Organic World Congress 2020 | FRANCE

SEPTEMBER 21ST TO 27TH, 2020 IN RENNES
AT THE COUVENT DES JACOBINS • RENNES MÉTROPOLE CONFERENCE CENTRE
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OWC 2020 Paper Submission - Science Forum

Topic 3 - Transition towards organic and sustainable food systems

OWC2020-SCI-928

WHAT IS THE CONTRIBUTION OF ORGANIC AGRICULTURE TO SUSTAINABLE DEVELOPMENT? RESULTS OF 10 YEARS FARMING SYSTEMS COMPARISON IN THE TROPICS (SYSCOM)

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Preferred Presentation Method: Oral or poster presentation

Full Paper Publication: Yes

Abstract: Tropic will be the epicentre for food production as population will sore from 7 billion to 10 billion by the end of century. It is imperative to explore the potential of different food production system in tropics. In 2006-07 FiBL started the 'Long-term Farming Systems Comparison in the Tropics (SysCom) Program' in collaboration with local partners in three tropical countries to produce scientifically sound data on the agronomic, ecological and socio-economic performance of organic and conventional production systems over a long-term. The program comprises of a network of four long-term experiments (LTEs) in Kenya, India and Bolivia, in concert with participatory on-farm research (POR) aimed at developing locally adapted sustainable technologies. Our research in the tropics shows that organic agriculture and agroforestry systems have large potential to contribute to sustainable development especially in the field of soil fertility and biodiversity conservation while productivity and profitability are usually equal. Yet, for full exploitation of the benefits of organic agriculture major efforts are needed to tackle agronomic/ technological challenges (lack of input, pest management), capacity development for farmers (technical know how) and institutional/governance challenges (markets, agri-business).

Introduction: Organic agriculture (OA) is advocated for its benefits to human health, environment and socio-economic well-being of farming communities. However, there are concerns about its productivity and economic sustainability. Research conducted mainly under temperate conditions in developed countries has demonstrated the potential of OA. However, empirical evidence on the performance of OA under tropical conditions is still limited. Tropical agriculture is typically characterised by small to medium holder farms with limited availability of resources. Besides being global ecological hotspots, tropics are projected to inhabited more than half of global population by middle of this century.

Material and methods: In 2006-07 FiBL started the 'Long-term Farming Systems Comparison in the Tropics (SysCom) Program' in three tropical countries (representing Africa, Asia and South America) in collaboration with local partners. The program comprises of a network of four long-term experiments (LTEs) in Kenya, India and Bolivia, in concert with participatory on-farm research (POR) aimed at developing locally adapted sustainable technologies.

Long-Term Experiments (LTEs) produce scientifically sound data on the agronomic, ecological and socio-economic performance of organic and conventional production systems over a long-term. Experiments reflect the best practices of local farmers for prevalent cropping systems in each context.

In Bolivia, cocoa as the main cash crop is cultivated in organic and conventional monoculture as well as in agroforestry systems. Agroforestry systems include timber, palm and legume trees, as well as by-crops such as bananas, coffee, ginger and peach palm.

In India, an annual cash crop based production system is being studied with a 2-year crop rotation including cotton, soybean and wheat crops grown under four farming systems, namely biodynamic, organic, conventional and conventional with Bt-cotton.

In Kenya, four treatments comprising conventional and organic management at two input levels are studied in a 3-year crop rotation with maize, beans, potatoes and vegetables. The low-input treatments reflect rainfed subsistence farming while high-input treatments reflect irrigated commercial-scale production.

Results: Yields…

-of maize and soybean in Kenya and India were similar in organic and conventional systems.

-of wheat and cotton in India were about 20% lower in organic systems.

-of vegetables in organic systems (in Kenya) were particularly lower due to severe pest damage.

- in agroforestry systems (whether organic or conventional) were comparable or higher to global average cocoa yields (where monoculture is dominating).

- in agroforestry systems were substantially higher compared to monoculture when all food products (cocoa, plantain, banana, coffee, other fruits/cereals/tuber crops) were counted. Especially, bananas in agroforestry systems contribute to high system yields.

Organic carbon in the soils of organic systems was higher compared to conventional.

Nutritional output in terms of calories and nutrients in agroforestry systems were substantially higher compared to monoculture system.

Crop yield development in India (2007 – 2019)

Cumulative crop yields in Bolivia (2010-2017)

Discussion: Our research in the tropics shows that organic agriculture respectively agroforestry systems have tremendous potential to contribute to sustainable development especially in the field of soil fertility and biodiversity conservation while productivity and profitability is comparable. . Higher returns on investment and higher labour productivity make organic and agro-forestry systems interesting for resource-poor small-holder farmers. Yet, for full exploitation of the benefits of organic agriculture major efforts are needed to tackle agronomic/ technological challenges (lack of input, pest management), capacity development for farmers (technical know how) and institutional/governance challenges (markets, agri-business).

Productivity:

In annual crops, productivity in organic production is primarily limited by nutrient availability and pest & disease damage. Legumes, being capable of supplying themselves with nitrogen through (symbiotic nitrogen) fixation from air achieved similar yields in organic and conventional systems.

Slow nutrient (N and P) release from organic manures in organic systems leads to lack of sufficient nutrient availability at crucial crop growth stages, limiting yield particularly for high nutrient demanding crops such as wheat, cotton, maize. Adjustments in timing and quality of organic fertilizers (e.g., compost and manure) as well as, novel strategies of legume and green manure incorporation into cropping systems are promising options.

In perennial crops (cocoa), complexity of the cropping systems (monoculture vs. agroforestry) has more influence on productivity than type of management (organic vs. conventional).

Profitability:

In organic systems, labour – for fertilizer preparation and weeding – is a prominent factor contributing to production costs, where as in case of conventional systems, it is mainly determined by costs for external inputs. High labour costs and low mechanisation lead to increased production costs where more time is needed for fertilizer preparation and weeding.

Lower costs for external inputs and higher market value of organic produce can often compensate the economic loss due to lower yield in organic systems.

Depending on the crops, economic returns on production costs or returns on labour are higher in organic, making it a suitable option for small holder farmers.

Soil fertility

Organic systems build up soil fertility over a long-term, demonstrated by higher build-up nutrients (e.g. N, K), higher biological activity, and improved soil-physical and chemical properties. After a decade of continuous organic inputs, soils start to build up carbon. There were only little changes in conventionally managed soils. Nutrient management practice in organic need to be further improved to enhance nutrient availability at key crop stages.

References: For more information see https://systems-comparison.fibl.org/about.html

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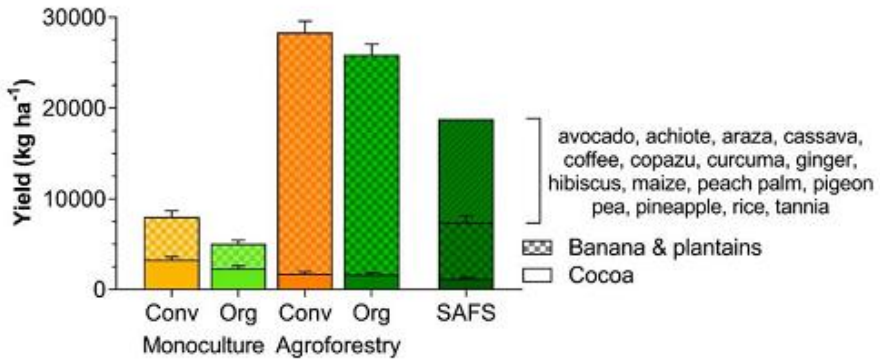
Image:



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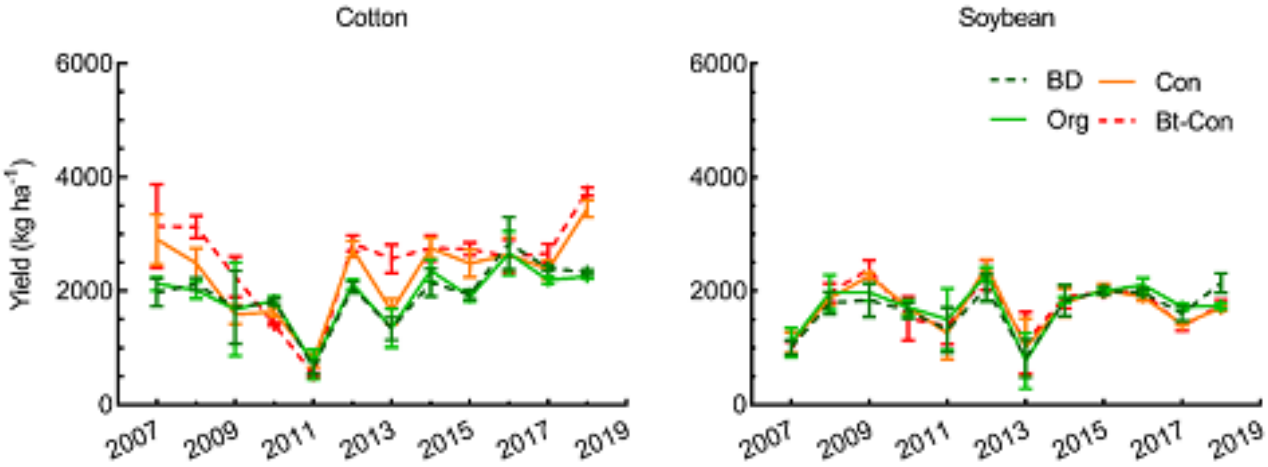

Disclosure of Interest: None Declared

Keywords: agroforestry systems, long term experiment, profitability and productivity, sustainable development, systems research, tropical agriculture