Productivity and profitability of different cacao production systems in Bolivia

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Introduction

Increase in global demand

Intensification of management
Expansion of cultivated area in tropical forest areas

Environmental problems, loss of biodiversity, deterioration of farmers’ livelihood, etc.
Hypothesis and objectives

**Rationale**
More sustainable production systems such as agroforestry and organic managed systems are needed. To guarantee a further extension, such systems need to be profitable for the farmers.

**Hypothesis**
Agroforestry and organic managed systems are expected to yield less cacao, but by-crops and premium prices, might economically compensate for the lower yields.

**Objective**
To compare the productivity, return on labour (return per working day) of four different cacao production systems, i.e., agroforestry and monocultures under organic and conventional farming.
Methods

Site description

➢ Bolivia, Alto Beni, alluvial terraces of the river Alto Beni, transition zone Andean plateau and Amazon
➢ 400 m asl, precipitation: 1’550 mm, winter dry
➢ 20 years of fallow land before set up of trial

Trial layout

➢ Long-term trial, set up in 2008-2009
➢ Fully replicated 4 times
➢ Gross plot: 48 m x 48 m (144 cocoa trees), net plot 24 m x 24 m (36 cocoa trees)
➢ 12 cocoa varieties: 4 local selections, 4 introduced clones and 4 hybrids
Trial layout
## Methods

### Production systems

<table>
<thead>
<tr>
<th>Management</th>
<th>Monoculture</th>
<th>Agroforestry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shade tree canopy</strong></td>
<td>- banana trees in establishment phase</td>
<td>42 trees plot(^{-1}) (227 trees ha(^{-1})): legumes, timber, fruit trees, etc.</td>
</tr>
<tr>
<td><strong>Fertilization</strong></td>
<td>Mineral fertilizer. Occasional foliar sprays</td>
<td>Compost. 50% of monoculture dose. Occasional foliar sprays</td>
</tr>
<tr>
<td><strong>Weed control</strong></td>
<td>Herbicides (4-5 year(^{-1})) Manual weeding, brushcutters</td>
<td>Herbicides (4-5 year(^{-1})) Manual weeding, brushcutters</td>
</tr>
<tr>
<td><strong>Pest and disease control</strong></td>
<td>Manual control, occasional pesticides</td>
<td>Manual control occasional pesticides</td>
</tr>
</tbody>
</table>

### Data collection

Cacao and by-crop yields, costs, revenues, and labour were registered during the first **5 years after establishment**, i.e. 2010-2014 (young plantation)
Cacao yields were higher in monocultures (40%)
Cacao yields were higher under conventional management in the monoculture but no differences between organic and conventional in agroforestry

Banana/plantain yields were higher in the agroforestry systems
No differences in banana/plantain yield between organic and conventional management

Afc: Agroforestry conventional
Afo: Agroforestry organic
Mc: Monoculture conventional
Mo: Monoculture organic
Revenues from cacao higher in monoculture than agroforestry, but revenues from by crops in agroforestry overcompensate this

Premium price for organic cacao was 13% higher than for conventional

Costs were lower in agroforestry systems: less fertilizer, less weeding

Costs were higher under conventional farming: fertilizers and herbicides

 implication for smallholder farmers, who usually hold limited savings and lack of access to credit

Bs stands for bolivianos. 1 US $ is approximately 7 Bs

Afc: Agroforestry conventional
Afo: Agroforestry organic
Mc: Monoculture conventional
Mo: Monoculture organic
Agroforestry were more work demanding than monocultures (16%)
Organic management was not more work demanding than conventional management

Return on labour was twice as high in the agroforestry systems compared with the monocultures, it did not differ between organic and conventional management

It exceeds the amount of 1.90 US$ day$^{-1}$ set by the World Bank as the international poverty line, but is still a bit lower than the minimum salary in Bolivia (8.7 $ day$^{-1}$).
Conclusions and perspectives

Agroforestry systems and organic management may be as profitable or even more profitable than full-sun monocultures and conventional farming in young cacao plantations

   Adding to: the maintenance / enhancement of biodiversity and farmers’ livelihood

Major role of by crops not only for self-consumptions but also in revenue

   Thoughtful planning of agroforestry systems including market oriented by-crops combined with by-crops for self-consumption

   Further development of accessible markets for by-crops

Further monitoring until reaching full production is indispensable for having comprehensive understanding of productivity and profitability

   E.g. : a potential fast cacao yield increase in monocultures will be compensated by the sales of a broader range of by-crops and timber trees?
   E.g. : narrow yield gap between organic and conventional monocultures?
Acknowledgments

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Bolivian partners

Thank you for your attention