



# 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

Applied research

Farming systems comparison in the tropics  
Kenya, India, Bolivia

SYPROBIO: cotton  
Benin, Burkina, Mali

Fertile soils for Hyderabad

Cocoa production  
system research, Malaysia

SALSA: Value added food chains  
in LA soybean and beef

# 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 100m<sup>2</sup>
- › 30 year-trial



# Selected results from the DOK trial

	Organic		Conventional
Winter wheat yield	4.7 t/ha	- 15% ←	5.6 t/ha
Fertilisation (NH <sub>4</sub> NO <sub>3</sub> Equivalent)	122 kg/ha	- 60% ←	360 kg/ha
Energy (Diesel Equivalent)	340 l/ha	- 30% ←	570 l/ha
Plant protection (Active Ingredients)	0-200 g/ha	- 97% ←	6.0 kg/ha
Soil fertility (Microbial Biomass)	40 t/ha	+ 60% ←	24 t/ha

# 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)

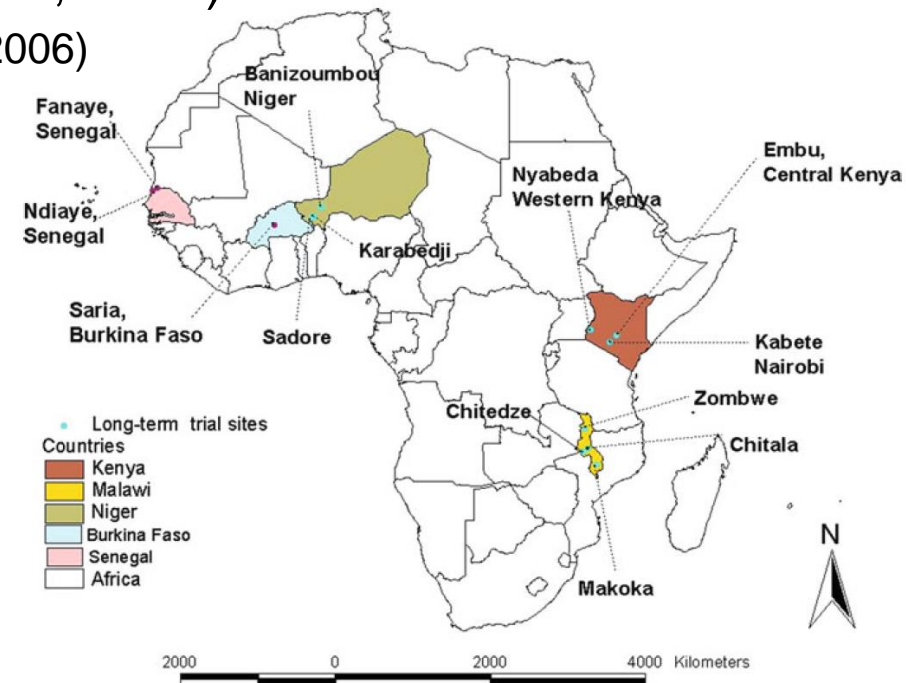


Fig. 1.1 Map showing location of selected long term trials in Africa

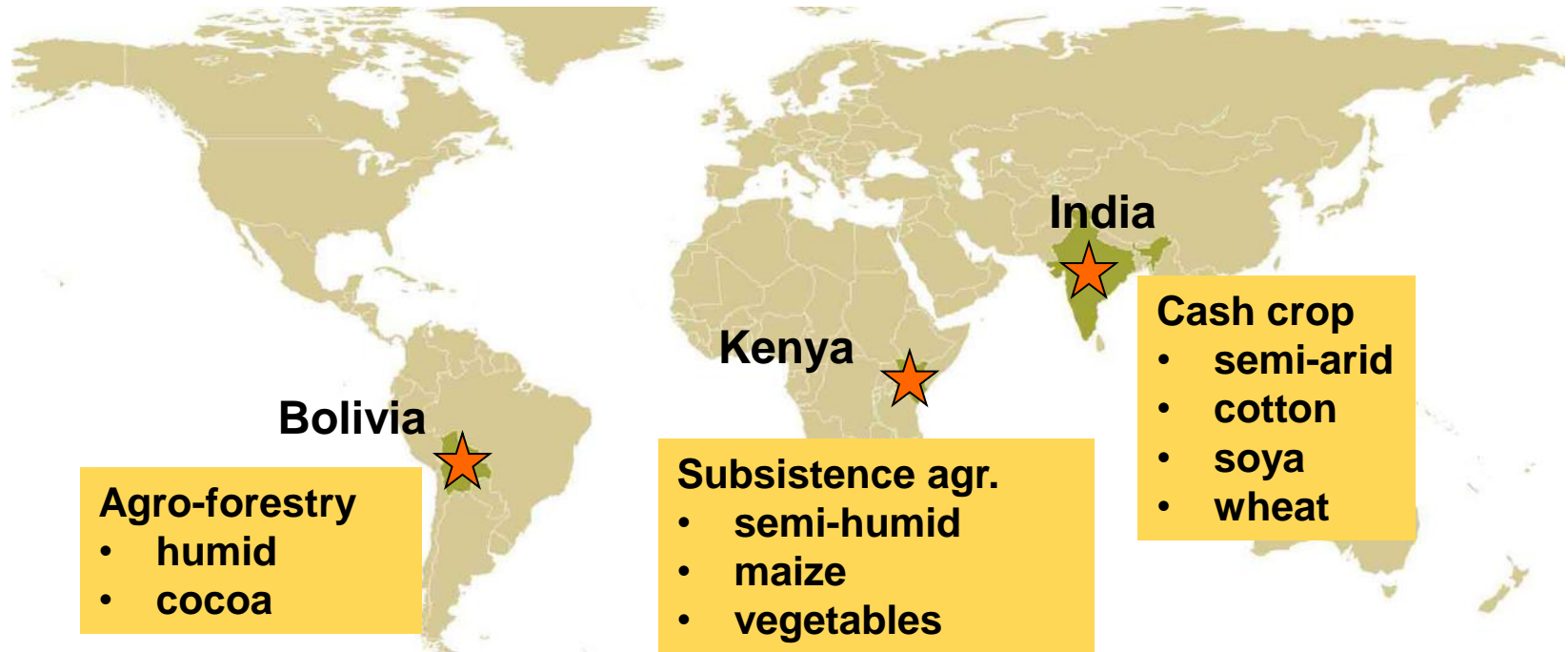


# Strategic objectives

**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





# 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



bioRe Association

### › Kenya

Noah Adamtey (GH) with *icipe*, KARI, KIOF



**icipe**

African Insect Science for Food and Health

# 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

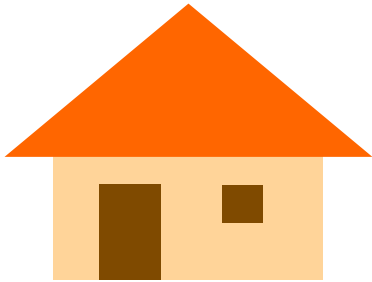
→ *long term experiment (LTE)*

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



A1	A2	A3	A4
B2	B4	B1	B3
C3	C2	C4	C1
D4	D1	D3	D2

Number: Treatment  
Letter: Replication

Example:

A1: Bio-dynamic Treatment

A2: Bio-organic Treatment

A3: Conventional Treatment

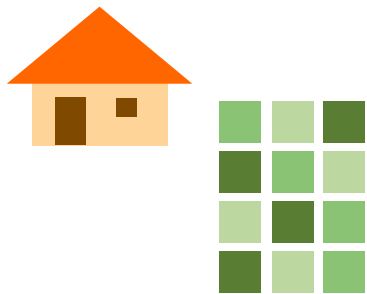
A4: Conventional GM Treatment

# 2. Participatory technology development (PTD)

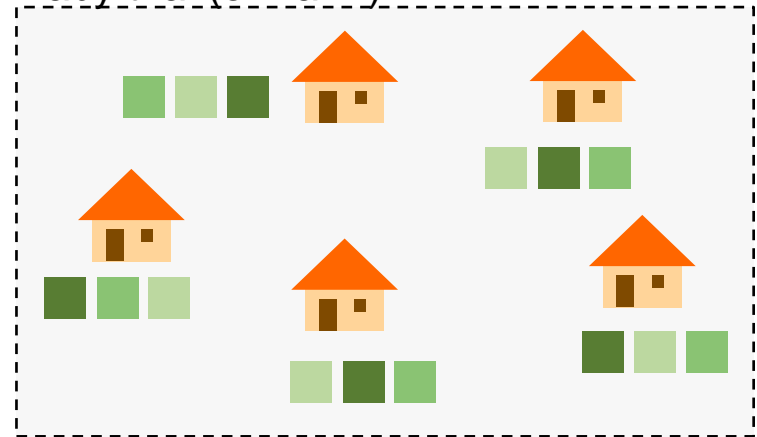
Technology improvement with organic farmers

Farmers decide topics and propose solutions to test

Mother trial (on-station)



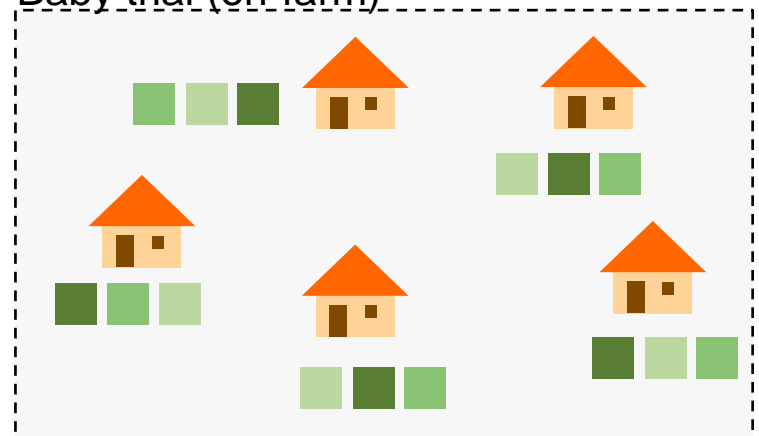
Baby trial (on-farm)



Baby trials (on-farm)



Baby trial (on-farm)



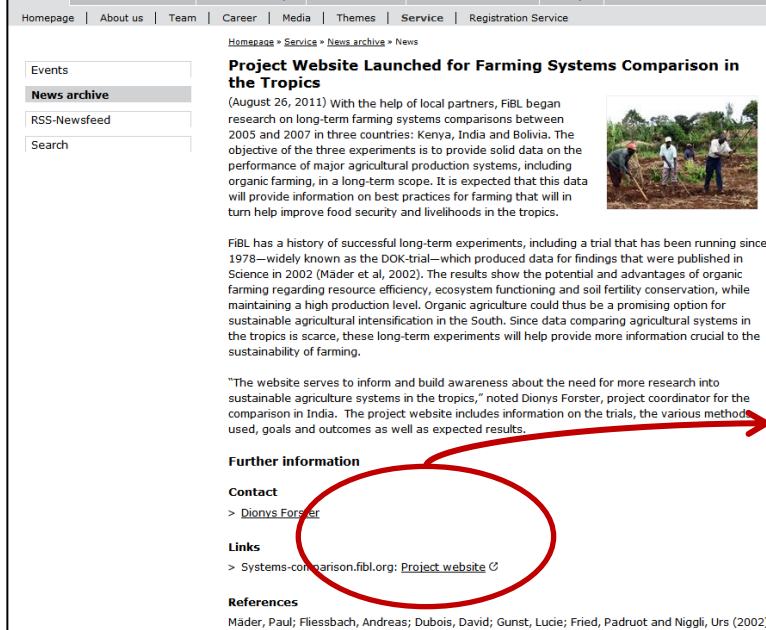
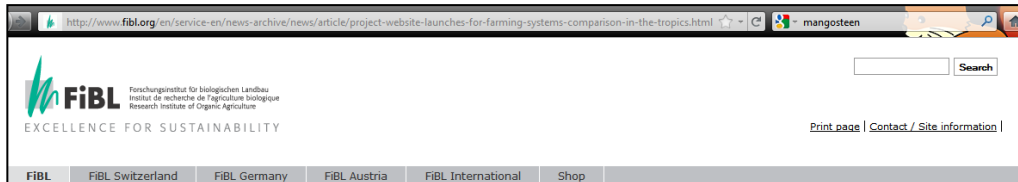
# PhD projects

- Nitrogen and water dynamics in organic and conventional systems in the Sub-humid highlands of central Kenya. **University Hohenheim**
- The Contribution of Organic Farming to Ecological and Socioeconomic Resilience in a Changing Climate – A Comparison of Different Cocoa Cultivation Systems in Alto Beni, Bolivia. **University Berne, CDE**
- 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](http://www.systems-comparison.fibl.org)







# **SysCom India**

## **Methodologies and results from LTE and PTD**

# 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:

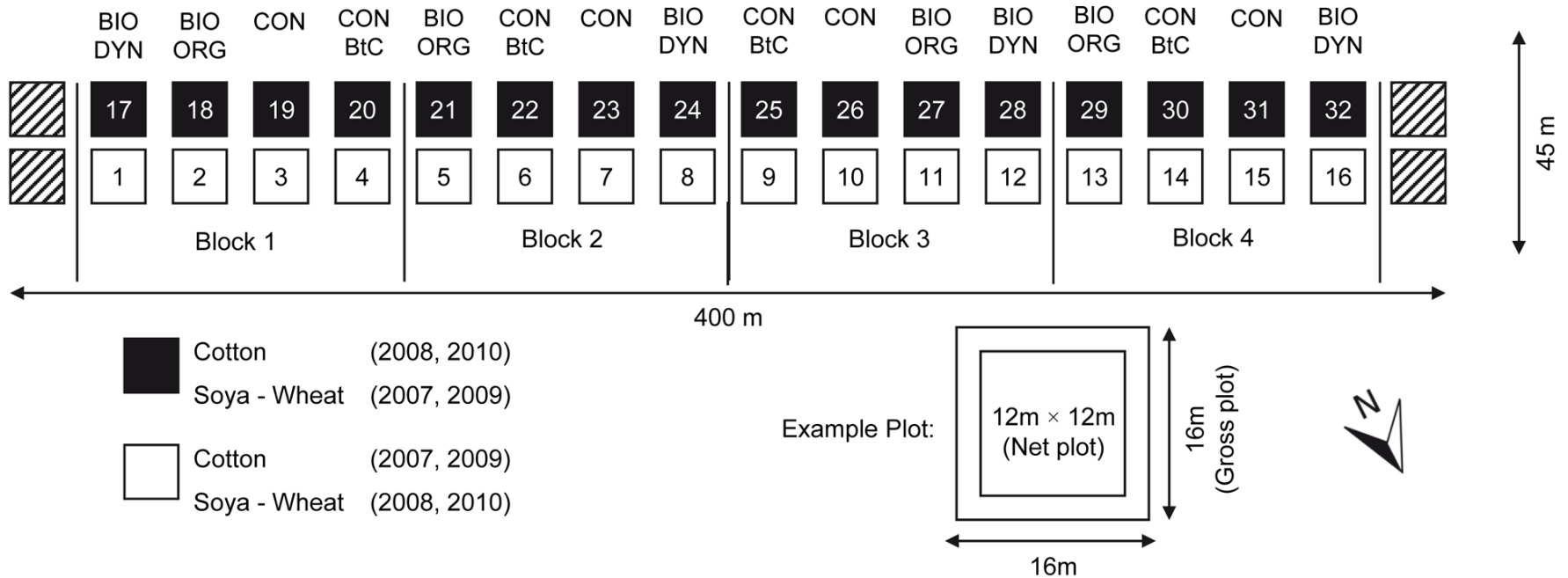
Year 1	Year 2	
Cotton	Soya	Wheat



bioRe Association



# 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*

Particular	BIODYN	BIOORG	CON	CON-GM
Genetic material (cotton)	Non- <i>Bt</i>	Non- <i>Bt</i>	Non- <i>Bt</i>	<i>Bt</i>
N input [kg ha <sup>-1</sup> ]	100	100	150	170
Green manuring	Yes	Yes	No	No
Weeding	Manually	Manually	Manually Herbicide	Manually Herbicide
Plant protection	Organic pesticides	Organic pesticides	Synthetic pesticides	Synthetic pesticides
Irrigation	Yes	Yes	Yes	Yes
Special treatments	Biodyn. P.	No	No	No

*Relatively intensive production system*

# LTE India: 1<sup>st</sup> peer-reviewed publication

## Title

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

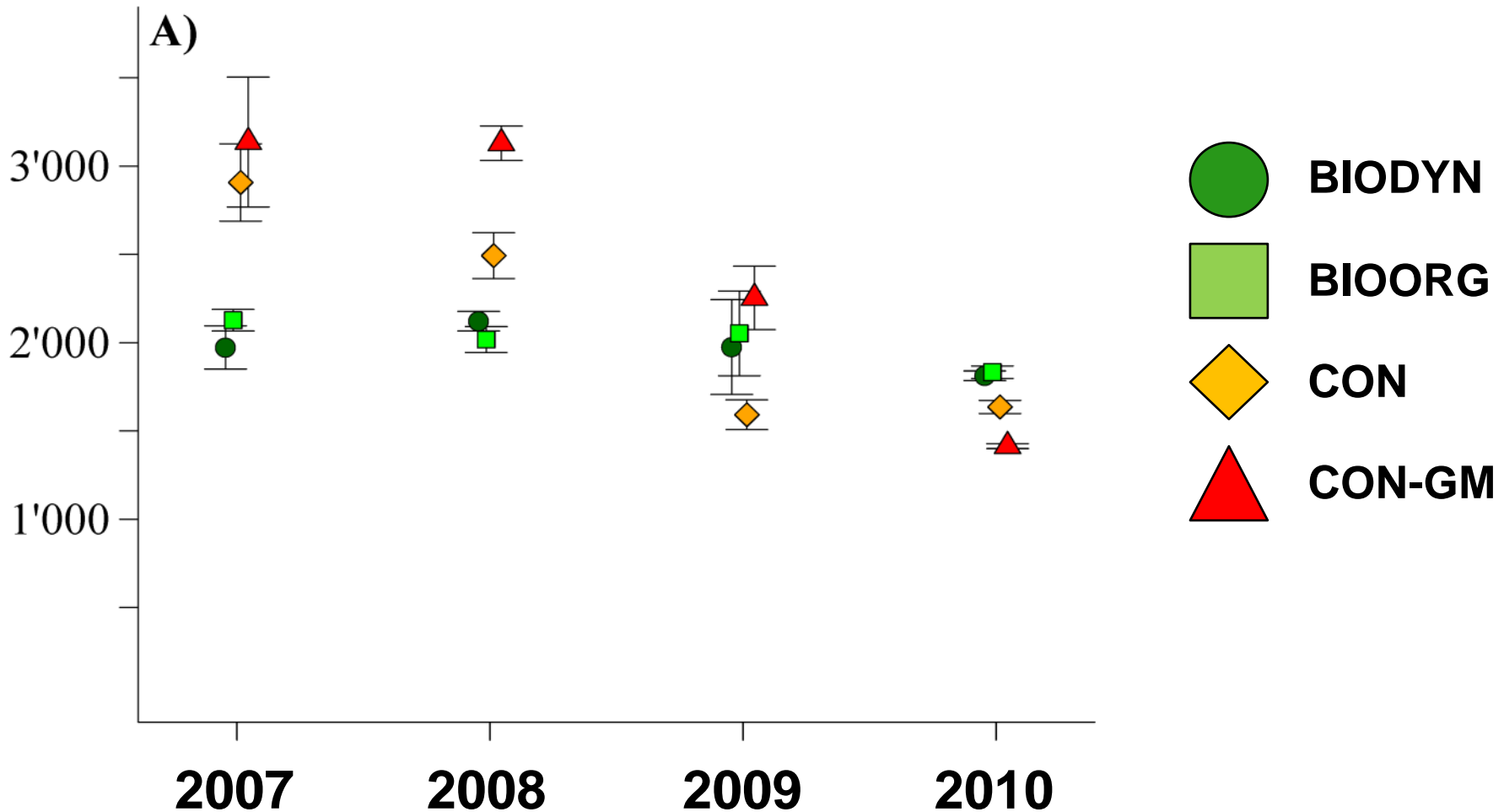
## Main aspects

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

Resubmitted in July 2013

# LTE India: Results cotton yield

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





# 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



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

## II. Dissemination of information gathered in stage 1

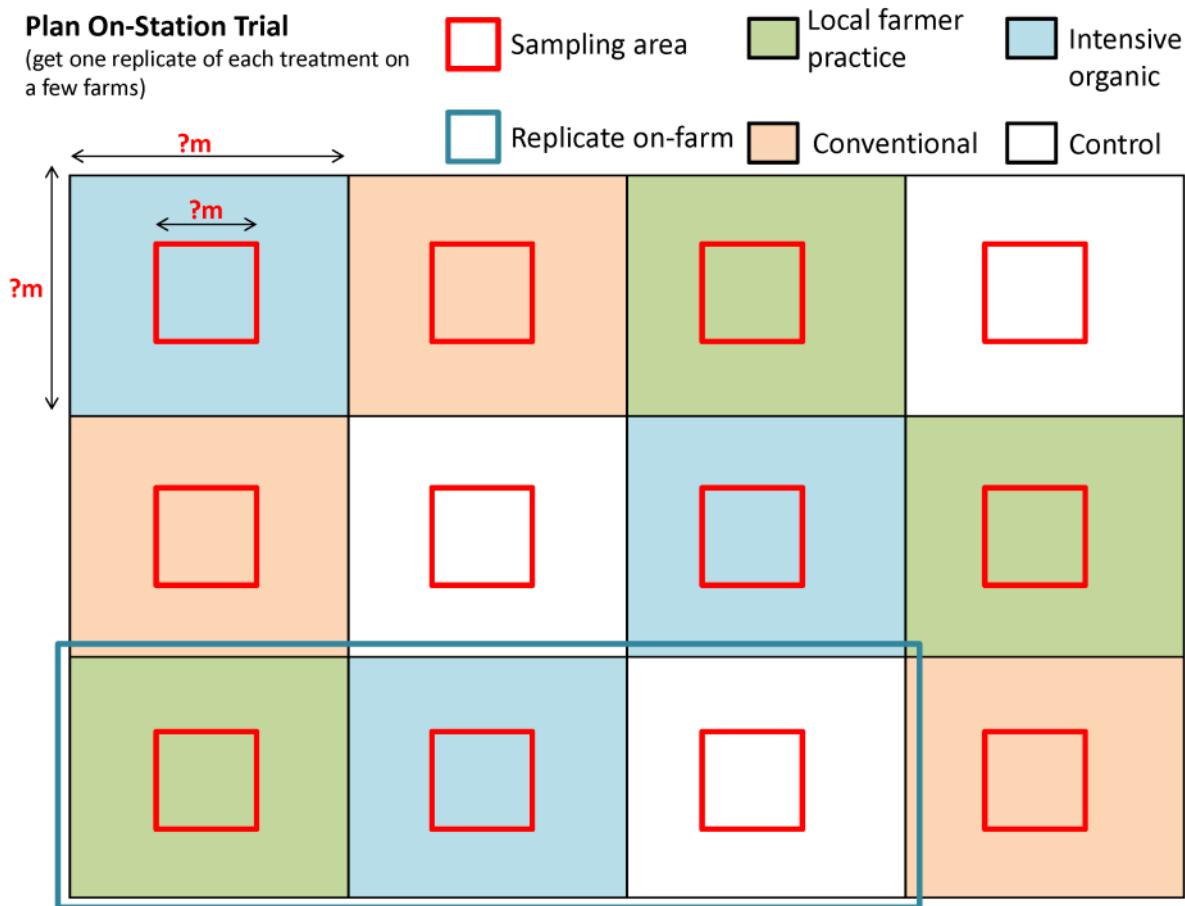




# PTD India: Organic pest management


(in between stage 1 and 2)

## 1. On-station field trial



# Thank you for your attention!



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Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

Direktion für Entwicklung  
und Zusammenarbeit DEZA

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ENTWICKLUNGS-  
DIENST 



Sustainability fund

  
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 **FiBL** [www.fibl.org](http://www.fibl.org)

  
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**icipe**  
African Insect Science for Food and Health