Nutritional Effects of Agricultural Diversification and Commercialization in Children in Zambia

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Why Nutrition?

- Zambia has one of the highest rates of malnutrition in the world
  - Stunting rates: 46.7% (rural area: 48.3%) 2010
  - Underweight: 13.3% (reduced from 25.1% in 1992 but 2015 MDG target is 12.5%)
  - Wasting: 6% (increased from 3.1% in 1996)
- Smallholder rural households are most vulnerable
  - depend on seasonal food production
Why agricultural diversification and Commercialization

- Agricultural diversification and commercialization provide alternative strategies for the rural households to improve diets (Hendrick and Msaki 2009; Khandker and Mahmud 2012)
- Diversification yields diverse food items for consumption
- Commercialization increases income and the household’s ability to purchase a diverse range of food items.
Why agricultural diversification and Commercialization cont.

- Increase in incomes during early childhood decreases stunting in the long-run (e.g. Zere and McIntyre 2003; Monteiro et al. 2010; Alderman et al. 2006).
Presentation Outline

- Study Area: Eastern Province
- Impact assessment framework
- Data Sources
- Results
- Conclusions and Policy Implications
Study area: Zambia’s Eastern province

- Crop diversification (0.47 SI)
- Third highest province in livestock production.
- Low protein production diversification (0.3 SI)
- High malnutrition level (Stunting: 51.7%)
- Poverty level: 80% (National rural average 75%)
Impact assessment framework

- **Propensity Score Marching (PSM):**
  - Households with similar characteristics are matched
  - Similarity is computed as the propensity to diversify/sell products
  - Disadvantage: requires a binary treatment variable

- **Generalized Propensity-Score (GPS):** The GPS balances differences in farm characteristics and estimates the nutrition effect of different intensities of diversification and commercialization, respectively
Average potential nutrition outcome of different intensity levels

  - GPS: conditional density of the treatment, given observed covariates \((Z)\)
  - Balancing property: for farms with similar GPS, the probability of realizing a specific treatment level \((T)\) is independent of farm characteristics \(Z\)

- GPS estimated with Generalized Linear Model (GLM)

- Conditional expectation of outcome \(Y\) given actual \(T\) and the GPS\((T)\)

\[
Y = \beta_0 + \beta_1 T + \beta_2 T^2 + \beta_3 GPS(T,Z) + \beta_4 GPS(T,Z)^2 + \beta_5 GPS(T,Z) * T
\]

- **Dose Response Function (DRF)**
  - Evaluates the average potential outcome \((Y)\) for a given intensity level \((t)\)
Treatment Variables:

- Commercialization (COM),
  - index derived from the share of agricultural sales in household’s total value of agricultural production.

- Diversification (DIV)
  - Simpson Index over production of 8 major food groups; starchy foods, legumes-nuts-seeds, starchy vegetables, non-starchy vegetables, starchy fruits, non-starchy fruits, dairy, and eggs).

\[
PDIV = 1 - \sum_{i=1}^{S} p_i^2 \quad \quad CDIV = 1 - \sum_{i=1}^{S} c_i^2
\]
• **Outcome Variables**

a) Height-for-Age (HAZ) (Stunting)

c) Weight-for-age (WAZ) (Underweight)

b) Weight-for-Height (WHZ) (Wasting)
## Covariates

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Farm characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FHHdefacto</td>
<td>=1 if de facto female-headed HH</td>
<td>0.12</td>
<td>0.33</td>
</tr>
<tr>
<td>noformaled</td>
<td>=1 if HH head has no formal education</td>
<td>0.18</td>
<td>0.39</td>
</tr>
<tr>
<td>grade1_4</td>
<td>=1 if HH head completed lower primary (grades 1 to 4)</td>
<td>0.18</td>
<td>0.39</td>
</tr>
<tr>
<td>grade5_7</td>
<td>=1 if HH head completed upper primary (grades 5 to 7)</td>
<td>0.34</td>
<td>0.47</td>
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<tr>
<td>agehead</td>
<td>Age of the HH head</td>
<td>40.48</td>
<td>12.51</td>
</tr>
<tr>
<td>ftesum</td>
<td>Full-time equivalent HH members</td>
<td>6.19</td>
<td>2.57</td>
</tr>
<tr>
<td>shareAgeun~5</td>
<td>Share of household members aged below 5</td>
<td>0.20</td>
<td>0.14</td>
</tr>
<tr>
<td>shareAge5_14</td>
<td>Share of household members aged 5 to 14</td>
<td>0.30</td>
<td>0.19</td>
</tr>
<tr>
<td>shareAbove60</td>
<td>Share of household members aged 60</td>
<td>0.04</td>
<td>0.12</td>
</tr>
<tr>
<td>deathinfam~y</td>
<td>=1 if the household experienced death of a member within the reference period</td>
<td>0.05</td>
<td>0.23</td>
</tr>
<tr>
<td>landholdsz12</td>
<td>Total land holding size less rented in and borrowed in</td>
<td>3.58</td>
<td>3.09</td>
</tr>
<tr>
<td>landother</td>
<td>sum of land borrowed in and rented in</td>
<td>0.16</td>
<td>0.81</td>
</tr>
<tr>
<td>Landtitled</td>
<td>land with title deeds</td>
<td>0.28</td>
<td>1.56</td>
</tr>
<tr>
<td>deflstock</td>
<td>Value of livestock (real ZMK, 2007/08=100)</td>
<td>2781176.00</td>
<td>4534321.00</td>
</tr>
</tbody>
</table>

*Kwacha-dollar rate was $1 = ZMK5012 (June 2012).*
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<th>Std Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>defvalequip</td>
<td>Value of farm equipment (ZMK/10,000; 2007/08=100)</td>
<td>43.07</td>
<td>88.94</td>
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<tr>
<td>fisphh</td>
<td>=1 if HH acquired FISP fertilizer</td>
<td>0.47</td>
<td>0.50</td>
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<tr>
<td>remit_c</td>
<td>Cash remittances received</td>
<td>139725.90</td>
<td>808848.70</td>
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<tr>
<td>remit_m</td>
<td>Value of maize received</td>
<td>7527.23</td>
<td>32657.21</td>
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<tr>
<td>remit_o</td>
<td>Value of other commodities received</td>
<td>15975.00</td>
<td>110869.80</td>
</tr>
<tr>
<td>bomai</td>
<td>Km from the homestead to the nearest boma</td>
<td>31.20</td>
<td>20.74</td>
</tr>
<tr>
<td>feedroadi</td>
<td>Km from the homestead to the nearest feeder road</td>
<td>1.81</td>
<td>5.07</td>
</tr>
<tr>
<td>agrodealeri</td>
<td>Km from the homestead to the nearest agro-dealer</td>
<td>24.99</td>
<td>20.84</td>
</tr>
<tr>
<td>clinic_max</td>
<td>distance to the nearest clinic</td>
<td>6.49</td>
<td>5.97</td>
</tr>
<tr>
<td>district2</td>
<td>dist==Katete</td>
<td>0.22</td>
<td>0.42</td>
</tr>
<tr>
<td>district3</td>
<td>dist==Lundazi</td>
<td>0.25</td>
<td>0.43</td>
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<tr>
<td>district4</td>
<td>dist==Nyimba</td>
<td>0.10</td>
<td>0.30</td>
</tr>
<tr>
<td>district5</td>
<td>dist==Petauke</td>
<td>0.19</td>
<td>0.39</td>
</tr>
</tbody>
</table>
Data Sources

- Socioeconomic, agricultural and anthropometric data
- 2012 Anthropometric data used to calculate stunting wasting and underweight in children (USAID FTF, 2013)
- 1120 children (0 – 59 months) from different households in five districts in Eastern province.
Results of GPS

i. Treatment with CDIV

a. HAZ

b. WAZ

C. WHZ
ii. Treatment with PDIV

a. HAZ

b. WAZ

C. WHZ
ii. Treatment with COM

a. HAZ

b. WAZ

C. WHZ
Conclusion

- High levels of diversification reduces wasting and underweight - high amount of nutrients
  - May reduce production efficiency of the households
  - Increase possibility of stunting.
- Specialization in very few crops results in a permanently less diverse diet with quickly arising long-term consequences for nutritional status of the child.
Conclusion cont.

- Commercialization has a significant but non-linear effect on improving both the long and the short-term malnutrition status in Children
- At low intensities, the impact is negative
  - Households maybe selling everything and leaving little or non for consumption
  - Cultural/gender control over sells and home consumption
- Nutrition status improves at high intensities of commercialization because there is increased income to purchase diverse food
Policy Implications

- Two options to improve nutrition in rural Zambia
  - Specializing in cash crops
  - Or specializing in a subsistence farm with high levels of diversification, which has other income sources than agriculture
Thankyou!

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