Research on organic agriculture and other agroecological approaches in view of the SDG’s

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Content

• Organic agriculture as part of the agroecology strategy.
• Shortfalls of research activities organic agriculture/agroecology.
• Ways forward.
• Conclusions.
While sustainable intensification is generally loosely defined, so that almost any model or technology can be labeled under it, ecological intensification proposes landscape approaches that make smart use of the natural functionalities that ecosystems offer. The aim is to design multifunctional agroecosystems that are both sustained by nature and sustainable in their nature.” (Tittonell, 2014)
Relevance of organic farming: Organic farmland in 2017

**World**

- **69.8 Mio ha**

In Oceania there were 35.9 Mio ha, in Europe 14.6 Mio ha, and in Latin America 8 Mio ha.

**1.4% of the world’s farmland is organic**

- **+533% since 1999**

14 countries have 10% or more of their agricultural land under organic management.

In 2017, over 11.7 million hectares more were reported compared with 2016.

**Global markets:**

- **90 billion €**

Increasing trade from low income to high income countries.

**Distribution of organic agricultural land by region 2017**

Top 5 countries with more than 10 percent of organic agricultural land 2017

- **Liechtenstein**
- **Samoa**
- **Austria**
- **Estonia**
- **Sweden**

Global sales of certified organic foods (from 1999 to 2017)

**Growth of the organic agricultural land 1999-2017**

**Global markets:**

- **90 billion €**

Increasing trade from low income to high income countries.

**Source:** FiBL survey 2019  www.organic-world.net – statistics.fibl.org

www.fibl.org
Shortfalls of research activities organic agriculture/agroecology.
Productivity in terms of yields is a challenge for organic and agroecological practices

\[ \text{Org. Yield} = 0.81 \times \text{Conv. Yield} - 0.15 \]

\[ R^2 = 0.81 \]

(Tittonell, 2014)
Resource and input efficiency

Transformation of natural resources

- Natural soil fertility (rocks, relief, climate, living organisms)

Transformation of short- and long-acting anthropogenic measures

- Synthetic fertilizers.
- Fossil fuels.
- Synthetic plant protection agents.
- Soil tillage.
- Crop rotation.
- Biologically based and natural plant protection agents.
- Organic fertilizers, (green) manure.

Momentary natural influences

- Weather, air quality, pests, pathogens

Outcome

- Yield
- Aqui-red soil fertility
- Ecosystem services

Wilbois & Niggli, submitted

www.fibl.org
A sustainable economy is defined by 3 narratives:

**(Eco-)Efficiency:** More output with less input and less environmental footprint

**Consistency:** Adaptation to territorial, cultural and socio-economic context, resilience, anthropogenic and natural flow of material compatible, cradle-to-cradle.

**Sufficiency:** Reduction of consumption and waste, temperance, avoidance of rebound effects

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**Sustainable Food Systems**
DOK long term comparison experiment, in Switzerland: One from < 300 field studies

- running since 1978
- 7 year crop rotation (P-WW-Veg-WW-WB-GC-GC)
- 0 – bio dynamic - organic - IP - conventional
- Loess soil, 833 mm precipitation, 9.4 °C temperature
Organic farming: best ecological performance in temperate zones
(Swiss DOK-trial 1978 – today)

- Yields (5 x 7 years)
- Nutrients efficiency
- Energy efficiency
- Soil percolation stability
- Soil aggregate stability
- Abundance of beneficials
- Earthworm biomass
- Microbial biomass
- Enzyme activities
- Mycorrhiza
- Energy efficiency of MO
- Weed diversity

IPM stockless

IPM plus manure

Organics

Mäder et al. 2002, Science
Estimated annual spending on organic farming research

Optimistic guess: 290 million US$ = less than 1%

Source: Niggli et al. (2017) A global vision for organic farming research. TIPI & FiBL
Ways forward

Organic and agroecological research programmes are characterized by system integration. This requires appropriate teams, scientists and methods.

“Even in oral traditions, agriculture has always been perceived as a system. More than ever, the science of agriculture stands at the centre of a broader system integrating human society and its physical environment.”

Jean Mayer, 1974: Agriculture, the Island Empire. Tufts University, Medford, USA
Make better use of the strength of organic research: joint development work between scientists and farmers.
Plant breeding tailored to the needs of organic agriculture

- plant – fauna – microbe interaction
  = disease and pest tolerance or resistance

- plant – plant interaction
  = best performance in mixtures; competitive against weeds

- plant – soil microbe interaction

Monika Messmer, FiBL
Lost opportunities of indirect selection

Dry matter grain yield of maize breeding material group 151 across 3 locations in 2008

Most genotypes performing best under OF would be discarded by indirect selection under CF

$r_p = 0.36$
$r_g = 0.59$

Selected under CF

Messmer (FiBL), Schmidt (KWS)
The development of plant protection compatible to organic standards?
~ 50 % of global research is spent by pesticide, fertilizer & seed companies.

FiBL tested >> 3000 plant extracts of the library of the University of Basel on fungicidal effects

1% of the tested extracts of the tested extracts significantly inhibited spore germination of 1-3 pathogens.

Screening in the growth chamber and in the field; identification of active compounds in the plant extracts with GC-MS or HPLC, feasibility of mass production & formulation, EU registration

Lucius Tamm, FiBL 2017
Even more dramatic: veterinaria

E.g. antibiotics and anti-worm drugs (anthelmintics) in animal production

Bio control with *Duddingtonia flagrans* fungal strains (nematophagous fungus)

Infectious bursal disease (Gumboro) in young hens. Recombinant vaccines
Redesign of farming systems with modern technologies (digitalisation)

Redesign of farms and crop rotation towards higher system integration with precision farming (GPS, sensors, cameras, databases on soil quality, robots etc.).

Examples shown is a 3000 hectare organic farm in Argentina owned by the Thompkins family.
Capitalizing of organic agriculture on novel technologies

- Autonomous field mini-/micro-robots.
- Precision agriculture which foster diversity.
- Application techniques for organic inputs.
- Open source data.
- Integration of farmer knowledge in the algorithms
- Integration of public goods in the algorithms
Conclusions

- Productivity of organic agriculture can be considerably increased with more research funding.
- All low input-high output systems (organic, agroecology, LEISA even IPM) would equally profit from agronomically better solutions.
- There is a huge research gap in tropical and arid zones.
- Truly sustainable farming systems remain less productive.
- All 3 narratives of sustainability in combination contribute to the SDG’s.