Legume Technology and Agricultural Productivity: Evidence from Zambia

Christine M. Sauer, Mywish K. Maredia, and Nicole M. Mason

Introduction

- **Legumes** impart several agronomic, environmental, and economic benefits to smallholder farm households.
- As natural nitrogen fixers, legumes reduce the need for inorganic fertilizer and enhance long-term soil fertility and productivity.
- Due to their high protein, mineral, and fiber content, legumes also carry nutritional benefits.
- Legumes therefore likely play a positive role in ensuring a household’s food security through two pathways:
  - The income pathway (i.e. increasing the productivity and income-generating capacity of the production system), and
  - The consumption pathway (i.e. increasing the diversity of nutrient-rich food for self-consumption).
- **This research explores** the effects of maize-legume intercropping and cereal-legume rotation **on crop productivity and calorific and protein production.**

Methods

- We utilize data from the Rural Agricultural Livelihoods Survey (RALS) conducted in 2012 in Zambia.
- The *nationwide representative data* collected from 8,839 small rural farm households contain information on household demographics, farming practices, and crop harvest and sales. A total of 26,139 plots are analyzed.
- The field-level analysis employs an Ordinary Least Squares regression to explore the effect of maize-legume intercropping and cereal-legume rotation **on three measures of productivity** for fields with maize and/or legumes: net value of crops harvested, total calories harvested, and total protein harvested, all in per hectare terms.
- We also control for plot characteristics (e.g., soil type), other inputs (e.g., fertilizer application, seed varieties), and household characteristics (e.g., household size, age of the household head).

Results

- Current analyses indicate that there is no statistically significant difference between the net value of production per hectare on maize monocropped vs. intercropped or rotated fields.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Average Yield (kg/ha) on Monocropped Fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>2,187</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>528</td>
</tr>
<tr>
<td>Soybeans</td>
<td>837</td>
</tr>
<tr>
<td>Mixed Beans</td>
<td>582</td>
</tr>
</tbody>
</table>

Table 1: Average yields for maize and commonly grown legume crops

- However, **cereal-legume rotation increases** calorie production by over 200,000 Kcal/ha/year relative to maize monocropping. On the other hand, maize-legume intercropping produces **almost 800,000 Kcal/ha/year** less than maize monocropping but produces significantly more Kcal/ha/year than legume monocropping.
- Relative to maize monocropping, maize-legume intercropping **has a significant, positive effect** on protein produced per hectare; cereal-legume rotation has a positive but statistically insignificant effect on protein production.

Conclusions and Future Work

- **This research suggests overall positive effects** of the two legume-based technologies on food security (i.e., calories) and nutrient production (i.e., protein). However, the effects of individual technologies on specific indicators are mixed.
- The negative effect of maize-legume intercropping on calorific production per hectare relative to maize monocropping could be due to the generally lower yields of legume crops (Table 1), and points to the need for increasing legume productivity. This may also partially explain the lower adoption of this practice by farmers in Zambia (Figure 1).
- Next steps:
  - Examine the effects of legume technologies on household food security and anthropometric measures.
  - Use panel data techniques with the 2015 wave of the RALS to further control for potential endogeneity issues.