



Long-term farming systems comparisons in the tropics

What is the contribution of organic agriculture to sustainable development?

Gurbir S. Bhullar, Monika Schneider, Noah Adamtey, David Bautze,
Amritbir Riar, Laura Armengot, Harun Cicek, and Beate Huber

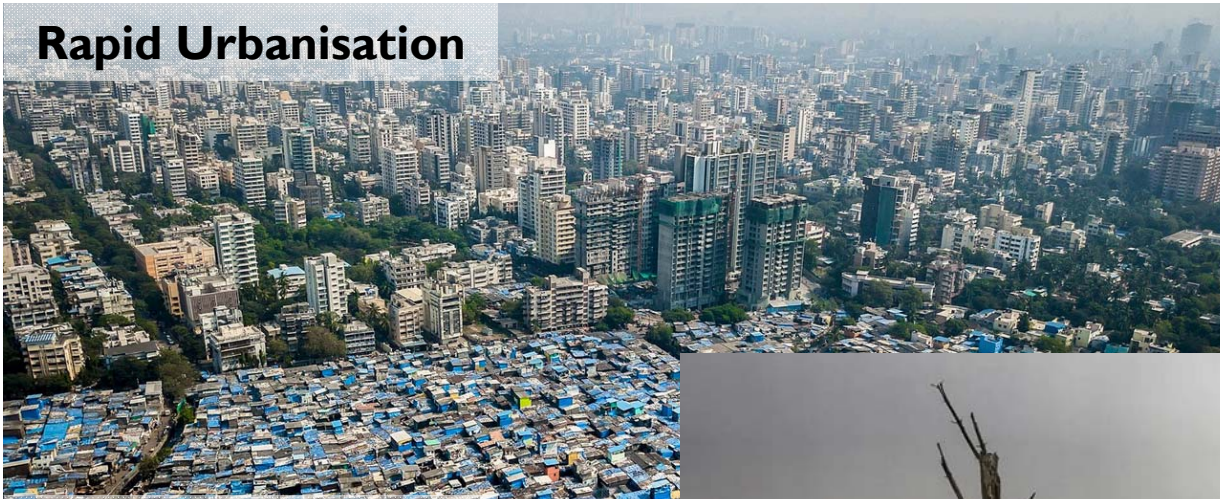
Farming systems for the future – SFIAR Award ceremony and public discussion

ETH Zurich

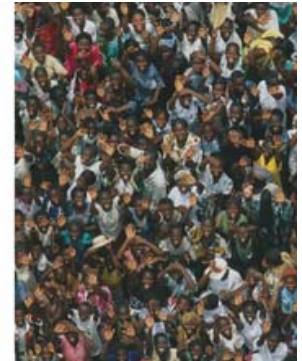
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Agricultural systems face multifaceted challenges More so in the Tropics

Rapid Urbanisation



“Population in the Tropics will grow by 1.6 billion people by 2050, accounting for over 75% of global growth.”



Small farm holdings



Climatic extremes

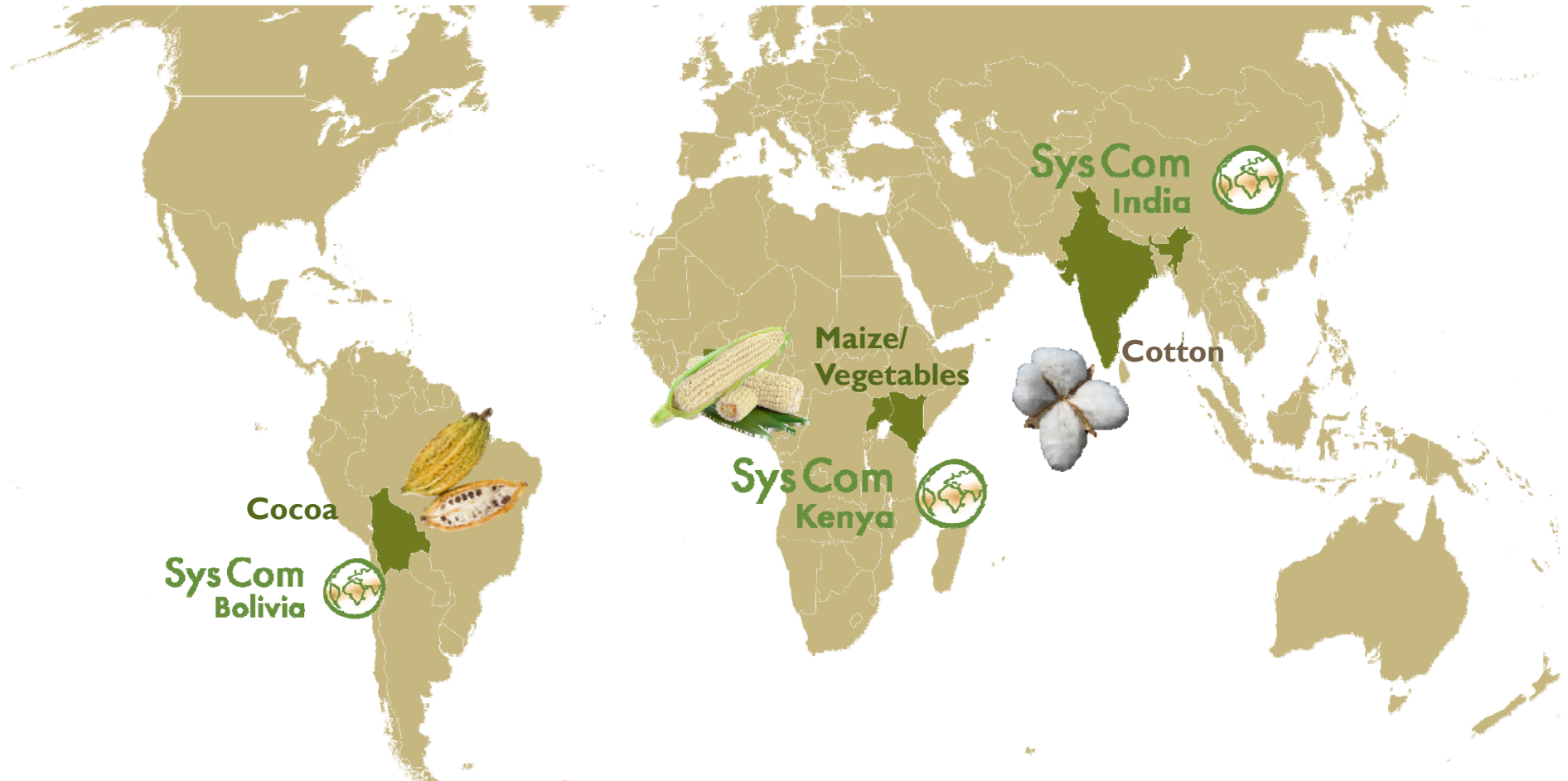


Tough policy choices



SysCom

Long-term Farming **S**ystems **C**omparisons in the Tropics



Unique combination of Long-term On-station research trials with
Participatory on-farm research

LTE - Kenya



Treatments:

- Conventional, high input
- Conventional, low input
- Organic, high input
- Organic, low input



LTE - India



Treatments:

- BT Cotton (GMO)
- Conventional
- Organic
- Biodynamic



LTE - Bolivia



Treatments:

- Conventional, monoculture
- Organic, monoculture
- Conventional, agroforestry
- Organic, agroforestry
- Organic, successional agroforestry
- Fallow



Agroforestry

Monoculture

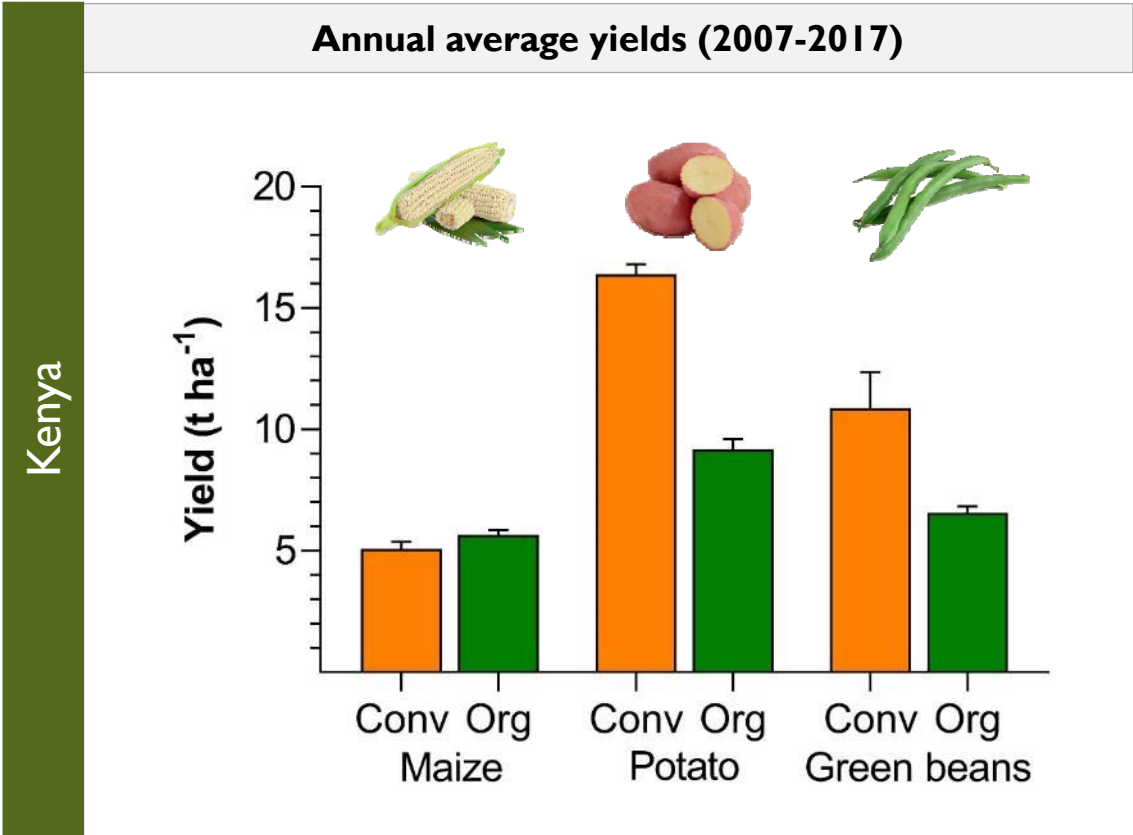


**SELECTED RESULTS
FROM
(SysCOM) LONG-TERM EXPERIMENTS
IN KENYA, INDIA AND BOLIVIA**



Productivity & Profitability

▶ Crop yields in high input systems - Kenya

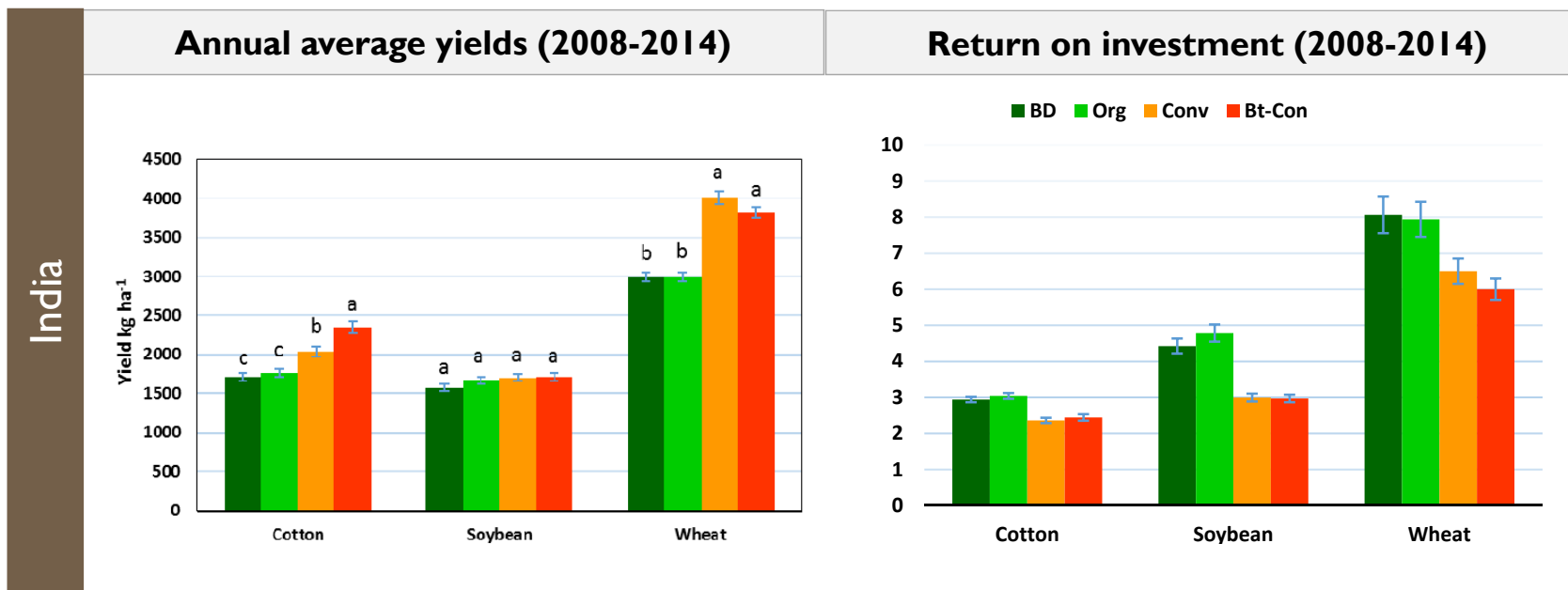


- ▶ Maize yields similar in conventional and organic.
- ▶ Potatoes and green beans yields are lower in organic (→ pest and diseases!)

Source: Adamtey et al. (2016) & Bautze et al. (unpublished)

Productivity & Profitability

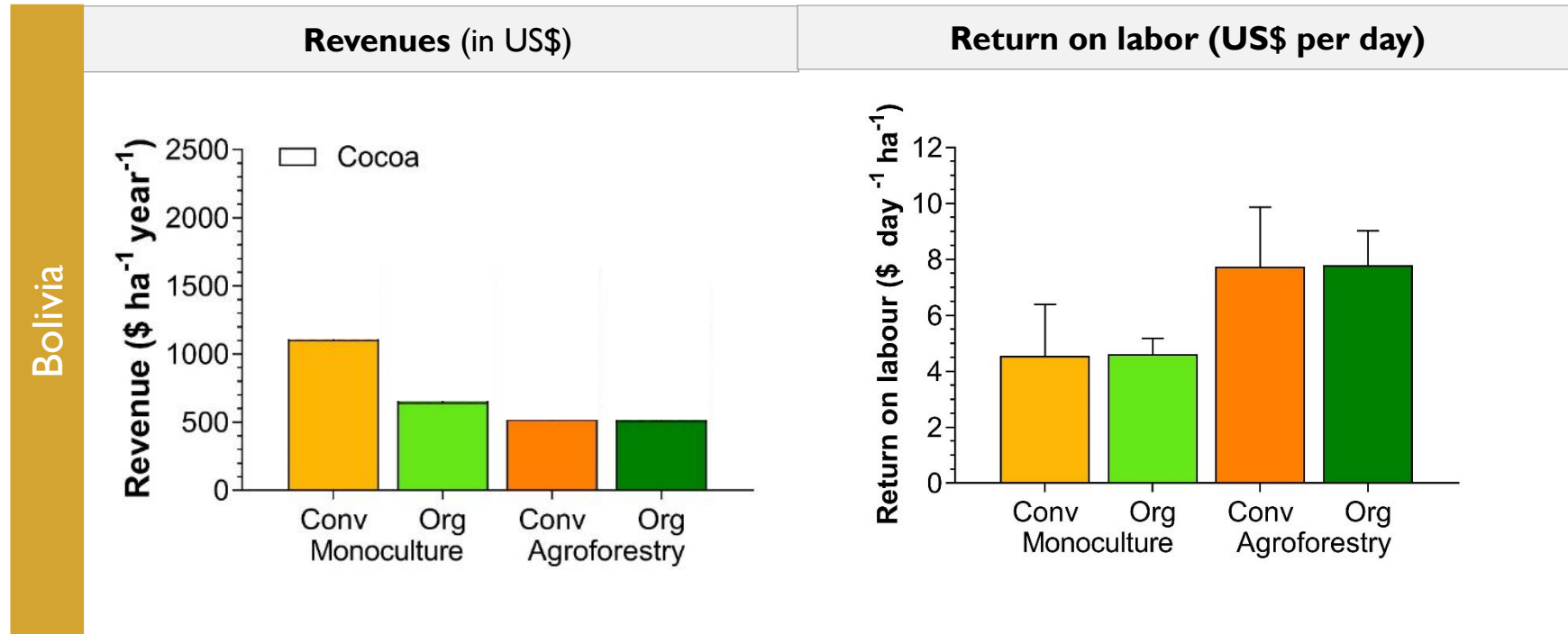
▶ Crop yields and economic differences - India



- ▶ Cotton and wheat yields lower in organic, soybean yields equal
- ▶ Organic production systems can have equal or higher gross margins
- ▶ Organic production systems have higher Return on Investment
- ▶ Organic production is highly relevant for resource poor farmer

Productivity & Profitability

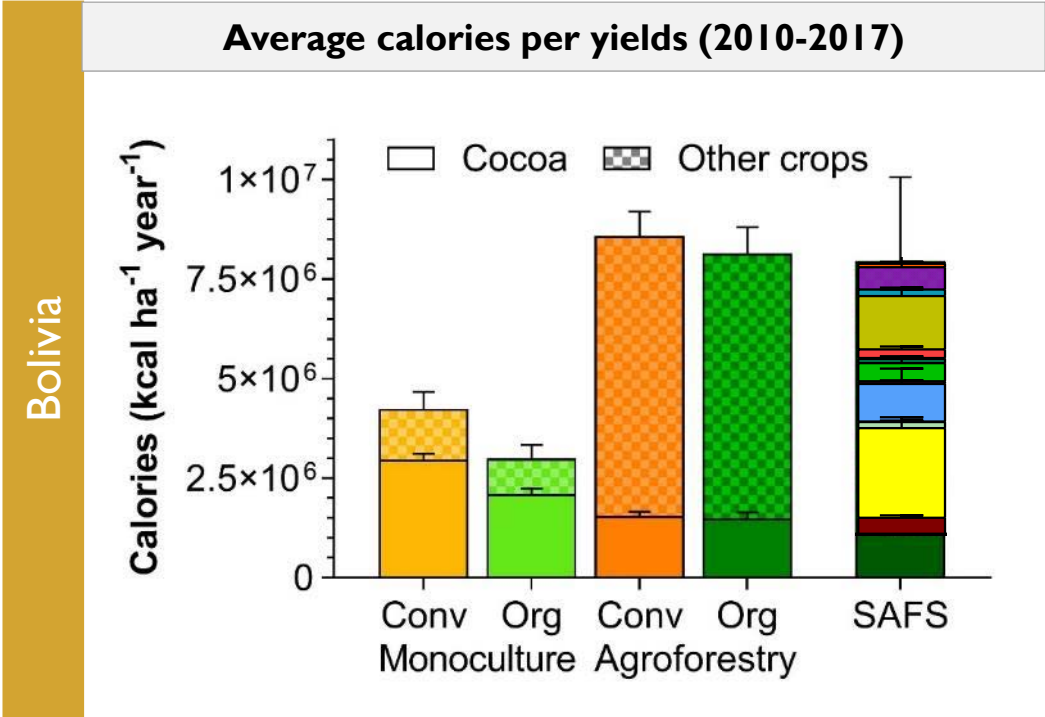
► Revenues and Return on Labor (initial 5 years) - Bolivia



- Revenues from cacao higher in monoculture compared to agroforestry.
- Revenues from by-crops in agroforestry overcompensate lower cocoa yields.
- Costs lower in agroforestry and organic systems: less fertilizer, less/no herbicides
- Higher Return on labor in Agroforestry Systems

Nutrition potential

► Calories of yields of the different crops

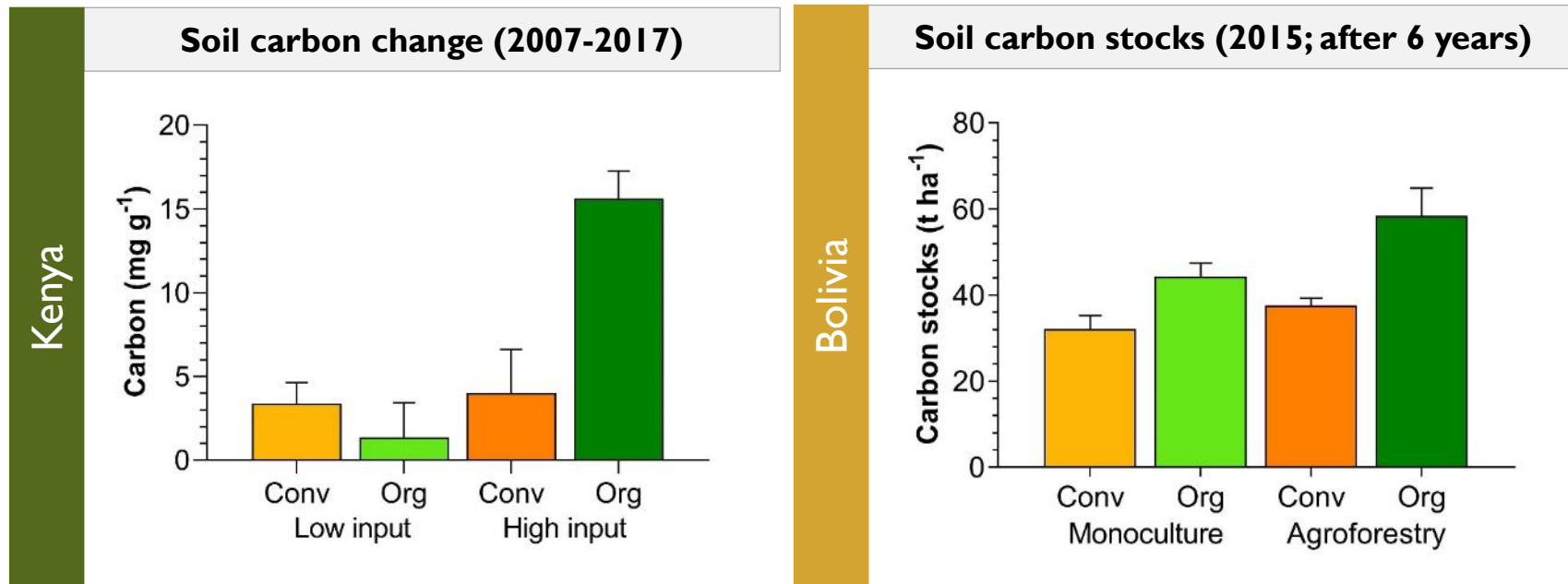


- Higher cumulative yields in agroforestry systems.
- Higher calorie production in agroforestry systems
- Diversity of nutrition in agroforestry systems



Soil organic carbon

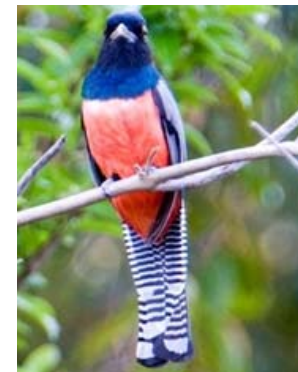
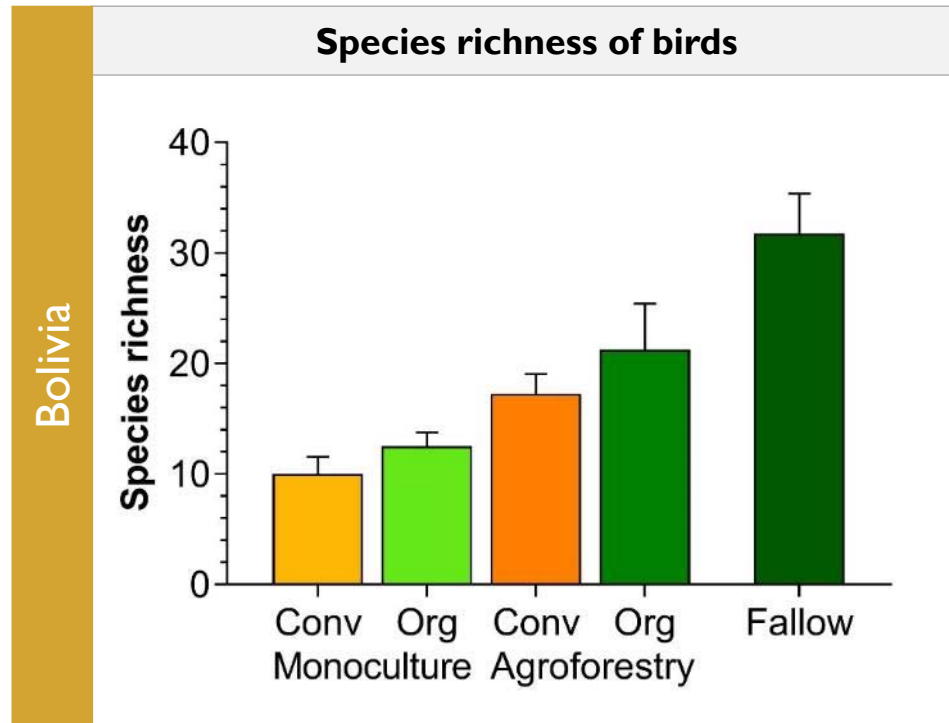
▸ Kenya and Bolivia



- Soil carbon in organic is higher in High Input systems compared to conventional
- Soil carbon is lowest in organic Low Input systems (soil depth 0-20cm)
- Soil carbon in agroforestry and in organic systems is higher compared to monocultures / conventional (soil depth 0-10cm)

Biodiversity conservation

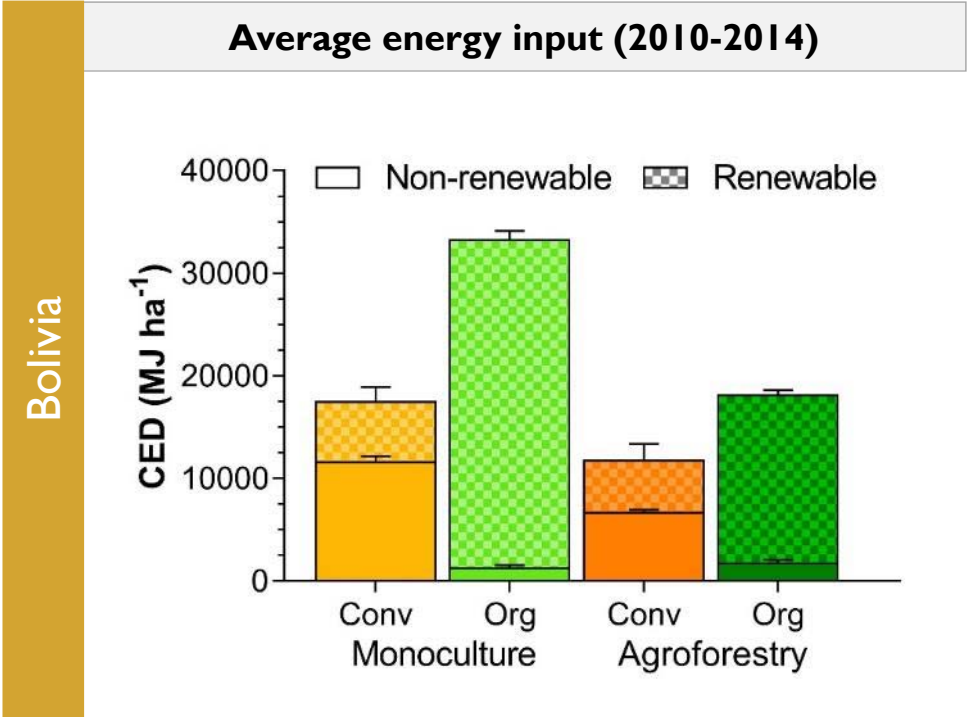
► Birds - Bolivia



- Agroforestry production systems have higher species richness of bird species compared to monocultures.
- Agroforestry is lower compared to fallow (secondary forest) of the same age.

Resource use efficiency

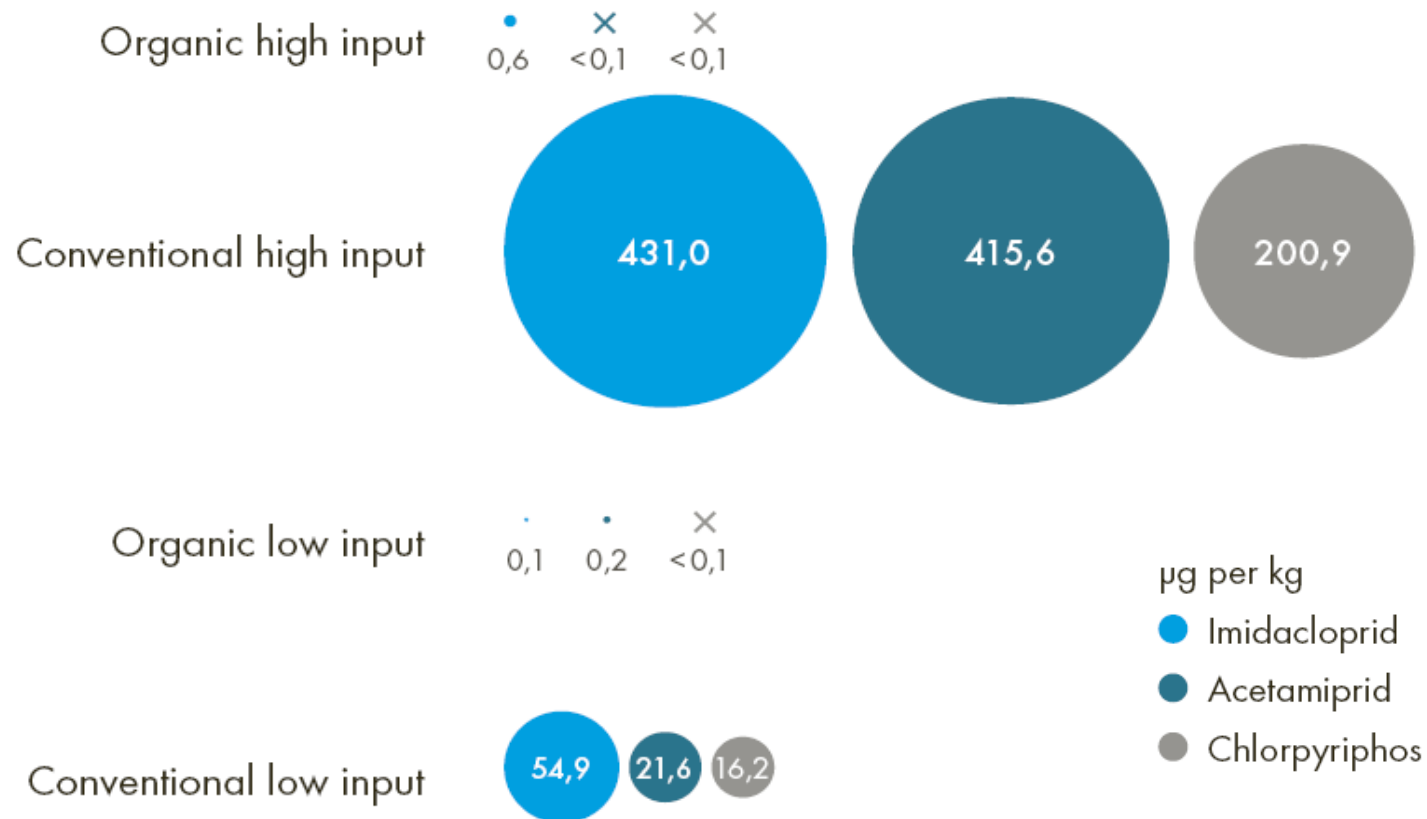
► Renewable and non-renewable energy input - Bolivia



► Non-renewable energy inputs substantially higher in the conventional systems

Nutrition potential

▸ Pesticide residues in vegetables - Kenya



▸ Conventional crop products are prone to be contaminated with toxic chemicals

Participatory On-farm Research (POR)

to develop locally adapted technologies together with the local farmers



Capacity development

- ❖ 46 young academics – PhD, MSc and BSc students
- ❖ 30 research staff in the partner countries
- ❖ About 1000 farmers and practitioners participate in farmer meetings, group discussions, field days and training workshops every year.



Dissemination and Policy Engagement

- ❖ More than 25 peer reviewed publications (mostly open access).
- ❖ Dozens of conference contributions, dissemination events and media outputs.
- ❖ 2 policy releases
- ❖ Several stakeholder meetings with policy and sector (organic, cocoa and cotton) relevant stakeholders
- ❖ Leaflets and brochures freely available on SysCom website



Key Messages:

- The productivity of crops in organic and conventional systems varies with type of crop grown – Soybean and maize produce equal yields, while there is yield gap for wheat, cotton and vegetables.
- In annual crops, productivity in organic production is primarily limited by nutrient availability and pest & disease damage.
- With higher returns on labor and higher return on investment (benefit-cost ratio) organic and agroforestry systems are economically interesting for small holder farmers
- Organic agriculture can contribute to enhancing soil fertility, biodiversity, resource conservation and improved produce quality
- Capacity development of farmers and local stakeholders is of key value for development of sustainable food systems
- Institutional/governance challenges (markets, agri-business) and policy issues need to be addressed along with agronomic/technological challenges



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