Carbon sequestration through *Jatropha curcas* afforestation
Preliminary results from Burkina Faso

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Introduction

Since 2007 *Jatropha curcas* is actively promoted as biofuel crop suitable for poor dryland areas in Burkina Faso, a promising solution to energy scarcity without compromising food security. To proof this hypothesis, the PhD project is evaluating the sustainability of existent Jatropha production systems with the focus on carbon and energy budgets using the Live Cycle Assessment (LCA) tool. This poster provides first results of the research by presenting plant growth characteristics and carbon budgets during the production phase of different Jatropha systems.

Methods & Data

- Inventory study for the identification and classification of Jatropha systems in Burkina Faso: mapping, stakeholder and farmer interviews (Hallensleben, 2011).
- In-depth investigations of selected Jatropha systems: Tree measurement, destructive above- and below-ground tree biomass sampling, soil survey for the detection of soil carbon dynamics, farmer inquiry on management decisions & intervention practices.

Results

Fig.1 - Jatropha systems in Burkina Faso

1. Jatropha plantation systems:
   - Plantations on marginal land
   - Small scale intercropping of Jatropha with food or cash crops
   - Large scale plantations with high intensity management
2. Jatropha planted in hedge systems:
   - Living fences for the protection of the field against animals
   - Jatropha along erosion contour lines for their stabilization

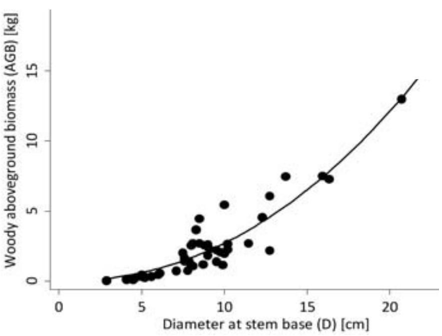

Fig. 2 - Allometric biomass estimation

Allometric relationship between diameter at stem base (3-21cm) and woody above-ground biomass AGB (kg) yielded the power function $AGB=0.018*D^{2.165}$ explaining 92% of the variation of the observed points.

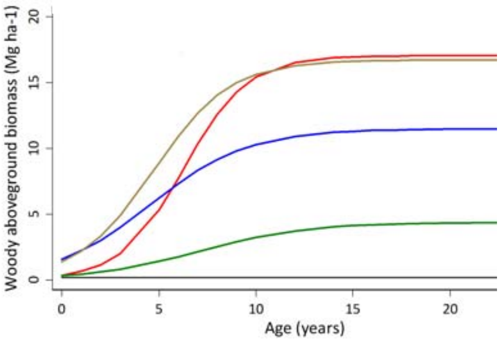

Fig. 3 - Growth curves

For all systems woody above-ground biomass (Mg ha^{-1}) was plotted against time (years). The relationship could be fitted with a logistic curve $AGB = \alpha/(1 + e^{(-\beta*(Age - \gamma))})$. Intensively managed plantation show the fastest growth. Intercropping systems have a slow start and fast accumulation after the third year. All systems have reached their senescence by latest 10 years.

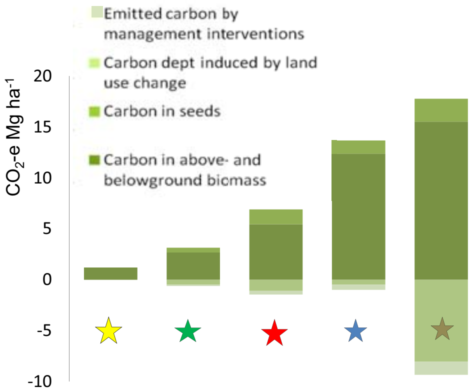

Fig. 4 - Carbon balancing

The carbon balance estimation of the production phase of Jatropha comprises carbon in biomass, carbon emissions through management and land use change. In the third year, intensively managed plantations show significant higher biomass accumulation ($p<0.05$) than most other systems, but the carbon offset is counteracted by the carbon emissions. Living fences show best results, with high carbon sequestration and low carbon emissions.

Conclusions and Outlook

Jatropha cultivation is still at its infancy in Burkina Faso. However, significant difference in growth development could be detected among the most common practiced systems. So far, the living fence system seems to be most promising: high carbon sequestration, external benefits as land protection, no competition with other land-use systems. The estimation of soil organic carbon dynamics in Jatropha plantations are still to be incorporated into the balance and will likely change the picture even more in favor of the extensive systems. The next step of the research is the carbon balancing of the transformation process from Jatropha seed to biodiesel and of its final utility as alternative fuel for electricity generation, transport, or cooking.

Financed by :
Dreyer Foundation

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