved cattle could help satisfying energy demands in the peri-urban areas of these towns, either at household level or for enterprises

> **Regional concentration**
  - Potential for the production of energy from sisal pulp, sugarcane bagasse and sunflower seed hulls is concentrated in 4 regions (Kagera, Tabora, Morogoro, Tanga).



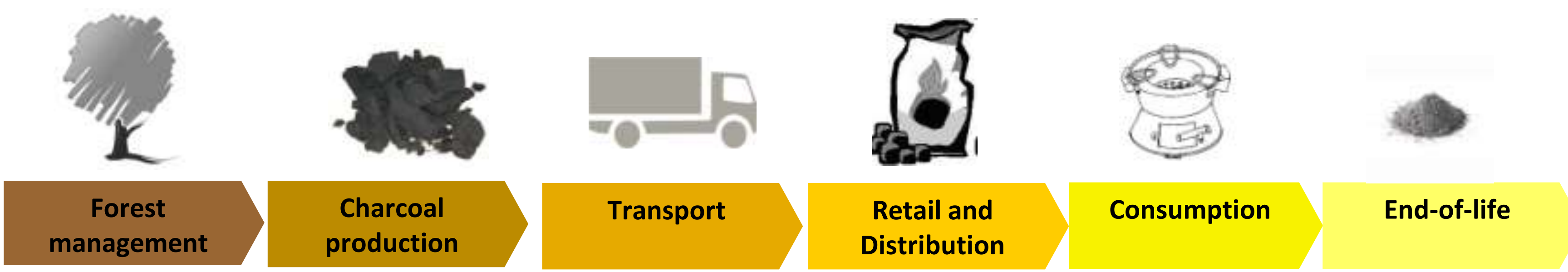
Conclusion

- **More attention to non-woody biomass energy carriers**
- **Contextualized approach needed**
  - Geographical
  - Large scale vs. small-holder

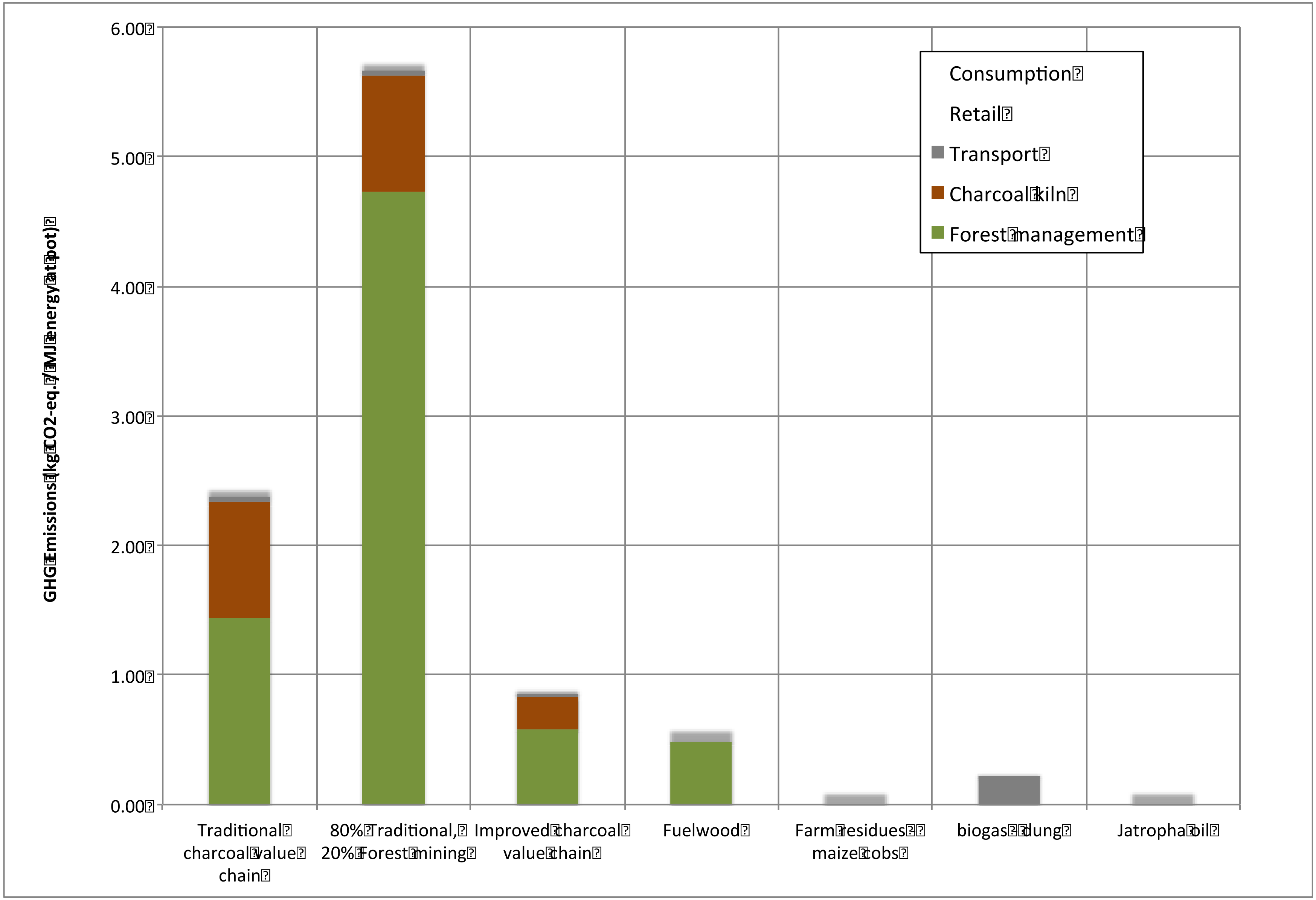
Greenhouse Gas Mitigation Potential

Methods

- The method is based on the LCA report on charcoal value chains (Gmünder & Zah, 2014)
- Functional unit is the final demand for energy in Tanzania
- All impacts along the full value chain are included
- All relevant greenhouse gases are included: CO_2, CH_4, N_2O
- Carbon stock change due to land use impacts (e.g., transformation from forests to agrcultural area) is included
- Above ground biomass, below ground biomass and dissolved carbon is considered

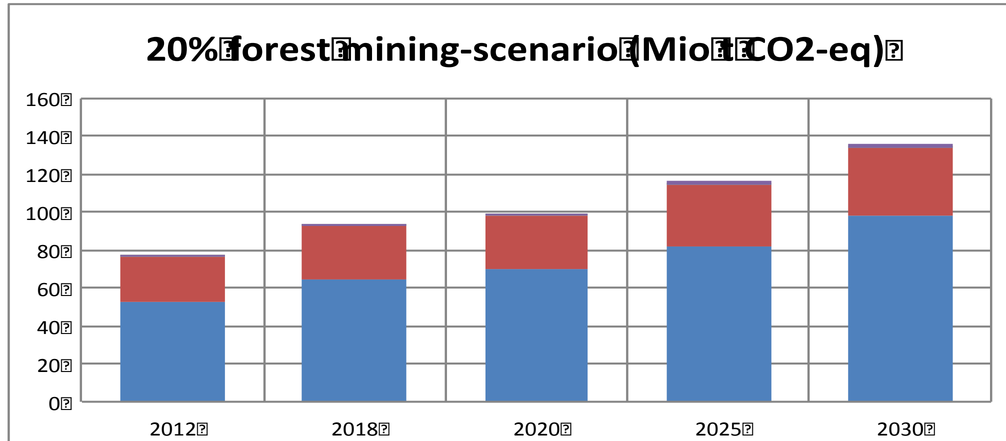


GHG results for different bioenergy value chains

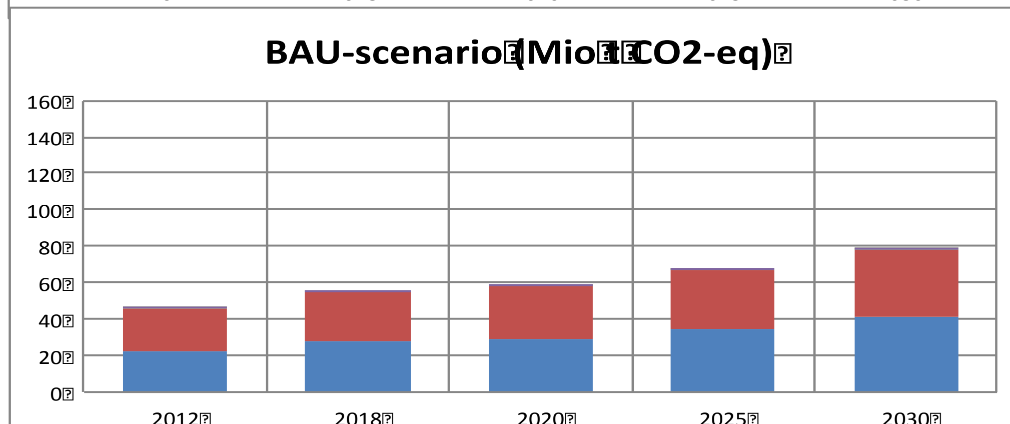


What does this mean for the future development?

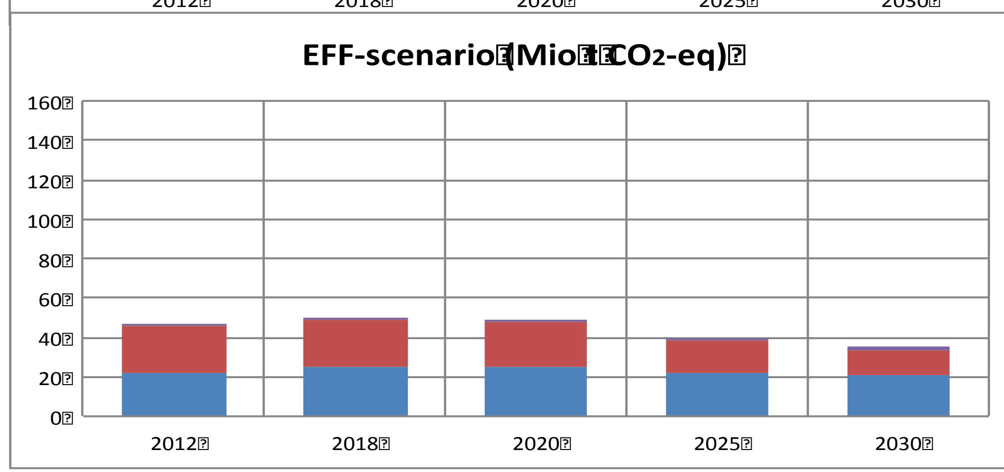
- When mining of forests for charcoal continues: massive increase in GHG emissions



- Without forest mining but with low efficiency of charcoal production: GHG emissions will also increase but on a lower level



- With sustainable forest management and optimized kilns and stoves: GHG emissions can be lowered although energy demand is rising



Local Sustainability

Sustainability Analysis

- Multi-criteria assessment
  - Technical
  - Economic
  - Environmental
  - Social

Results for Charcoal carrier

Technical Aspects

- Conversion efficiency was 20 – 25% for IBK while for traditional kiln was 15-19% (11 more bags of charcoal for IBK)
- The IBKs were either of Box or Bottle shape
- Bottle shape IBK is preferred by charcoal producers due to its high efficiency (50-120 bags per kiln) compared to 50-60 bags for Box shaped IBK
- The high efficiency of Bottle shaped IBK kiln - flexibility to accommodate many and big log sizes
- The low efficiency in Box IBK - rectangular shape which allows more air circulations and hence more wood is burnt to ashes

Bottle shape IBK

Box shape IBK

Economical Aspects

- The investment cost for the IBK is about TSh 16,000 for buying a chimney while labour force is provided by charcoal producers
- Charcoal makers have opted to sell their charcoal at the production site to avoid high operational costs
- These costs relate to transportation, charcoal royalty paid to the village, transport permit, registration of charcoal business, and registration of charcoal store in the market
- The kilns are used only once but the metal sheet chimney can be used up to three times
- On average IBK kiln produces up to 100 bags of 56 kg sold at TSh 5,000 - 7,000 each

Environmental Aspects

- The IBK uses less wood as compared to the traditional kiln to produce the same amount of charcoal
- The IBK kilns require frequent visits during carbonization as compared to the traditional ones and hence reduced wild fires
- The total forest area for Ulaya Mbuyuni is 3,540 ha of which 253 ha is set aside for charcoal production (is less than 10%)
- Charcoal production forest is divided into 24 coupes, one harvested per year to allow the same area to be revisited after 24 years
- Selective harvesting to retain trees with timber values, bees colonies, bird nests, on river banks, steep slopes and catchment areas
- The cutting height is 1m from the ground to facilitate coppicing


Social Aspects

- The use of IBK has contributed to improved household incomes for charcoal makers by being paid TSh 5,000 - 7,000 for each bag of 56 kg
- The village earns a royalty of TSh 14,400 per bag and this money is used by the village for development projects such as water, schools as well supporting forest management
- Charcoal production using IBK is done by all villagers regardless of age and sex, though women concentrate more on marketing (retail) than production of charcoal

Factors for success of sustainable charcoal production:

- Presence of land use plan, forest management plan, harvesting plan and village bylaws
- Charcoal makers organized in groups and trained
- High production efficiency of the IBK
- Charcoal royalty paid directly to village government and used for development projects and forest management

Factors for failure of sustainable charcoal production:

- Because most of villagers do not use charcoal, the market is limited to outside demand
- Illegally produced charcoal goes untaxed and therefore it may be cheap which could compete with sustainable charcoal if not controlled
- Charcoal producers are discouraged to carry out charcoal business because of the associated costs and hence the business is done by outsiders

Conclusion and Recommendations

- Scaling up of this carrier in different places should be done with care by considering the situation and the need of the beneficiaries
- Modification of the technology might be very important to address some of the challenges experienced in the original design
- The adoption rate of this technology in different places has been very low despite their great potentials in addressing environmental problems
- Therefore there is a need as a country to come up with specific policies, strategies and laws to make the users more obliged to use this technology

Thank you...