What is the contribution of organic agriculture to sustainable development?

Long-term farming systems comparisons in the tropics

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Current research projects at International division

Strategic research

Farming systems comparison in the tropics
Kenya, India, Bolivia

SYPROBIO: cotton
Benin, Burkina, Mali

Cocoa production system research, Malaysia

Applied research

Fertile soils for Hyderabad

SALSA: Value added food chains in LA soybean and beef

FiBL  www.fibl.org
Background: DOK Long-term field trial Therwil (BL)

Since 1978, DOK Trial, Therwil (BL), Switzerland

- 8 treatments
- 5 crops in a 7 years' rotation
- 4 replications
- 96 plots à 100m²
- 30 year-trial
## Selected results from the DOK trial

<table>
<thead>
<tr>
<th>Category</th>
<th>Organic</th>
<th>Conventional</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter wheat yield</td>
<td>4.7 t/ha</td>
<td>5.6 t/ha</td>
<td>-15%</td>
</tr>
<tr>
<td>Fertilisation (NH₄NO₃ Equivalent)</td>
<td>122 kg/ha</td>
<td>360 kg/ha</td>
<td>-60%</td>
</tr>
<tr>
<td>Energy (Diesel Equivalent)</td>
<td>340 l/ha</td>
<td>570 l/ha</td>
<td>-30%</td>
</tr>
<tr>
<td>Plant protection (Active Ingredients)</td>
<td>0-200 g/ha</td>
<td>6.0 kg/ha</td>
<td>-97%</td>
</tr>
<tr>
<td>Soil fertility (Microbial Biomass)</td>
<td>40 t/ha</td>
<td>24 t/ha</td>
<td>+60%</td>
</tr>
</tbody>
</table>

Mäder et al. (2002), Science 296
Is this also true in the tropics?

We want to know how organic farming:

- affects yield, yield stability, product quality and storability
- contributes to the conservation of natural resources, i.e. soil fertility, biodiversity (incl. beneficial organisms) and water
- influences resource use efficiency
- affects economic returns of farmers
Very few long-term farming systems comparison trials in the tropics

- Yields of OA=CA in diverse low-input food crop systems in Bangladesh (Rasul & Thapa, 2004) but: sample size too small in view of farm heterogeneity
- Economic benefits of OA>CA (cotton, India) but factors are not clear (Eyhorn, 2006)
- Yield OA>CA (cotton, India) if large amounts of organic manures are used (Blaise, 2006)
Strategic objectives

We want to establish a network of long-term farming systems comparisons, because:

➢ we aim to put the discussion about organic farming in the countries of the South on a rational basis

➢ we aim to support the policy dialogue of the countries in the South, and of the donors

➢ we aim to identify the challenges for organic farming in tropical countries thus address them in a targeted way
Long-term farming systems comparisons in the tropics

- **Bolivia**
  - Agro-forestry
    - humid
    - cocoa

- **Kenya**
  - Subsistence agr.
    - semi-humid
    - maize
    - vegetables

- **India**
  - Cash crop
    - semi-arid
    - cotton
    - soya
    - wheat
Implementation with local partners

FiBL coordinators and main partners

› Bolivia
Monika Schneider (CH) with Ecotop, PIAF-El Ceibo, Institute of Ecology (UMSA, La Paz)

› India
Gurbir Sing Bhullar (IN) with bioRe

› Kenya
Noah Adamtey (GH) with icipe, KARI, KIOF
Long-term farming systems comparisons in the tropics

Enhanced know-how on advantages and limitations of different agricultural production systems in three tropical countries contributes to sustainable agriculture

Program objectives

1. To collect, publish and disseminate solid agronomic and socio-economic data on major organic and conventional agricultural production systems in selected regions

→ long term experiment (LTE)

2. To research new locally-adapted technology innovations for major organic production systems and provide them for dissemination

→ participatory technology development (PTD)
1. Long-term experiment (LTE)

Agronomic on-station experiment → similar to DOK trial

Number: Treatment
Letter: Replication

Example:
A1: Bio-dynamic Treatment
A2: Bio-organic Treatment
A3: Conventional Treatment
A4: Conventional GM Treatment
2. Participatory technology development (PTD)

Technology improvement with organic farmers
Farmers decide topics and propose solutions to test

Mother trial (on-station)

Baby trial (on-farm)

Baby trials (on-farm)
PhD projects

- Nitrogen and water dynamics in organic and conventional systems in the Sub-humid highlands of central Kenya. University Hohenheim


- Production systems and effects on water supply, water use efficiency and performance of cocoa (Theobroma cacao L.) in Alto Beni, Bolivia. University Göttingen

- Carbon and nitrogen fluxes in different cocoa (Theobroma cacao L.) production systems in Alto Beni, Bolivia. University Göttingen

Plus integration of BSc, MSc and diploma students at all sites in LTE or PTD activities
Website

www.systems-comparison.fibl.org
SysCom India
Methodologies and results from LTE and PTD

Christian Andres  (christian.andres@fibi.org)  16.01.2014
The Indian SysCom project

- Partner institution: bioRe Association
- Location: Central Indian cotton belt (Madhya Pradesh)
- Eco-zone: Semi-arid tropics
- Fertile vertisols, high yield potential
- Agricultural system: Annual fibre and food crops (cash crops)
- Crop rotation:

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>Soya</td>
</tr>
<tr>
<td></td>
<td>Wheat</td>
</tr>
</tbody>
</table>
**LTE India: Experimental layout**

- **Data collection** started in 2007
- **Expected** to run for 20 years
- **Treatments** mirror local farming practices
**LTE India: Systems**

Main differences in *agricultural management* and *genetic material*

<table>
<thead>
<tr>
<th>Particular</th>
<th>BIODYN</th>
<th>BIOORG</th>
<th>CON</th>
<th>CON-GM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genetic material (cotton)</td>
<td>Non-<em>Bt</em></td>
<td>Non-<em>Bt</em></td>
<td>Non-<em>Bt</em></td>
<td><em>Bt</em></td>
</tr>
<tr>
<td>N input [kg ha$^{-1}$]</td>
<td>100</td>
<td>100</td>
<td>150</td>
<td>170</td>
</tr>
<tr>
<td>Green manuring</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Weeding</td>
<td>Manually</td>
<td>Manually</td>
<td>Manually Herbicide</td>
<td>Manually Herbicide</td>
</tr>
<tr>
<td>Plant protection</td>
<td>Organic pesticides</td>
<td>Organic pesticides</td>
<td>Synthetic pesticides</td>
<td>Synthetic pesticides</td>
</tr>
<tr>
<td>Irrigation</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Special treatments</td>
<td>Biodyn. P.</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

**Relatively intensive production system**
Title
Yield and Economic Performance of Organic and Conventional Cotton-based Farming Systems - Results from a Field Trial in India

Main aspects
Yield development, economic analysis of first two cropping cycles (2007 – 2010)

Resubmitted in July 2013
LTE India: Results cotton yield

Yield [kg ha$^{-1}$]

2007 2008 2009 2010

BIODYN  BIOORG  CON  CON-GM
LTE: Overall results yield

Results confirm yield gaps between CONV and ORG, yet in our trial they are:

• **smaller compared to:**
  
  i. *reported values for same crops in other parts of India*  
     (Ramesh et al., 2010)

  ii. *findings of recent international (meta-)studies*  
      (Seufert et al., 2012, De Ponti et al., 2012)

• **larger compared to:**

  iii. *neighbouring farmers’ field comparison*  
       (Eyhorn et al., 2007)
LTE India: Economic analysis

- Variable production costs (= costs for input & labour & purchase of inputs) 32% higher in CON/CON-GM (statistically significant)
- Gross margin (= gross return – variable production costs) on par in CONV and ORG (no statistical difference)
  - Lower yields balanced by lower variable production costs in ORG (without premium price for organic products)
- In our trial, ORG economical equally rewarding, but less capital-intensive production system
  - Higher benefit-cost ratio in ORG
LTE India: Preliminary conclusion

• ORG promising alternative to CONV in cotton-based systems under semi-arid, irrigated conditions in central India

• Less capital intensive → implication for smallholders
  ➢ more independent (no credits with high interests)
  ➢ Less risk (crop failure, vicious debt cycles)
  ➢ Assumption: knowledge, purchased inputs (org. fert., pesticides, non-GM seeds), existing market demand, developed certification system
LTE India: Outlook

• Future research:
  - Verification of outcomes in further crop cycles and on geographically spread on-farm comparisons
  - Ecological impact of the different farming systems (Nutrient use efficiency, soil fertility, biodiversity, etc.)
Projects proliferating from LTE India

• How close are we to the farmer’s reality?
  ➢ On-farm validation trials since 2009 (additional component of SysCom)

• Are modern hybrids best choice for organic production?
  ➢ Cotton Cultivar Screening trials since 2011
  ➢ Green Cotton project since 2012 (participatory cotton breeding)
PTD India: Action lines

i. Efficient use of rock phosphate (RP) on high pH soils
ii. Improved farm yard manure (FYM) management
iii. Best organic pest management strategies
iv. Evaluation of GM-free cotton genotypes (cultivar trials)
v. Introduction of nitrogen fixing plants (alley cropping trial)
PTD India: Concept

1. Participatory identification of current practices, local knowledge and associated problems (surveys)

2. On-station (mother) trial and smaller on-farm (baby) trials

3. After identification of most promising technologies
   a) Increase number of on-farm trials
   b) Dissemination of information
PTD India: RP & FYM trials
(already in stage 3)

I. Partial acidulation of RP (pacRP) with locally available, acid liquid (butter milk)
PTD India: RP & FYM trials
(already in stage 3)

II. Mixing of pacRP with FYM to prevent binding of P to soil particles and enable slow P release from organic matter
PTD India: RP & FYM trials
(already in stage 3)

III. On-farm trials and evaluation of treatments by farmers
PTD India: Organic pest management
(in between stage 1 and 2)

I. Documentation of best practices in local organic farming
II. Dissemination of information gathered in stage 1

PTD India: Organic pest management
(in between stage 1 and 2)
PTD India: Organic pest management (in between stage 1 and 2)

1. On-station field trial

Plan On-Station Trial (get one replicate of each treatment on a few farms)

- Sampling area
- Local farmer practice
- Intensive organic
- Replicate on-farm
- Conventional
- Control

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Thank you for your attention!