How does labour availability influence pesticide use on cocoa farms?

Lina Tennhardt\textsuperscript{1,2}, Eric F. Lambin\textsuperscript{2,3}, Gianna Lazzarini\textsuperscript{1}, Kagimu Martin\textsuperscript{4}, Christian Schader\textsuperscript{1}

\textsuperscript{1} Research Institute of Organic Agriculture FiBL, Switzerland; \textsuperscript{2} University of Louvain, Belgium; \textsuperscript{3} Stanford University, USA; \textsuperscript{4} Farmer Action Learning for Sustainable Agricultural Management FALSAM, Uganda

2022 International Symposium on Cocoa Research (ISCR), Montpellier, France
1. Background
1. Background

Cocoa production systems
• Resource-constrained smallholder farmers in the tropics
• Mainly manual labour
• Low yields

Pest and disease management
• Synthetic pesticides
  • Common in pest and disease management\(^1\)
  • “Quick fix” / need to maintain yields
  • Issue for human and environmental health\(^2\)
• Alternative pest and disease management
  • Labour intensive\(^3\)
  • Knowledge intensive
  • Few incentives

Farm labour availability
• Household labour
  • Demographic changes
  • Ageing farmers\(^4\)
  • Reduced physical strength
• Hired labour
  • Costly\(^5\)

\(^1\)Aneani et al., 2012; \(^2\)Rani et al. 2021; \(^3\)Armengot et al. 2016; \(^4\)Abdulai et al. 2020; \(^5\)Vigneri et al. 2016
I. Background

• Strict governmental response to Covid-19 pandemic in Uganda
  ➔ Increase in farm household members and household labour availability

• Data collection carried out Feb/March 2020 and Feb/March 2022
  ➔ Unique experiment setting comparing farm data for 2019 and 2021

Do changes in household labour availability
(mediated by alternative pest and disease management practices)
reduce pesticide use on cocoa farms?
2. Materials & Methods
## 2. Materials & Methods

<table>
<thead>
<tr>
<th>Materials</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quantitative data:</strong> Farm pesticide use quantities, farm labour availability, and diverse control variables for 2019 &amp; 2021</td>
<td><strong>Ordinary least square (cross-sectional data) and two-way fixed effect (panel data) models</strong></td>
</tr>
<tr>
<td><strong>Qualitative data:</strong> Farmers’ estimated changes in labour investment in specific cocoa production activities</td>
<td><strong>Fisher’s exact test to compare response frequencies between farms with / without more household labour availability</strong></td>
</tr>
</tbody>
</table>

- **Methods**
  - Pesticides
  - Practices
  - HH Labour
2. Materials & Methods
3. Results
### 3. Results - Descriptives

<table>
<thead>
<tr>
<th></th>
<th>2019 (N=194)</th>
<th>2021 (N=194)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pesticide use in cocoa (1/0)</td>
<td>77 (39.7%)</td>
<td>82 (42.3%)</td>
<td>0.614</td>
</tr>
<tr>
<td>Pesticide active ingredient (kg / ha)</td>
<td>0.86 (2.37)</td>
<td>1.52 (5.15)</td>
<td>0.701</td>
</tr>
<tr>
<td>Concoctions use (1/0)</td>
<td>45 (23.2%)</td>
<td>75 (38.7%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pruning cocoa (1/0)</td>
<td>60 (30.9%)</td>
<td>162 (83.5%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Phytosanitary measures in cocoa (1/0)</td>
<td>76 (39.2%)</td>
<td>122 (62.9%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Household labour (1000 hours / ha / yr)</td>
<td>2.40 (2.58)</td>
<td>3.09 (3.33)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Household labour (people)</td>
<td>3.89 (2.38)</td>
<td>4.75 (2.45)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hired labour (1000 hours / ha / yr)</td>
<td>0.48 (0.90)</td>
<td>0.08 (0.19)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total labour (1000 hours / ha / yr)</td>
<td>2.87 (2.60)</td>
<td>3.17 (3.34)</td>
<td>0.140</td>
</tr>
</tbody>
</table>

Note: Paired Chi2 and Wilcoxon rank sum test
## 3. Results – Quantitative models

<table>
<thead>
<tr>
<th>Outcome: Pesticide quantities (g of active ingredient / ha)</th>
<th>OLS</th>
<th>FE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pruning cocoa (1/0)</td>
<td>-0.33 (0.96)</td>
<td>-0.82 (0.47)</td>
</tr>
<tr>
<td>Concoctions in cocoa (1/0)</td>
<td>2.85** (0.93)</td>
<td>-1.97*** (0.56)</td>
</tr>
<tr>
<td>Phytosanitary measures (1/0)</td>
<td>-0.34 (0.90)</td>
<td>-1.21** (0.40)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome: 2021 data</th>
<th>Pruning</th>
<th>Concoctions</th>
<th>Phytosanitary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in household labour hours / ha</td>
<td>-0.02 (0.03)</td>
<td>0.06* (0.03)</td>
<td>0.04 (0.02)</td>
</tr>
<tr>
<td>Change in hired labour hours / ha</td>
<td>-0.03 (0.05)</td>
<td>-0.04 (0.04)</td>
<td>-0.02 (0.04)</td>
</tr>
</tbody>
</table>
3. Results – Qualitative insights

Perceived changes in time investment in cocoa in 2021 compared to pre-Covid times

- **a) General cocoa production**
  - Full sample: Increased
  - More: Increased
  - Same/less: Increased
  - Statistical significance: $p = <0.000$

- **b) Manual weeding**
  - Full sample: Increased
  - More: Increased
  - Same/less: Increased
  - Statistical significance: $p = <0.000$

- **c) Mulching cocoa**
  - Full sample: Increased
  - More: Increased
  - Same/less: Increased
  - Statistical significance: $p = 0.001$

- **d) Pruning cocoa**
  - Full sample: Increased
  - More: Increased
  - Same/less: Increased
  - Statistical significance: $p = <0.000$

- **e) Pruning shade trees**
  - Full sample: Increased
  - More: Increased
  - Same/less: Increased
  - Statistical significance: $p = 0.001$

- **f) Brewing concoctions**
  - Full sample: Increased
  - More: Increased
  - Same/less: Increased
  - Statistical significance: $p = 0.012$

- **g) Spraying concoctions in cocoa**
  - Full sample: Increased
  - More: Increased
  - Same/less: Increased
  - Statistical significance: $p = 0.004$

- **h) Spraying synthetics in cocoa**
  - Full sample: Increased
  - More: Increased
  - Same/less: Increased
  - Statistical significance: $p = 0.002$
4. Conclusions
4. Conclusions

• Increased household labour first used for food production, then cash crops
• Alternative management practices influenced pesticide quantities
• Increased household labour did not automatically influence alternative practices

→ Alternative pest and disease management practices important pillar for cocoa production with little / without synthetic pesticides
→ Adoption on cocoa farms should be incentivised more strongly, especially on resource and labour-constrained farms
Thank you!

Contact: lina.tennhardt@fibi.org
Sources


