Enhanced Food Security via adoption of Improved Cooking Stoves and local wood plantations in Tanzania

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Background
Fuelwood scarcity and food security are reported issues in developing countries. In degraded and deforested areas of Tanzania, firewood supply is a severe challenge. Through Improved Cooking Stoves (ICS) the absolute firewood consumption for cooking purposes compared to traditional Three-stone-fire stoves (TSF) can be reduced. More frequent and advanced dishes could be cooked. The integration of on-farm wood plantations can contribute to both firewood supply and food security. Increased on- farm wood plantations bear the potential - when intercropped with crops - to enhance agricultural yields. Although abundant research has been done on the intercropping farm-systems, little attention has been paid to the simultaneous firewood and crop production. We investigate the biomass production of different intercropping systems with crops and trees.

Research question
• Can ICS with a two-pot design contribute to food security via time savings?
• What are the actual savings of ICS with a two-pot design compared to TSF with regard to firewood consumption?
• How many trees are needed to achieve firewood autarky by on-farm plantations?
• What are the impact pathways of ICS and tree plantations with regard to food security: direct (change of meals, crops/fodder yields); indirect (time savings)?

Current results

<table>
<thead>
<tr>
<th>Type of Stove</th>
<th>Meal</th>
<th>Firewood consumption (g)</th>
<th>Firewood consumption (g)</th>
<th>Total firewood savings (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rice and vegetables</td>
<td>2187 (SD 879)</td>
<td>1375 (SD 792)</td>
<td>812 * (37.1 %)</td>
</tr>
<tr>
<td></td>
<td>Beans and rice</td>
<td>4241 (SD 1540)</td>
<td>3576 (SD 696)</td>
<td>665 (15.6 %)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Stove</th>
<th>Meal</th>
<th>Cooking time (min)</th>
<th>Total time savings (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rice and vegetables</td>
<td>82.4 (SD 28.3)</td>
<td>60.3 (SD 13.6)</td>
</tr>
<tr>
<td></td>
<td>Beans and rice</td>
<td>179.7 (SD 43.3)</td>
<td>138.8 (SD 23.1)</td>
</tr>
</tbody>
</table>

* Differences are significant at a level of significance of 0.05 %

Tab 1: Firewood and time savings (Three-Stone-Fire stoves vs Improved Cooking Stoves)

<table>
<thead>
<tr>
<th>Cropping pattern</th>
<th>Space demand (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3m by 3m</td>
</tr>
<tr>
<td>3m by 3m</td>
<td>16344</td>
</tr>
<tr>
<td>(4 acre)</td>
<td></td>
</tr>
</tbody>
</table>

Tab 2: Space demand of Gliricidia Sepium per household to cover the firewood demand for cooking purposes by own plantations

• Average firewood consumption per year and household with ICS is 1140 kg (air-dried)
• Time savings per year through cooking with ICS instead of TSF = 143 hours
• 1800 trees of G. Sepium are needed to reach firewood autarky on household level (2300 kg wood growth, air-dried, 2-year rotation)
• Potential time savings if all firewood for cooking with TSF is collected on farm = 450 hours (firewood collection for TSF)

Outlook

Analyze different cropping systems:
Monocropping vs. intercropping with trees
• How to optimize the intercropping production system (Agroforestry-System): Correlation between crop and tree production?
  → Randomized complete block design with three replications and five treatments >> 15 plots

Strategies to enhance Energy Supply and Food Security

Three-stone-fire stove vs Improved Cooking Stove

Integration of trees and intercropping systems
(Maize + Pigeonpea + G. Sepium)
Monocropping intercropping crop+tree integration

Methods
• Controlled Cooking Test (to determine firewood and time consumption of ICS and TSF)
  → Location: Idifu (January 2016, N = 40 households, 2 cooking tasks per household and day)
• Destructive measurement of biomass yield of tree plantations (Gliricidia sepium)
  → Location: Laikala (February 2016, Gliricidia sepium 3m by 3m, maize intercropping, area assessed 2000 m²)

References:
1 Leibnitz Centre for Agricultural Landscape Research (ZALF), Institute of Socio-Economics, Eberswalder Street 84, 15374 Müncheberg, Federal Republic of Germany
2 World Agroforestry Centre (ICRAF), MARI Mikocheni, P.O. Box 6226, Dar es Salaam, United Republic of Tanzania
3 Ministry of Natural Resources and Tourism, P.O. Box 191, Kidatu - Morogoro, United Republic of Tanzania