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The most important knowledge gaps in organic food and farming systems

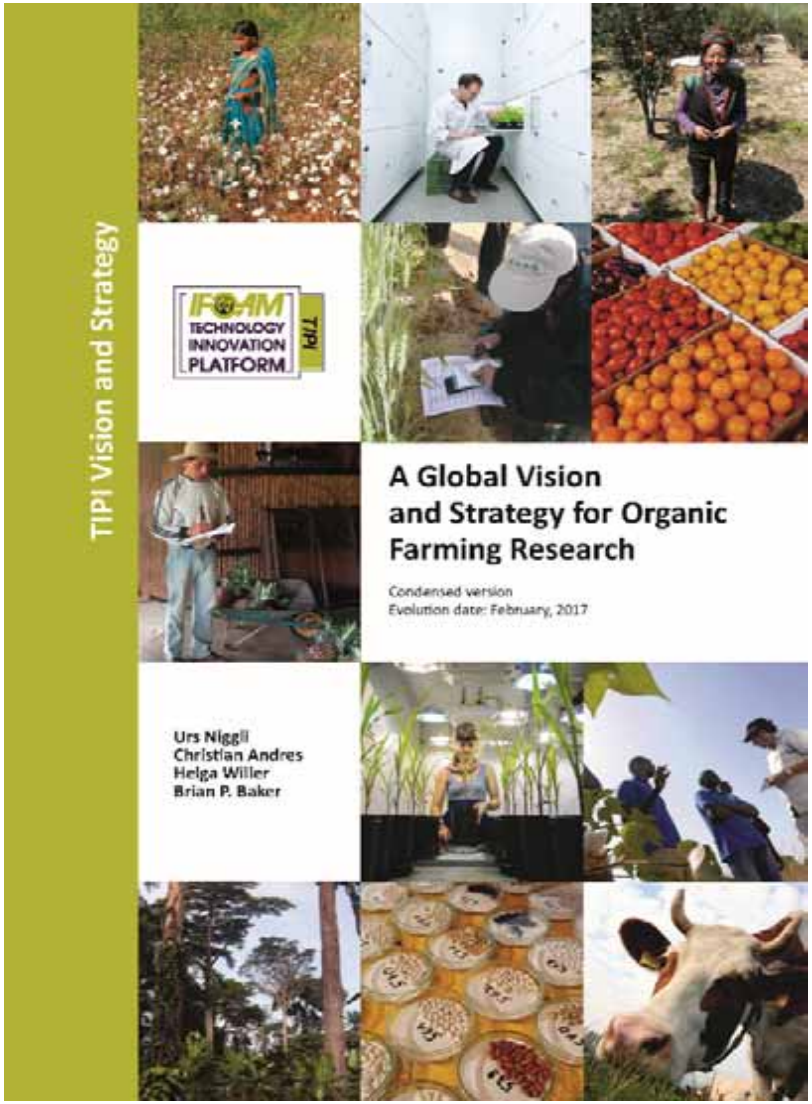
Christian Andres and Urs Niggli

TIPI – Pre-conference

Constitution Club of India, New Delhi

8th November 2017

TIPI Vision & Strategy



Different policies and challenges for organic farming research in tropical and temperate zones

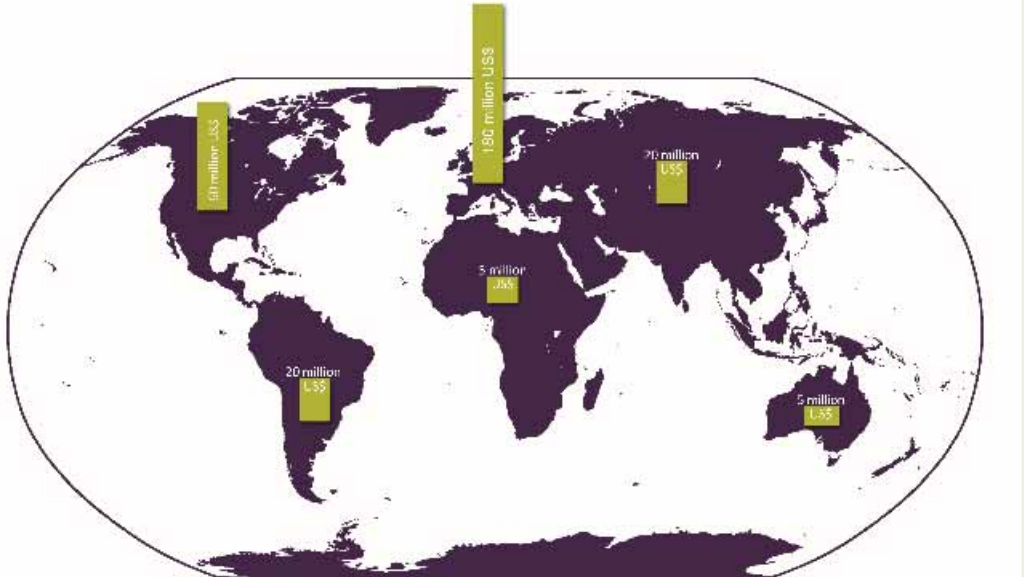
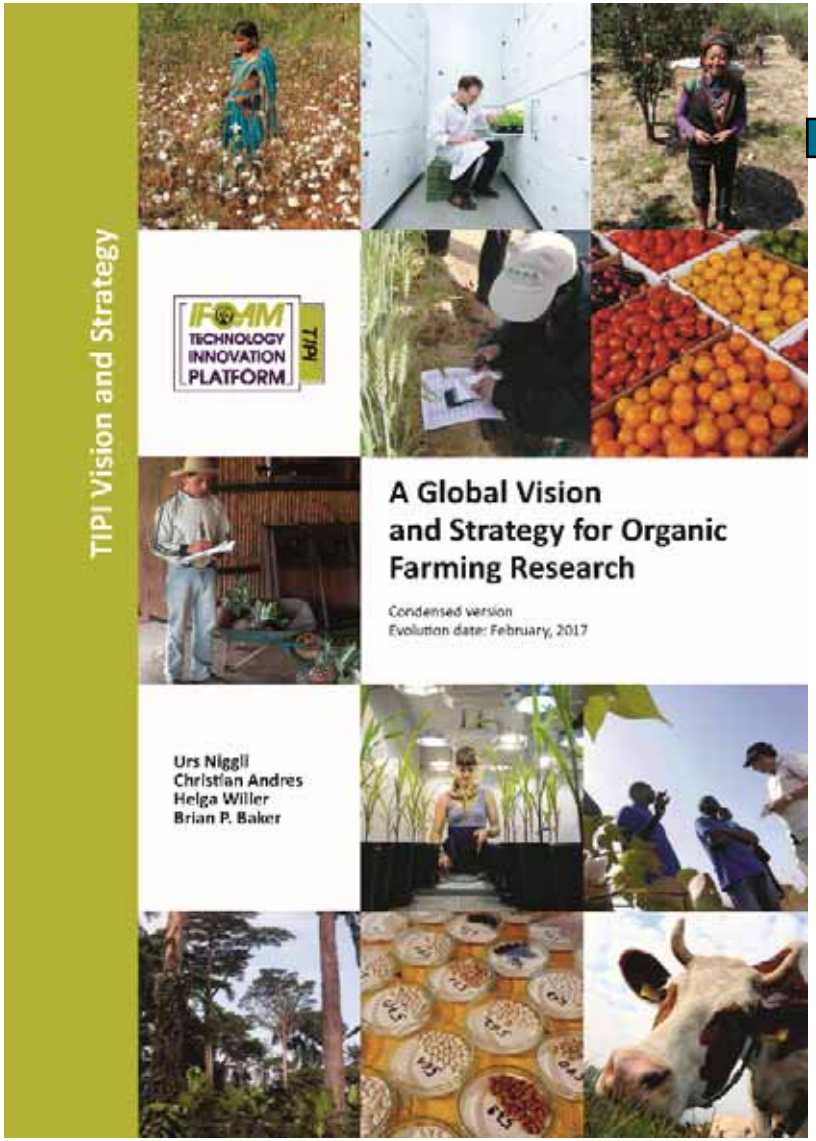


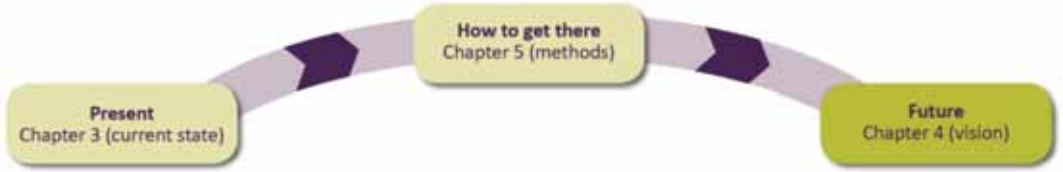
Figure: Annual spending on organic food and farming system research

Towards implementation of vision & strategy (process)



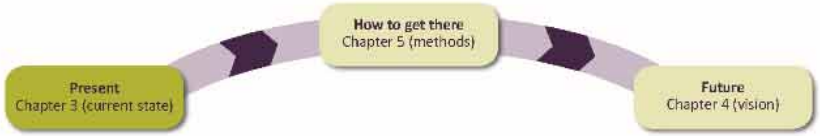
2. Strategic research agenda

3. Implementation action plan



1. Vision & Strategy (incl. str. action plan)

3 The current state of organic farming research



The next three chapters address the current state of organic farming research (chapter 3), TIPI's vision for the future development of organic farming until 2030 (chapter 4), and the strategy to move from the current state to the future (chapter 5).

3.1 Global overview

Agriculture faces the challenge of feeding a rapidly growing population while maintaining the capacity to provide for future generations. Future food production is jeopardized by unsustainable practices that lead to climate change, depletion of non-renewable resources, and water pollution. Holistic farming systems that ensure high productivity by making use of locally available resources and ecological processes are more suitable to meet these challenges than reductionist approaches whose focus is on maximum productivity alone [83]. Sustainable agricultural systems also rely on the traditional knowledge and entrepreneurial skills of farmers [40], and include both organic farming and agro-ecological methods.

International cooperation has the potential to uplift research on organic food and farming systems, which in turn may raise organic agriculture's productivity, improve livelihoods, preserve local cultures, maintain environmental services, and enhance the quality of rural areas. Organic food and farming systems can help smallholders in low-income countries diversifying and becoming locally self-sufficient in food, which may mitigate the adverse effects of exposure to price fluctuations on global markets of internationally traded commodity crops. Because results obtained in temperate zones cannot be readily transferred to (sub-)tropical and (semi-)arid zones, organic farming systems need to be adapted to local contexts and the associated socio-ecological trade-offs for sustainable agricultural intensification need to be studied.

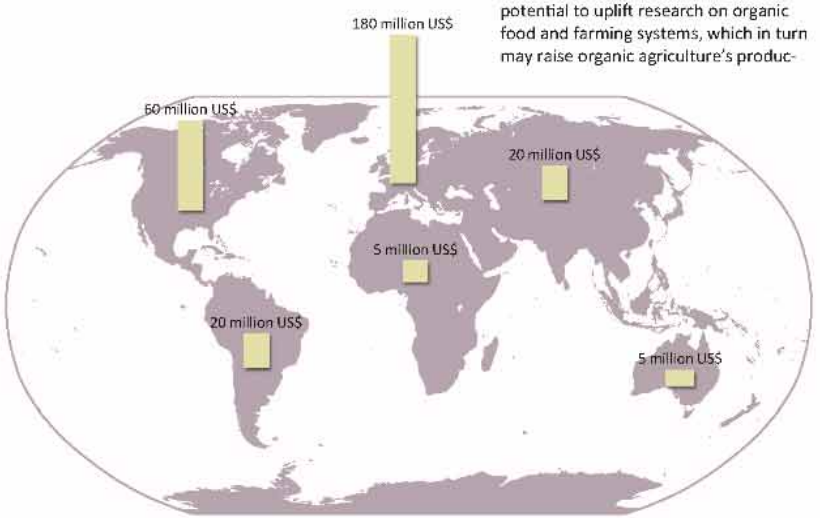


Figure 1: Annual spending on organic food and farming systems research, disaggregated by continents. 180 million = 0.4% of total research funding (estimations of FiBL).

Organic agriculture is based on IFOAM – Organic International's principles of health, ecology, fairness, and care [81]. Standards for organic production were developed from these principles to protect what it means in the marketplace. The integrity of organic food is verified by third-party certification and participatory guarantee systems (PGSs). To meet the growing demand for organic food and develop technologies that are consistent with organic principles, institutions around the world have built the capacity to conduct research on organic farming systems. However, those capacities are not evenly distributed, leading to research gaps, limited access to published results, and lags in technology transfer.

The highest annual spending on organic food and farming systems' research occurs in Europe and North America (Figure 1). Research is mostly carried out in a national context, but international coordination and collaborative efforts are increasing. However, only a few countries provide data on their funding for organic farming research.

Table 1: Evaluation of key indicators describing the performance of the organic sector worldwide.

Continent	Research (million US$)	Extension	Networks	Farmland (million hectares)	Share of total farmland (%)	Markets (billion US$)	Challenges
Africa	~ 5	poor	poor	1.7	0.1	<0.1	big, poorly addressed
Asia	~ 20	poor	insufficient	4.0	0.2	6.9	big, poorly addressed
Europe	~ 180	moderate	moderate	12.7	2.5	33.0	addressed with some progress
Latin America	~ 20	insufficient	moderate	6.7	0.9	<0.1	big, poorly addressed
North America	~ 60	insufficient	moderate	3.0	0.7	42.8	addressed, but insufficient
Oceania	~ 5	poor	poor	22.8	5.4	1.2	big, poorly addressed
World	~ 290	poor	poor	50.9	1.1	84.0	big, poorly addressed

Colour code: moderate | insufficient | poor

Sources: Research, Extension, Networks and Challenges: FiBL estimates.
Farmland and market data are figures for 2015 [82].

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The current state of organic farming research

Global overview

- Challenge: feed growing population while maintaining the capacity to provide for future generations
- Results obtained in temperate zones cannot be readily transferred to (sub-)tropical and (semi-)arid zones
- Institutions around the world have built capacity to conduct research on organic food and farming systems (OFFS).
- Capacity not evenly distributed, leading to research gaps, limited access to published results, and lags in technology transfer

Results survey on regional research needs in OFFS

Main questions are challenges relating to:

- Systems
- Field practices
- Inputs
- Pests and diseases of crops
- Livestock
- Socio-economy
- Post-harvest and processing

Results survey on regional research needs in OFFS (cont.)

Scale of issues:

- Global
- Africa
- Asia & Pacific
- Latin America
- Drylands of the World

- Europe
- US & trading partners
- Canada

Results survey on regional research needs in OFFS (cont.)

Challenges relating to systems:

- How do farming systems work (esp. in non-temperate zones)?
- Combining local tradition with innovation
  (Regional adaption of existing and proven solutions)
- Identification of contamination risks within the system

Ecofunctional intensification

Alto Beni, Bolivia, FiBL, Schneider & Jacobi 2014

Moniliophtora perniciosa
"Witches' Broom Disease"

Results survey on regional research needs in OFFS (cont.)

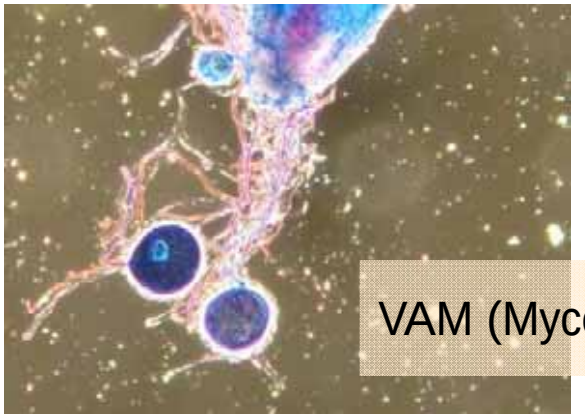
Challenges relating to field practices:

- Understanding soil-building factors and organisms
- Weed management (ecology, cultural practices, effective rotations, bio-herbicides)
- Further development of no-till and reduced till methods
- Biocontrol

Research into soil fertility and farm productivity

Ground beetles
(Carabides)

PGPR (Plant growth-promoting rhizobacteria)



VAM (Mycorrhizal fungi)

Factors of influence (by farmers):

soil tillage
crop rotation
(organic & green) manuring
xenobiotics

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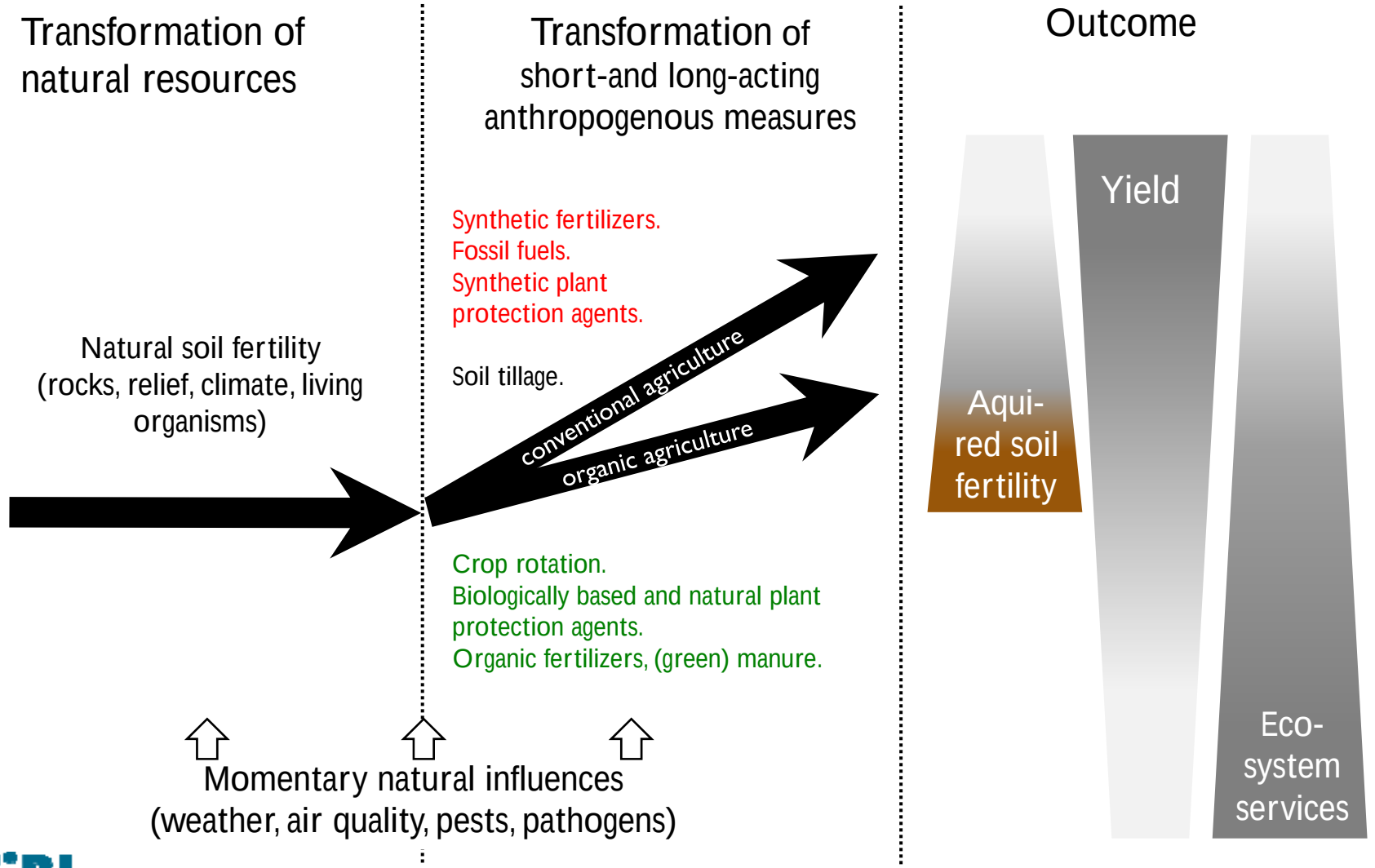
Crop productivity in organic & low input systems is also a challenge



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Niggli, Wilbois, 2017

Results survey on regional research needs in OFFS (cont.)

Challenges relating to inputs:

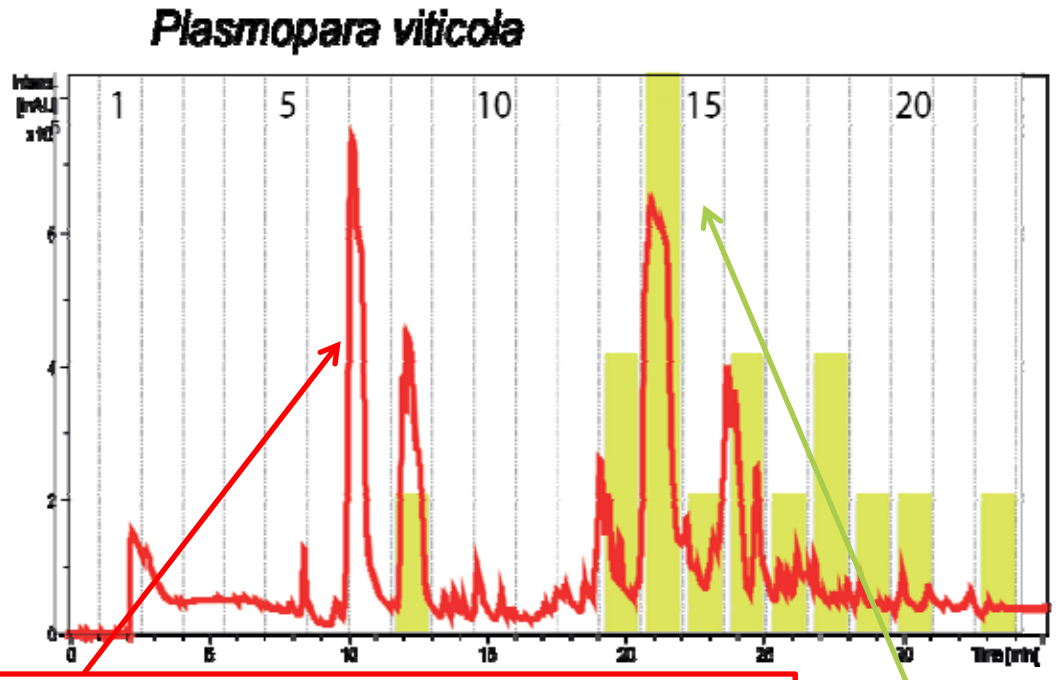
- Alternatives to copper
- Suitable varieties (breeding)
- Identification of micronutrient sources and adequate application techniques (iron, magnesium, selenium)

Results survey on regional research needs in OFFS (cont.)

Challenges relating to pests and diseases of crops:

- *Erwinia amylovora* (fire blight), *Drosophila suzukii and* brown marmorated stink bug (*Halyomorpha halys*) in US in fruits
- *Fitoplasma solanii* in wine
- Citrus greening virus (HLB) in citrus fruits
- Fruit fly, red spider mite, white moth
- Giant African Snail in leafy vegetables

Development of novel fungicides from plant extracts



HPLC- UV chromatogram

Fungicidal effects of fractions in micro-screening

In EU and Swiss projects more than 3000 plant extracts have been tested since 2009
> than 5 very promising candidates for formulation and registration.

Research into biocontrol with novel plant extracts, biocontrol organisms, physical methods and new application technology

Example with *Trichogramma* polyphagous wasps (endo-parasitoids) against European corn borer (*Ostrinia nubilalis*), applied by drones (see right) instead of by hand (see below).

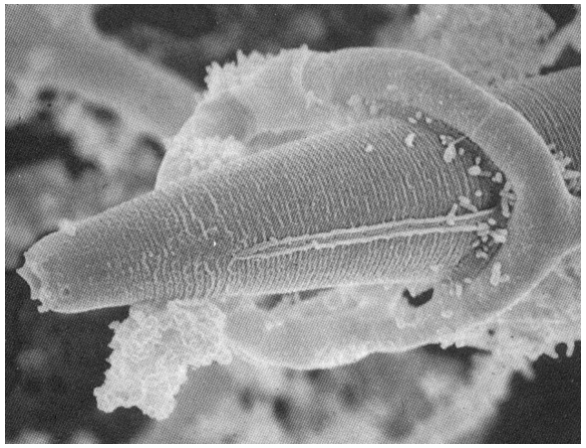
Results survey on regional research needs in OFFS (cont.)

Challenges relating to livestock:

- Preventive measures to improve livestock health
- Reduction of parasite pressure
- Mastitis prevention and therapy
- Pneumonia
- Natural sources of amino-acids (methionine)
- Alternative & additional feed (plant extracts)
- Aquaculture practices

Endoparasites (gastrointestinal worms) of grazing livestock (cattle, sheep, goat)

Breeding programs
for resistant traits



Bio control with
nemathophagous fungi
(*Duddingtonia flagrans*)

Bioactive fodder plants: esparset and chicory *(Onobrychis viciifolia, cichorium intybus var sativum)*

Felix Heckendorn and Veronika Maurer, FiBL

Results survey on regional research needs in OFFS (cont.)

Challenges relating to socio-economy:

- Factors of consumer trust in different regions
- True Cost Accounting
- Novel communication tools to reach different stakeholders

Results survey on regional research needs in OFFS (cont.)

Challenges relating to post-harvest and processing:

- Innovative organic cocoa processing
- Efficient cracking of indigenous nuts, solar drying
- Development of sustainable packaging materials

The current state of organic farming research (cont.)

Africa's major challenges

- Limited evidence about productivity and profitability challenge for advising policy based on sound science
- Limited technology transfer, as well as access to organic inputs (seeds, equipment, bio-pesticides) and information
- Low nutrient availabilities (esp. phosphorous) due to extreme soil conditions (highly acidic to highly alkaline)
- Closing nutrient cycles (esp. in regions where crop and livestock production are separated by social structures)

The current state of organic farming research (cont.)

Africa's major challenges (cont.)

- Prevention and control of pests and diseases of both crops and livestock
- Suitable crop varieties and livestock races (breeding)
- Strong orientation towards cash crops for export hinders development of sustainable food systems
  - Production is of higher environmental concern than staple crops
  - high dependency on world markets

The current state of organic farming research (cont.)

Asia's major challenges

- Limited number of long-term research programs
- Severe shortage of extension services

The current state of organic farming research (cont.)

Latin America's major challenges

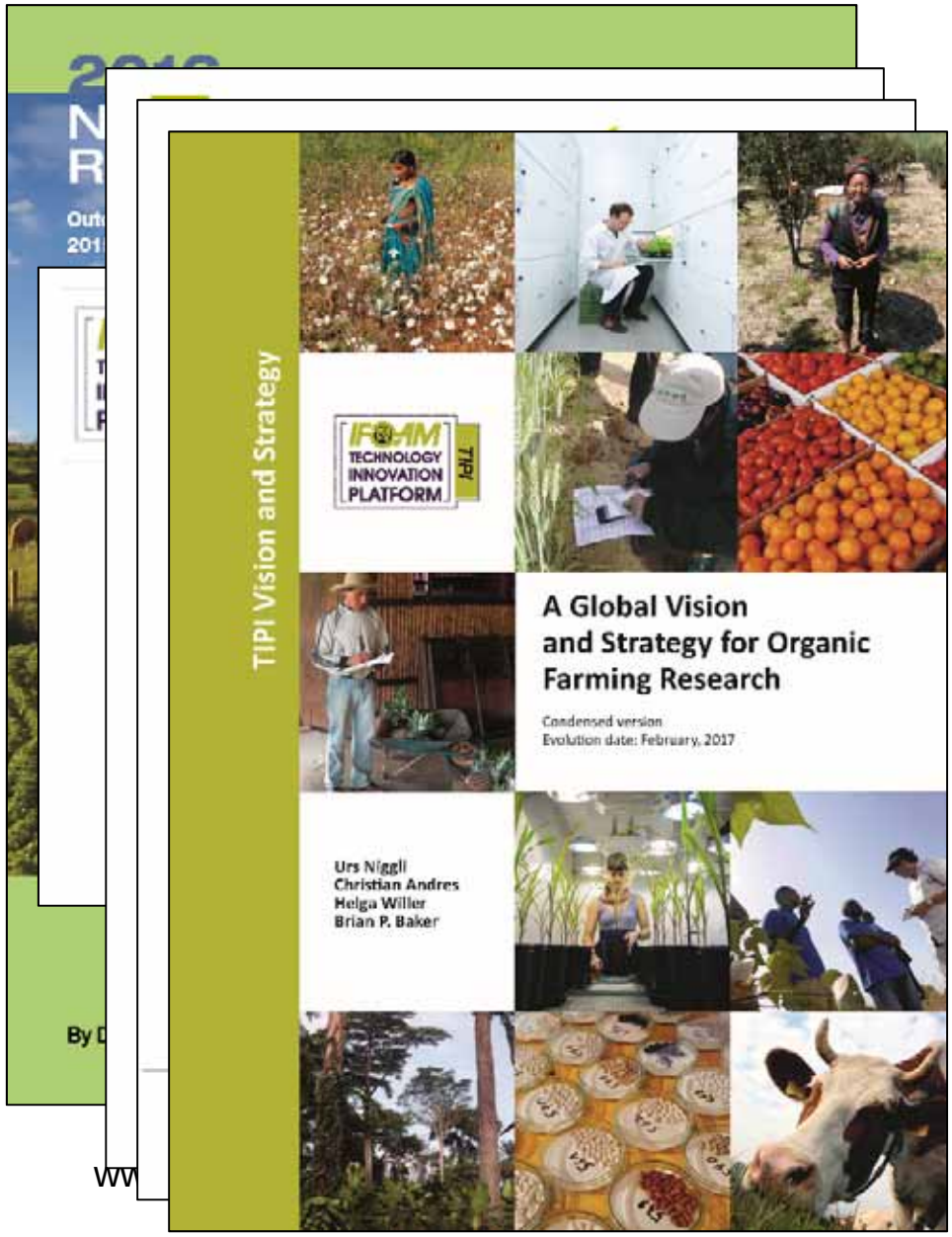
- Appropriate indicators to measure the performance of agro-ecological systems
- Consolidation of research networks
- Development of more inter- & trans-disciplinary research
- More research in the following areas: livestock, seeds and fruits, waste management, post-harvest storage, losses and processing, nutrition and marketing

The current state of organic farming research (cont.)

Latin America's major challenges (cont.)

- Promotion of agroforestry systems and fair marketing strategies to farmers and traders
- Technical challenges:
  - Weed management
  - Equipment for smallholders in hilly areas
- Enhancing consumption of organic products in family farming systems

Resources to be considered



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Results survey on regional research needs in OFFS (cont.)

Conclusions:

- Majority of research needs in OFFS may be covered by:
  - Dissemination and local adaptation of existing solutions
  - Further successful on-farm research and development
- Biggest challenges in biological control of pests & diseases
- General need for a better system understanding, also in tropical and subtropical climate

Thank you for your attention!