Activity report 2018

Research and development in and for the field

FiBL

Cover
Step by step the BodenDok app guides you through the spade test in the field (page13).

Back cover, top left
The effectiveness of natural extracts is tested by Barbara Thürig (l.) and Mathias Ludwig (r.) on Vines (page 26).

Back cover, top right
Soil and gas samples provide Else Bünemann-König (l.) and Norah Efosa (r.) with information on how recycling fertilisers work in the soil (page 16).

Back cover, below left
Farmer Alain Gisiger (l.) and FiBL consultant Stefan Schürmann (r.) are working on solutions for problem plants on alpine pastures. They publish their results online: www.bioaktuell.ch > Pflanzenbau > Grünland > Unkrautregulierung > Unterlagen zu Problempflanzen auf Alpen.

Back cover, below right
The effects of drought stress on conventional soil and on organic soil in the DOK long-term test (page 38) are tested by Martina Lori (page 14).

References Photos
Marion Nitsch: Cover, Back cover (top right and top left) Rückseite; pages 7 (6), 7 (9), 10, 11, 13 (top), 16, 19, 21, 22, 23, 26, 27, 30, 41, 43; Thomas Alföldi: Back cover (below right), 6 (4), 9 (15), 9 (17), 15, 20 (left); Franz J. Steiner: Back cover (below left); Andreas Basler: 2 (top); Marzena Seidl: 2 (middle), 9 (16), 37; Reinhard Geßl: 2 (below), 6 (3), 35; Franziska Hämmerli: 3, 51 (middle); Lisa Schulcz/ICOAS: 6 (1); Ulrich Quendt: 6 (2); fsp Architekten: 6 (5); Matthias Klaiss: 7 (7), 32; Andreas Tischler: 7 (8); Bäckerei Kerling aus Bamberg/ Regierung von Oberfranken: 7 (10); Pixybay: 8 (12), 8 (13); Fotolia sciencerfvideo.mov: 8 (11); Andrea Adriani Studio: 9 (14); Hansueli Dierauer: 12; Monika Macsai: 18; Christian Fischer/Creative Commons: 20 (right); Anja Eichinger: 25 (top); Christian Holzer: 25 (below); Simon Feiertag/Julius Kühn-Institut: 28; Firma Humus OMB: 29; Maike Krauss: 33; Christine Paukner/Bio Austria: 34; Uni Kassel: 36; Adrian Baer/Tierwelt: 39; DOK-Team: 40; Tom Kawara/SECO: 45; Anja Heidenreich: 46; «Kreislauf des Lebens»/Nachhaltigkeitsbewertung für «Zurück zum Ursprung»: 47; Katharina Scheuner: 48; Monika Schneider: 51 (top); Dionys Forster: 51 (below); Monika Messmer: 52

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Content

FiBL's governing bodies

The Foundation Council of FiBL Switzerland (from left to right): Urs Brändli, Ralf Bucher, Martin Ott, Claudia Friedl, Peter Felser, Markus Hausammann, Ulrich Siegrist. Absent from the picture is Roland Frefel.

Since 2017 FiBL Switzerland has been supported by a Scientific Advisory Board consisting of Dominique Barjolle, Stephan Dabbert, Annette Freibauer, Matthias Gauly, Johannes Jehle, Brigitte Kaufmann, Achim Walter, Hubert Wiggering.

The Board of FiBL Germany (from left to right): Robert Hermanowski, Uli Zerger, Urs Niggli, Jörg Grosse-Lochtmann, Wolfgang Gutberlet, Felix Prinz zu Löwenstein, Alexander Gerber, Steffen Reese, Gerold Rahmann. Absent from the picture are Jürgen Hess, Beate Huber and Jan Plagge.

The Board of FiBL Austria (from left to right, back row): Andreas Kranzler, Werner Zollitsch, Martin Preineder; (front row) Urs Niggli, Eva Hieret, Alexandra Pohl. Absent from the picture are Elisabeth Stöger, Josef Renner and Gerhard Zoubek.

Top-class, visionary research

FiBL prefers to treat controversial ideas as fruitful rather than divisive.

FiBL has been involved in the scientific study of organic agriculture for 45 years and is thus the oldest research institute in this field anywhere in the world. The only institution with a longer history is the Institute for Biodynamic Research in Darmstadt, whose activities are based on the anthroposophical ideas of Rudolf Steiner. In its early days FiBL built on Steiner's Goethean view of plants – which focuses on the life-manifestations of plants and their rhythms such as the formation of seeds, fruit and leaves – by adding in modern plant research encompassing ecology, biology, physiology and genetics. Animals, the environment, farm organisation, society and the economy are all subjects that have been included in our research and extension work from the outset. FiBL's approach is a strictly scientific one: for example, the DOK trial – a long-term comparison of biodynamic, organic and conventional cropping systems that has been ongoing since 1978 – has generated more than 120 high-quality scientific publications, which are also consulted by adherents of biodynamic farming. Although the two scientific approaches conflict, there has been fruitful cooperation between them. And that's a good thing.

FiBL will continue to embrace a wide range of issues in its research and development and its training and extension work. An example is digitalisation, which needs to be used sensibly. Automated machines and devices cope superbly with the high levels of complexity on organic farms and can record vast quantities of data. Sensors on the body, in the stall or outside continuously send information about the animals' health and wellbeing to the vet or farm manager's smartphone. Thanks to blockchain technology we have high-quality goods flow systems that are entirely transparent and secure. And artificial intelligence will start to be used in extension work: e-consultancy will be provided by experts who jobshare with agreeable robots. We are always looking for the best synergies between farmers' knowledge, tradition and modern sustainability – because it will be young farmers who take organic farming forward into the 21st century.

This optimistic vision is characteristic of FiBL. In Switzerland, Germany, Austria, Hungary and France, pessimism is not for us. We search out solutions and work with thousands of practitioners throughout the entire food chain to put them into practice. Two years ago we also opened FiBL Europe in Brussels. We recognise that via its legislation, its agricultural policy and its research programmes the European Union paves the way for the future development of organic farming, and we want to play our part in this. Fortunately we still have all sorts of ideas up our sleeves. Often it is the funding that we lack; if this were not the case, we would be unstoppable! We hope you enjoy reading our report.

Andreas Kranzler
Director of FiBL Austria

Urs Niggli
Director of FiBL Switzerland

Robert Hermanowski
Director of FiBL Germany

FiBL Europe

FiBL Europe, located in Brussels, forges contacts to potential European Union partners and donors and promotes databases such as inputs.eu for agricultural inputs and organicXseeds.com for seed.

4 employees
2 MSc/MA students per year
0.5 million euros annual budget

FiBL Switzerland

FiBL Switzerland is headquartered in Frick (team photo above) and has a branch in the French-speaking part of the country in Lausanne (team photo at top). Facilities in Frick include offices, laboratories, a vineyard with press house, a fruit-growing area, a working farm and a restaurant – all organic. FiBL Switzerland is committed at a national level and worldwide to research, consultancy and advanced training.

190 employees
95 students and trainees per year
26 million euros annual budget

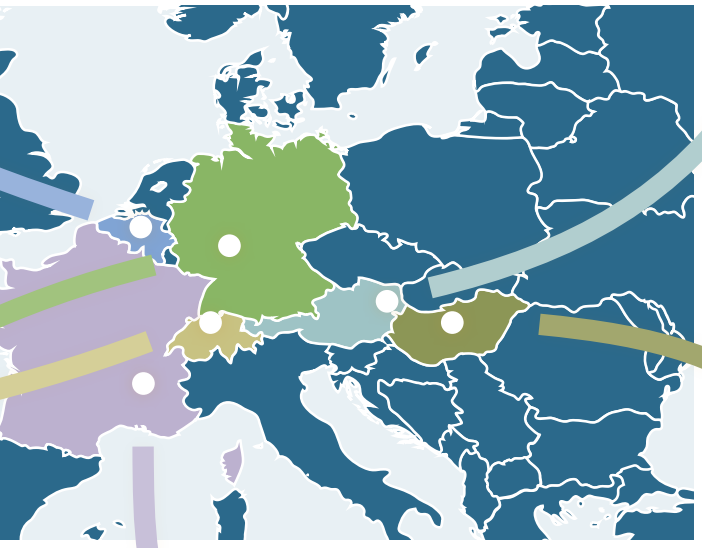
FiBL Germany

FiBL Germany operates at two sites, Frankfurt am Main and Bad Dürkheim, providing scientific expertise and practical advice on all issues of concern to the organic farming and food sector. Priorities include the organicinputs.org agricultural input list, the Organic Academy and the Organic Field Days.

50 employees
5 students and trainees per year
5 million euros annual budget

Detailed annual accounts and profiles of individual specialists are available online at:
www.fibl.org > Search > Activity Report

FiBL



FiBL Austria

FiBL Austria actively promotes the comprehensive exchange of knowledge along the organic food production chain. This involves research and market development projects informed by practice, and extends to the transmission of sound organic knowledge to consumers.

30 employees
8 students and trainees per year
1.3 million euros annual budget

FiBL CEE / ÖMKi Hungary

FiBL CEE (Central and Eastern Europe) is affiliated with ÖMKi, the Hungarian Research Institute of Organic Agriculture, which FiBL originally founded. The goal of FiBL CEE is to advance organic farming in Hungary by engaging in research at a national and international level.

15 employees
5 students and trainees per year
0.5 million euros annual budget

FiBL France

FiBL's French team works closely with practitioners. Topics include goat and sheep health, functional biodiversity, and the use of compost to promote soil and crop health.

4 employees
1 MSc/MA student per year
0.2 million euros annual budget

Highlights – a timeline

2018

DECEMBER

Environmental and efficiency benefits for grassland
FiBL Austria shows how diversified farming can boost both efficiency and biodiversity in grassland. An advice manual was produced together with a calculation and planning tool that enables farmers to identify the appropriate form of land management for their particular farm.

NOVEMBER

Organic conference 1
The 6th International Conference on Organic Agriculture Sciences (ICOAS), co-organised by FiBL Austria, is held in Austria – the first time Austria has hosted this event. 200 participants and speakers – including practitioners, researchers and policy-makers – from 30 countries meet in Schloss Esterházy. Elisabeth Köstinger, Austria's Minister of Sustainability and Tourism, leads the policy discussions.

OCTOBER

Pea & bean network 2
Via the Model Pea & Bean Demonstration Network, FiBL Germany is helping to expand cultivation of these crops. The project is extended until 2020.

The world's biggest conference for biological crop protection
Around 1000 participants attend the Annual Biocontrol Meeting (ABIM) in Basel. The meeting, which is the biggest international conference for manufacturers of biological crop protection products, has been organised annually by FiBL Switzerland since 2006.

SEPTEMBER

Animal husbandry conference
The Freiland-Tagung, one of the most important livestock ethology conferences in the German-speaking world, marked its 25th anniversary in 2018; it is organised by the Freiland Verband and FiBL Austria.

Doing organic differently 3
60 things, 60 experts, more than 650 organic enthusiasts and an extensive exhibition catalogue make FiBL Austria's four "Bio-Wissensmarkt" evenings – a sort of "organic knowledge marketplace" – a great success.

AUGUST

Research for all the family 4
Tours of the laboratories, fruit garden, viticulture areas and bee house and information on topics such as composting and apple breeding give the 4000 visitors to FiBL Switzerland's open day in Frick insight into the Institute's work.

New campus takes shape 5
Construction work starts on FiBL Switzerland's new research and education campus in Frick. 11 of the 25 million Swiss francs construction budget comes from the Canton of Aargau's Swiss lottery (Swisslos) fund.

FiBL Austria FiBL Germany FiBL Switzerland FiBL Europe

Better welfare in castration 6
A project to improve animal welfare in connection with the castration of male piglets under anaesthesia is launched at FiBL Germany.

JULY

Spotlight on plant breeding 7
The latest plant breeding projects are discussed by FiBL and its partners at Switzerland's first organic plant breeding conference.

JUNE

Field days: a great success 8
FiBL Austria and the Esterházy estate invite people to Austria's first organic field days. The opportunity to learn about organic farming at first hand attracts around 8000 visitors.

Organic action plan for Aargau
The Canton of Aargau becomes the first of Switzerland's German-speaking cantons to draw up an action plan to encourage organic farming. The Organic Action Plan Aargau 2021, which is coordinated by FiBL, promotes business initiatives and existing small and medium-sized enterprises.

First Organic Livestock Day 9
The first Swiss Organic Livestock Day focuses on dialogue between agricultural practitioners, advisors and researchers. Some 800 people explore issues of feeding, breeding and animal health and welfare from a practical point of view. The Organic Livestock Day, which FiBL Switzerland helps to organise, now takes place every two years, alternating with the Organic Arable Farming Day.

APRIL

Protecting water supplies 10
As part of the campaign "Groundwater protection – Drinking water for Lower Franconia", FiBL Germany's projects "Water protection bread" and "Groundwater protection through organic farming" are extended until 2022.

FEBRUARY

First European input list
Farmers throughout Europe can now quickly find out whether an input consists entirely of materials that are suitable for organic agriculture – thanks to the first input list for organic production that is applicable Europe-wide. It is presented by FiBL Europe at the 2018 Biofach trade fair in Nuremberg.

Organic info for visitors to trade fair
FiBL Germany has an organic stand at the "Land & Genuss" trade fair in Frankfurt.

JANUARY

Gardens for children
In the project "Children's gardens in the kindergarten" FiBL Germany sets up a nationwide network of 200 children's gardens as part of a campaign for greater biological diversity in daycare centres.

2017

NOVEMBER
Organic farming can feed the world – study published in "Nature"
Organic farming, combined with reduced meat consumption and less food waste, can feed the world. This is demonstrated in a study by FiBL Switzerland that is published in the respected journal "Nature Communications". (Page 42)

Sustainability award top three: Water protection bread
The "Water protection bread" project launched by FiBL Germany and the government of Lower Franconia is among the top three in the German Sustainability Prize for Research 2018. More about the project at www.wasserschutzbrot.de.

OCTOBER
Upper Austrian State Award for the Environment and Sustainability
The Schlägl Organic Competence Centre wins the prize in the category "Consolidating organic agriculture in the region". The centre was founded by FiBL Austria and Bioschule Schlägl.

SEPTEMBER
More life in organic soil 11
Organically farmed soils contain on average 59 per cent more biomass from microorganisms, which in addition are up to 84 per cent more active than those in conventional farming. These were among the findings of a global metastudy by FiBL published in the academic journal "Plos one". (Page 14)

Organic farming strategy for Burgenland
In the project "The future of farming – Strategies for agriculture in Burgenland beyond the growth-or-abandonment dilemma", FiBL Austria works with 130 experts to identify six strategic development areas for small and medium-sized farms; one of the six is "Organic farming, landscape and nature conservation".

Animal welfare competence centre 12
Via thematic and animal-related networks, demonstration farms are implementing innovative measures that go further than the statutory animal welfare standards. FiBL Projekte GmbH manages and coordinates the Competence Centre for Demonstration Farms in the Field of Animal Welfare. The project's term is extended to December 2019.

AUGUST
Taking organic further
How organic farming can be successfully developed is explored in a qualitative study conducted by the Freiland Verband, Science Communications Research and FiBL Austria – and discussed with consumers. Read more about it (in German) at www.biodreinull.at.

Making an issue of food 13
If we want to change something globally, we need to act locally. The Ernährungsrat Frankfurt, which was co-founded by FiBL Germany, seeks to regain local food sovereignty and put the subject of nutrition on the agenda of a democratic debate.

JULY
FiBL Europe celebrates launch 14
FiBL opens its new office in Brussels. FiBL Europe will offer farmers good technical solutions for implementation of the new EU Organic Farming Ordinance and produce scientific and political analyses.

JUNE
No-till farming 15
Organic farmers who dispense with ploughing can reduce soil erosion and help mitigate climate change. This is the finding of two studies by FiBL Switzerland.

Eco field days are a big draw 16
Germany's first nationwide eco field days take place at the Frankenhausen state domain in Hessen, organised by FiBL Projekte GmbH and the Stiftung Ökologie & Landbau (SÖL). (Page 36)

Launch of six new EU projects
2017 sees the start of six major new EU projects in which FiBL is involved: LIVESEED, ReMIX, GenTORE, LEGVALUE, SolACE, DriverIMPACTS. (Pages 31, 33)

Cooperation agreement
FiBL Germany enters into a cooperation agreement with the German Agricultural Society (DLG).

APRIL
Low-input cleaning
How cleaning and hygiene can be tackled in environmentally sound ways is the subject of FiBL Germany's new published guidelines on cleaning agents and disinfectants.

Research with France
FiBL Switzerland and the French National Institute for Agricultural Research (INRA) sign a cooperation agreement on research in organic agriculture.

MARCH
Comprehensive food assessment
In collaboration with the Werner Lambert consultancy, work starts on SMART surveys of the sustainability of Austrian organic products marketed under the "Zurück zum Ursprung" ("Back to the origin") label. (Page 46)

FEBRUARY
Cacao from agroforestry 17
Agroforestry systems and organic farming boost biodiversity, food security and incomes to a greater extent than monocultures and conventional agriculture, as a long-term study by FiBL Switzerland in Bolivia shows. (Page 50)

Organic growth continues
Each year at the Biofach trade fair in Nuremberg, FiBL Switzerland presents the latest edition of the "The World of Organic Agriculture" containing data from around 180 countries. The latest figures are also available at www.organic-world.net. At the end of 2017 the global area of organic agricultural land amounted to nearly 70 million hectares – almost 10 million more than in 2016.

JANUARY
On course for agricultural transition
On behalf of Greenpeace, FiBL Germany produces the "Kursbuch Agrarwende 2050 – ökologisierte Landwirtschaft in Deutschland" ("Charting the course for a transformation of farming – Ecologised agriculture in Germany").

This prototype of a multi-spectrum camera enables FiBL livestock researcher Anna Jenni to detect even the smallest injuries in pigs.

High-tech for organic farming

Cameras that see the number of scratches on a pig. Halters that feel whether the cow is eating, ruminating or sleeping. These and other new technologies are being used, tested and developed by FiBL in research and practice for the benefit of organic farmers.

Pigs: More precise appraisal of animal welfare

Skin lesions on pigs involving fresh or clotted blood can be detected and quantified with a new multi-spectrum camera. The camera is currently still at the development stage and is being tested by FiBL. The aim is to develop the technology to such a extent that the camera is able to measure the number of skin lesions more precisely and objectively than a human can. This would enable the camera to be used to assess animal health in scientific trials or for certification purposes.

Bloody skin is identified

The camera detects skin lesions by taking six pictures at six different wavelengths. The wavelengths are chosen so that the colour of the red blood corpuscles is preferentially absorbed and thus can be detected. The six pictures are taken in a very brief interval of 30 milliseconds. From the six pictures a software program creates two images: an accurate three-dimensional image of the pig and a black-and-white image in which the black areas depict skin lesions with blood and the grey areas patches of skin without blood. The program then calculates the ratio between black and grey pixels to arrive at the percentage of blood-covered skin – an exact measure of the animal's wellbeing.
Barbara Früh, Group Lead Animal Welfare and Housing, FiBL

Development of a multi-spectrum camera

Contact: barbara.frueh@fibl.org
Website: www.pigwatch.net
Funding: Swiss Federal Food Safety and Veterinary Office (FSVO)
The camera, which is part of the Anhiwa PigWatch project, has been developed in France by 3D Ouest and L'Institut National de la Recherche Agronomique (INRA); it is being tested on farms in collaboration with FiBL Switzerland.

Cattle: Using sensor halters to identify efficient animals

Cattle are extremely good at eating and ruminating the plants in our meadows and pastures. They convert grass into milk and meat in an efficient and environmentally friendly way. Efficiency on grassland is important, since efficient grazing minimises both nitrogen emissions and the use of farmland at home and abroad for animal feed. To achieve this efficiency it is essential that even without concentrated feed the animals are robust, healthy, productive, effective and long-lived and that they are well able to adapt their eating and ruminating behaviour to the different types of grazing. However, very little is known about precisely how

they do this and whether the traits in questions can be inherited. FiBL trials with sensor-equipped halters that record the animals' behaviour round the clock are providing the basic information that scientists need.

Cows that graze longer are more productive

It has for example been shown that grazing cows that receive common sainfoin (Onobrychis viciifolia), a valuable native forage plant, as a supplementary feed ruminate for longer and digest the feed more finely; this helps to maximise efficient use of the pasture fodder, thus reducing nitrogen emissions per litre of milk. It has also been found that cows that graze on pasture for a long time each day are more productive than cows that graze for shorter periods. Systematic observation sequences at times of feed change will provide further information about the animals' feeding-related behaviour and the potential for making use of the relevant behavioural characteristics in breeding.

Anet Spengler-Neff, Florian Leiber; Livestock Research, FiBL

RumiWatch project

Contact: anet.spengler@fibl.org

Funding: Fondation Sur la Croix, Swiss National Fund (SNF), EU Commission
Project partner: GenTORE

Sugar beets: Precision cultivation cuts costs

Until recently, the sugar beet had almost completely disappeared from Swiss organic fields – even though it fits nicely in the local climate and rotation scheme. However, weeds usually must be kept under control by hand, which was often too costly. But because the demand is high, the only Swiss sugar beet factory decided two years ago to raise the price for Swiss organic beets. Organic beets now command almost three times the price of conventional beets. As a result, the current organic beet production area of 80 hectares is expected to increase to 200 hectares by 2022, which corresponds to one per cent of the conventional production area. In spite of the favourable price, farmers have had reservations about getting into organic beet production because of the effort and expense for weeding.

Robots to take over the weeding chore

The average manual labour expenditure for weeding sugar beets is around 180 working hours per hectare. While the idea of solving the weed problem with robots is intriguing, putting it into actual practice is a real challenge. Autonomous weeding robots that can recognise the rows and cultivate between the rows with standard tools already exist. But what they haven't been able to do so far is pull the weeds within the rows. This is where the big challenge lies. The hand movement made by humans while weeding is very difficult for a robot to imitate, all the more so if it is expected to work in the field and not just under laboratory conditions. In collaboration with Bosch,

The sensor-equipped halter must fit well. FIBL cattle researcher Anet Spengler-Neff checks a dairy cow.

the Osnabrück University of Applied Sciences has developed a robot that recognises the weeds within the rows and rams them into the soil. The Bonirob is highly advanced in development and since it operates entirely mechanically, it could also be used in organic agriculture. However, it is not yet ready for practical application because the image recognition for distinguishing the weeds from the crop is still too inaccurate.
The Ecorobotix from Switzerland takes the easier approach, namely directed spraying of small weeds. With this robot, it is anticipated that twenty times less herbicide than now used will be applied. But what Ecorobotix still lacks is a technique in line with organic standards, in which the probe arm targets the weeds within the row with a laser, hot water or electricity. FiBL is working to develop such a technique in the scope of a project.

Cultivating the field across the rows

For two years, FiBL and Lenzberg Precision Farming have jointly been pursuing an approach that has been under discussion for some time. The idea is to cultivate the beets at a 90-degree angle across the rows in addition to the normal cultivation along the rows (cycloid hoeing). Cycloid hoeing is anticipated to simulate, and for the most part replace, the manual task of thinning and weeding within rows. With a width of nearly six metres, the hoe is highly efficient. High-precision sowing is required in order for this technique to work and to avoid accidentally hoeing out the beets. The beets must stand like soldiers in ranks of four. From an engineering standpoint, such precise sowing is only possible with real-time kinematic (RTK) positioning. RTK operates on a fee-based network of stationary transmitters, which are distributed throughout Switzerland and correct the 5 to 15-metre accuracy of the GPS satellite signals to almost two centimetres. Two years ago, contractor Heinz Denzler from the Canton of Thurgau purchased a Geoseed precision drill, which deposits each seed with an accuracy of nearly two centimetres and stores the data. The cultivator then takes the stored position data and corrects deviations automatically and continuously by means of a disc.
The first cultivation pass is made as early as possible, when the rows are still barely visible to the naked eye and when the weeds are still in the germination stage. In the first pass, the tines cultivate as closely as possible to the rows, without protective discs. The driving speed is a mere one to two kilometres per hour. The field is then cultivated across the rows. This functions in the same manner, only rotated by 90 degrees. To our eyes this looks strange, as the row spacings are now the distances between the plants, i.e., only 22 centimetres versus 45 centimetres as in cultivation along the rows.

Thanks to new technologies, sugar beets can now be cultivated crosswise and within two centimetres of precision.

Field studies indicate how to proceed

Cultivation is a very demanding task. There cannot be any deviations, as otherwise the sugar beet seedlings would be hoed out. Additional drive tracks across rows would help, but from an engineering standpoint this is not yet feasible. Another prerequisite for this technique is that the field must be accessible from a meadow or road on both sides in order to turn the tractor.
The system failed in the first year. Around 20 per cent of the beets were accidentally hoed out. In the second year, this problem was solved by increasing the within-row spacing of the beets from 18 to 22 centimetres. However, within-row effectiveness was still unsatisfactory. The weather was partially responsible for this. The extremely dry spring made irrigation necessary, which led to a second flush of weed germination in the plot. The weeds could then only be removed by tedious hand pulling.
The technique will undergo further testing and improvement in 2019. As soon as it is working well, machines equipped with the appropriate technology can be used among farms and substantially reduce the manual labour hours.

Hansueli Dierauer, FiBL Arable Extension Agent

Projects in precision farming and robotics

Contact: hansueli.dierauer@fibl.org
Funding: Coop Sustainability Fund, Swiss Federal Office for Agriculture (FOAG)
Partners: Agroscope, HAFL, FRIJ, Lenzberg Precision Farming

Practitioners and researchers jointly develop an app for evaluating soils: (left to right) farmer Peter Rey, scientist Andreas Fliessbach, and computer science students Lukas Marchesi and Jennifer Müller.

Evaluating soils with a cell phone

The spade test provides valuable information about the condition of agricultural soils. However, it has been little used in actual practice to date. The BodenDok app, which guides you step by step through the spade test in the field and records the observations on your smart phone, shall change that.

All you need is a spade and a smart phone – and then you can check the condition of your soils with the new BodenDok app. The app asks a series of questions about the soil and offers answers, from which you can choose by clicking on them. In addition, you take pictures of the soil surface and of the sample on the spade. A spade test with BodenDok takes between twenty and thirty minutes.

The app generates a report with photos

The app collects the answers entered during the soil evaluation and the photos, and together with information about the farm, it then generates a report. This report, along with the coordinates of the site, is saved on your mobile phone. The report can be sent in various file formats.

Filing the results is simple, and makes it easy to compare individual assessments of the same site at different times. You can thus monitor changes in the soil over an extended time period.

Gilles Weidmann, Communications, FiBL

BodenDok, the spade test app

Free download as of spring 2019; in the App Store for iOS and in Google Play for Android
Language variants: German, English, French
Contact: apps@fibl.org
Content implementation: Andreas Fliessbach, Else Bünemann-König, Gilles Weidmann, FiBL Switzerland
Technical realisation: Jennifer Müller and Lukas Marchesi, University of Applied Sciences and Arts Northwestern Switzerland FHNW
Design: Claudia Ammann, Zurich University of the Arts ZHdK

Organic soils tolerate drought better

The Europe-wide drought in the summer of 2018 made it clear: Climatic changes are posing major challenges to farming. A doctoral thesis conducted at FiBL found indications that organic soils, thanks to their more active microorganisms, are better able to handle drought than conventional soils.

As climate change progresses, drought-resistant agricultural systems are gaining importance. There is more and more evidence that organic farming has specific benefits in this respect. In a laboratory experiment, FiBL researcher Martina Lori was able to demonstrate that under drought stress, plants in an organic soil obtain 30 per cent more nitrogen from green manure than plants grown on conventionally farmed soils.

Microbes in organic soils: 84 % more active

But why are organic soils able to provide more nitrogen for plants under drought conditions than conventional soils? FiBL researcher Martina Lori is finding answers to this question. In her doctoral thesis project, she analysed 56 independent studies on field experiments from around the world. It emerged that organic farming exerts a very positive effect on the abundance and activity of microorganisms or microbes in agricultural systems: organically farmed soils contain on average 59 per cent more biomass in the form of microorganisms, and these minute lifeforms are up to 84 per cent more active than in conventionally farmed soils. The meta-analysis furthermore showed that organic fertilisers, a diverse rotation and legumes in the rotation also have positive impacts on the abundance and activity of soil microbes.

Performance despite drought stress

To test whether a larger and more active microbial community also benefits crop plants, an experiment was conducted with soil from the DOK study, a long-term FiBL project that has been running for forty years. Both optimum moisture conditions and drought stress were simulated in the FiBL laboratory in the scope of this plant nutrition experiment. The results indicated that under drought stress, the plants in the organic soil obtained 30 per cent more nitrogen from the green manure that did the plants grown in the conventionally farmed soil.

In addition, using next generation DNA sequencing methods, we were able to characterise the structure and diversity of the microbial communities. These methods have undergone vast improvements in the last decade and can now also be used for soil samples. It turned out that under drought stress, the conventional system was incapable of sustaining the initial diversity and composition of nitrogen-releasing soil microbes. Quite the opposite was found for the organic system, which also resulted in a higher yield of the test crop ryegrass.

While the findings of the plant nutrition experiment cannot be transferred directly to actual practice, they nevertheless encourage further research. At FiBL, we are currently evaluating the laboratory results in field studies as part of the SoilClim project.

Microbes provide nutrition for plants

We are beginning to understand more precisely just how important a diverse microbiome is. Microbes are the „engine" of the soil. They release, convert or store nutrients. Active microorganisms constitute the foundation for healthy plants. For instance, one of the most important plant nutrients, nitrogen, is present in the soil and in organic fertilisers in compounds that plants cannot assimilate directly. However, soil microbes are able to break down the protein compounds into smaller units. This process, known as proteolysis, is the first step of nitrogen mineralisation, via which nitrogen is converted into a form that plants can assimilate. Nitrogen mineralisation enables higher yields and is especially important in agroecosystems such as organic farming, as these systems preclude the use of chemical nitrogen fertilisers, which are directly available to the plants.

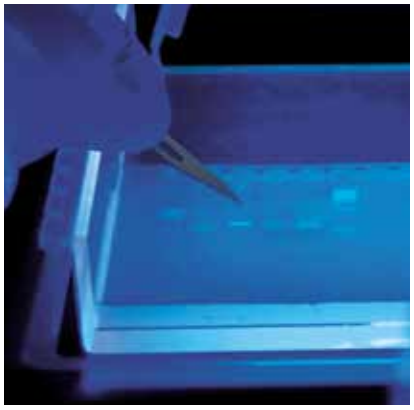
Paul Mäder, Director of the FiBL Soil Science Department, and Martina Lori, FiBL Biologist

Microbes in organic soils supply 30 % more nitrogen under drought conditions

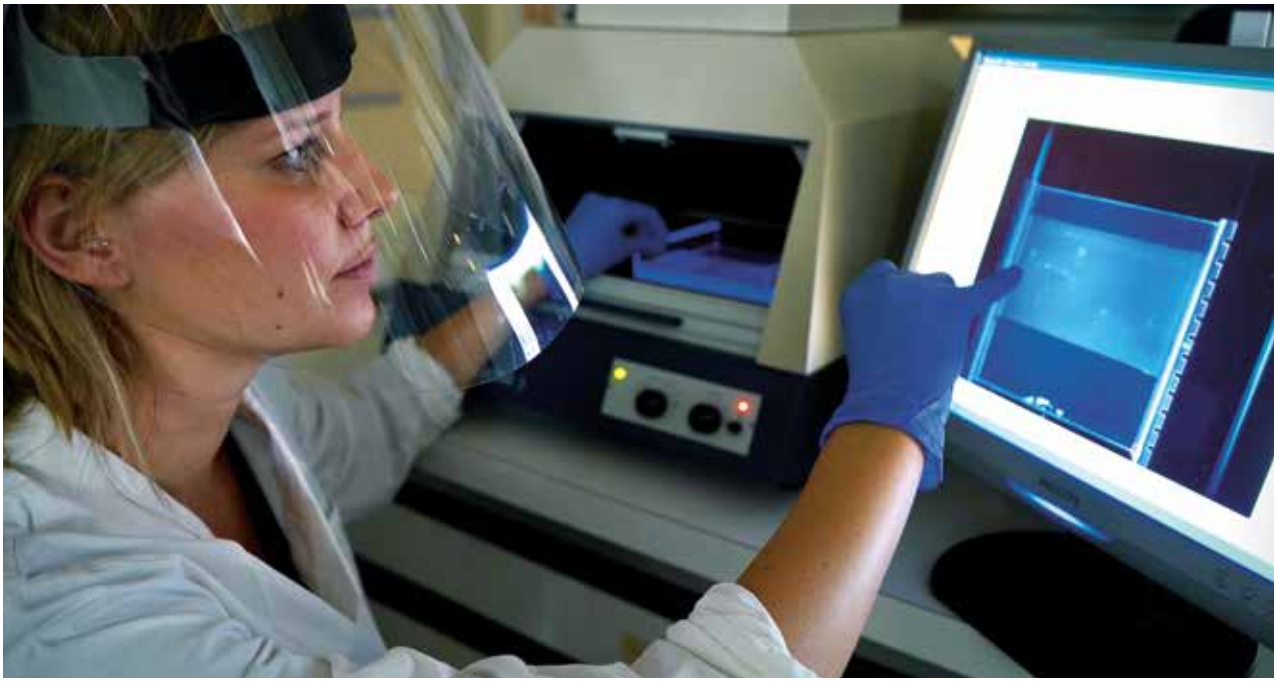
Greater resistance is in demand

The EU is sponsoring research on agricultural systems having a greater capacity to resist climate change-induced precipitation fluctuations. FiBL is engaged in this area in the European project ECO-SERVE.
www.ecoserve-project.eu

FiBL has found evidence suggesting why organic soils are better able to withstand drought compared to conventional soils: organic soils contain 2/3 more biomass in the form of microorganisms.



The genetic material of microorganisms is rendered visible under UV light in the FiBL laboratory.



FiBL researcher Martina Lori analyses the genetic material of microorganisms. She thus found out that even under drought conditions, organic soils have the capacity to sustain the species diversity of nitrogen-releasing microbes.

FiBL researchers Else Bünemann-König (left) and Norah Efosa are using soil and gas samples to determine how recycled fertilisers act in the soil.

Recycled nutrients for hungry crops

We lose nutrients. They escape from the field into the environment, where they contribute to eutrophication of waterbodies, or they end up unused in slag dumps. FiBL is seeking ways to close the nutrient cycle better.

Out of all nutrients, nitrogen is usually the first one that crops in organic agriculture lack. It can indeed be supplied to the soil by farmyard fertilisers such as manure or legumes such as clover and peas. Because synthetic fertilisers are prohibited in organic agriculture, the nitrogen must continuously be made available from the humus to the plants by microorganisms. Hence the supply is insufficient just when the plants are growing intensively and are especially hungry. Furthermore, nitrogen is easily lost to the environment: in gaseous form as ammonia and nitrous oxide or in liquid form as nitrate. Natural ecosystems and waterbodies are harmed by this nitrogen input, and furthermore nitrous oxide contributes to global warming. For these reasons, it is important to ensure optimum application and use of nitrogen in organic agriculture.

Although other nutrients such as phosphorus and potassium are not lost in gaseous form, they are lost through leaching and soil erosion. Moreover, unlike nitrogen these nutrients cannot be fixed from the atmosphere. The nutrient cycles for phosphorus and potassium must therefore be closed as well. Exploitable deposits of phosphorus- or potassium-rich minerals are finite, and sooner (in the case of phosphorus) or later (in the case of potassium) they will run out. In organic agriculture, the "small" nutrient cycle between crops and livestock is closed as much as possible by manure and slurry, and it is frequently supplemented by plant material compost. But with all products such as cereal, milk or meat that are sold, nutrients are removed from the cycle. Hence phosphorus and potassium in particular end up with human faeces in sewage plant sludge, and with food processing and household waste in the slag of incinerators. Many nutrients end up in landfills.

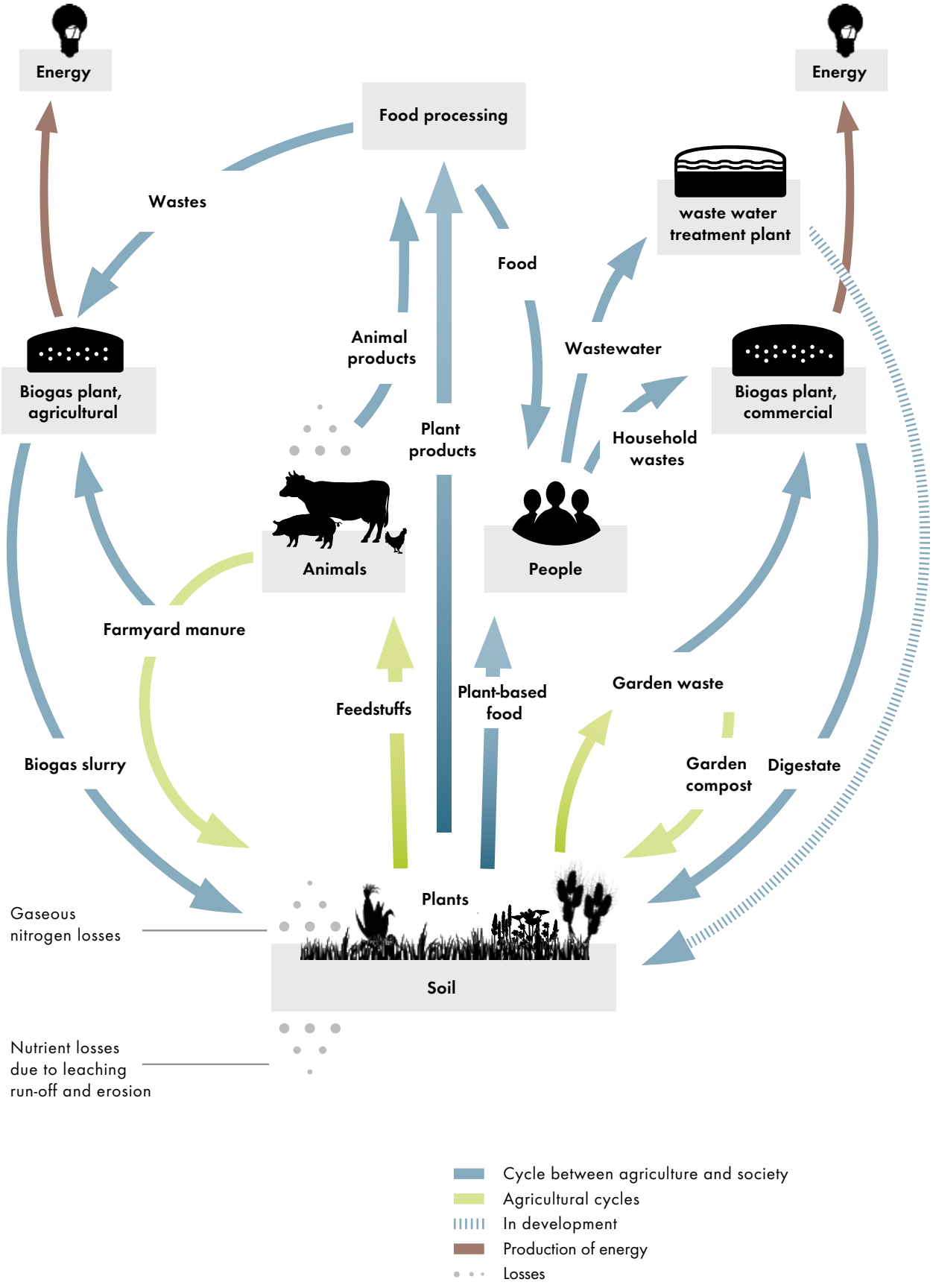
To prevent this, it is essential to close the "large" nutrient cycle. This requires the development of technologies that not only fulfil strict requirements regarding hygiene, nutrient content and pollutant content of the recycled fertilisers, but also comply with the restrictions of organic agriculture.

Many impacts have still not been studied

Many commercial fertilisers approved for organic agriculture are based on residues and are therefore already recycled. An example is the biogas slurry from agricultural biogas plants, in which slurry is fermented together with organic wastes such as crop residue. However, objections have been raised against some recycled fertilisers because, like the synthetic fertilisers forbidden in organic agriculture, they often take effect very quickly. Other criticisms include possible impurities and longer-term impacts on the soil and the quality of the products. These and other questions are being studied in several current FiBL projects.

Else Bünemann-König, FiBL Soil Scientist

Nutrient cycles between agriculture and society



New fertilisers need thorough testing

Valuable fertilisers can be obtained from diverse residues. More and more such recycled fertilisers are being marketed. Some are already approved for organic agriculture, and approval for others may soon follow. FiBL is thoroughly testing new recycled fertilisers in several projects.

Fertilisers can be obtained from sewage plant or biogas plant wastes. Such recycled fertilisers can be used to increase yields and close nutrient cycles. These fertilisers are therefore in keeping with the philosophy of organic agriculture. But much still needs clarification regarding the impacts of the new fertilisers on yields, soil organisms and the environment. FiBL Switzerland is seeking answers to such question in several projects.

Understanding water protection with "golden slurry"

The Gäu-Olten region of Switzerland has been struggling with high nitrate levels in groundwater for some time. As part of a resource conservation project, for over fifteen years the local farmers have been committed to an adapted management scheme for reducing nitrate losses. Whether these measures are effective will now be determined in the NitroGäu Project. The amounts of nitrate leached in conventional versus organic farming will also be compared.
Understanding exactly what happens to slurry in the field and how to use it so that as little nitrate as possible is lost is important. To answer these questions, FiBL PhD student Hanna Frick is producing "golden slurry". To do so, she is fertilising ryegrass with "gold-dyed" nitrogen molecules. "Dyed" ryegrass grows as a result, which the researcher then feeds to a heifer. The golden slurry comes from her urine and faeces. This slurry contains the marked nitrogen molecules, which can be distinguished over the years from the nitrogen already present in the soil. It was applied to two fields in the Gäu region, in which the marked nitrogen is now being monitored for two and a half years. The results of the laboratory analyses will show how much of the marked nitrogen is taken up by the plants, how much remains in the soil, and how much is leached out by seepage water.

Florentina supplied "golden slurry" for twelve days. She now lives on a dairy farm.

More autonomy for organic farming

Alternatives to fertilisers from finite resources (such as mined raw phosphate) are needed in organic agriculture. The use of slurry procured from conventional farms should also be cut back. Recycled fertilisers could help reduce the structural dependence of organic farming on conventional agriculture. FiBL's researchers are thus determining the nutrient needs and the current use of fertilisers on organic farms in six countries. They are doing so in collaboration with the Universities of Copenhagen and Hohenheim in the scope of the EU project RELACS. Particular emphasis is being placed on adapting the proportions of the different nutrients – in particular nitrogen, phosphorus and potassium – to the needs of crops. Imbalances can thus be avoided and recycled fertilisers applied in an optimum manner.

Improving fertilisers with biochar

More and more biogas plants are being built. Unlike in Germany, where crops are grown specifically for the biogas plants, only waste from the food industry and agriculture may be used in Switzerland. These wastes are converted into energy in the biogas plants, giving rise to biogas slurry and both liquid and solid digestates in the process. In the Recycle4Bio project funded by the Swiss Federal Office for Agriculture, FiBL and the Swiss national research institute Agroscope are jointly conducting research to determine how effective these materials are in agriculture compared to standard slurry and how much is lost through leaching or as gases.
New techniques, such as adding biochar to reduce nitrogen losses, are also being tested in a field trial set up in 2018. If the trial receives further funding after three years, then field research on how the different recycled fertilisers impact soil organisms and soil quality compared to standard fertilisers will also be possible.

Else Bünemann-König (left) and Norah Efosa are conducting tests to determine whether adding biochar to biogas slurry can reduce nitrogen losses.

Reducing greenhouse gas emissions

To find out how recycled fertilisers affect the climate, FiBL PhD student Norah Efosa is performing weekly measurements to determine how much nitrous oxide and methane are released in the field trial. She is involved in the GHG-Recycle4Bio project, in which ammonia losses immediately after application of the different fertilisers are also being determined. These measurements are being performed in cooperation with the Bern University of Applied Sciences (HAFL), with funding from the Swiss Federal Office for the Environment and the Swiss Federal Office of Energy.

Else Bünemann-König, FiBL Soil Scientist

Animal feed: Closing the cycle

Lemnoideae (duckweeds or water lenses) and insect grubs have the ability to convert waste into valuable protein-rich feedstuffs. FiBL research projects show how this can work. Failure to close animal feed cycles can have serious consequences.

European countries – especially Switzerland – and organic farmers depend heavily on imports of protein-rich feedstuffs for livestock. This appropriates land in the countries from which the feed originates and results in ecosystems here being subjected to high nitrogen inputs. Via the animal manure, large quantities of nitrogen from the imported feedstuffs enter our rivers and oceans and contribute to the acidification of water courses, species impoverishment and climate change.

Converting waste into feed

FiBL is exploring a number of alternative sources of protein for use in animal feed. One such option is the production of high-quality protein from "waste" – which in this case includes by-products of the food industry, restaurant waste and also nutrient-rich substrates such as manure. To recover the protein and nitrogen compounds and convert them into high-quality protein feed, we need organisms such as black soldier flies or water lenses that do the job for us.

Flying problem-solvers

One of the most important sources of protein for farmed fish bred for human consumption is fish meal. However, production of fish meal is contributing to overfishing of the oceans. High standards apply to organic aquaculture but, precisely because of this, certified fish meal is expensive and in short supply. There is a demand for alternatives, just as there is a need for alternatives to the feeding of soya to land animals.

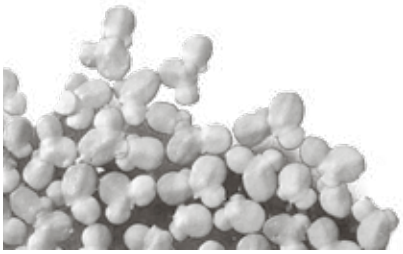
FiBL has been studying the black soldier fly for some time and in the last two years this work has been stepped up. Its scientists are currently investigating what composition of nutrients results in optimal larval growth, what part is played by the microorganisms in the larvae's digestive tract and whether there are genetic variants in different parts of the world that could be used to breed particularly suitable strains. Efficient conversion of waste substrates into high-quality protein is essential if insect-based feedstuffs are to be considered as a viable link in a sustainable food chain. FiBL's research work is laying the foundations for optimal sustainability and efficiency in larvae production.

Rescuers on the water

Another aspect of recycling-based feed production is being developed by FiBL with ever-increasing momentum: with the help of water lenses – small, floating plants – it is possible to remove significant quantities of inorganically bound nitrogen and use it to make plant protein. We are currently working with diluted cattle manure and have shown that the fast-growing water lenses can within a short time remove more than 95 per cent of the ammonium nitrogen from a water and manure mixture and convert it into plant protein. This purifies the water of volatile nitrogen compounds that are potentially harmful to the environment while at the same time producing a feed component that is already proving of value in fish feeding. There is a similarly positive effect on phosphorus.

Florian Leiber, Head of the Department of Livestock Sciences at FiBL

Maggots make clean protein from manure, food leftovers and slaughterhouse waste



Water lenses remove 95 % of manure nitrogen from the water

FiBL's aquaculture specialist Timo Stadtlander investigates how water lenses convert nutrients in manure into valuable animal feed.

As part of FiBL's fish feeding trials, MSc student Jaclyn Bandy and Timo Stadtlander explore the usefulness of insect meal in fish farming.

Taking young animals seriously at the outset

Cockerel chicks killed. Calves sold too early. Piglets suffering from diarrhoea. Even in organic agriculture there is room for improvement in the well-being of young animals. FiBL is therefore testing alternative rearing systems, improved feeding methods, herbal tonics and new marketing strategies.

In Europe, Switzerland is a true pioneer when it comes to animal well-being in agriculture. The organic farms are at the forefront in Switzerland. But is everything really so good that we can rest on our laurels? Young animals, whether calves, piglets or chicks, are a sore point. Too many bull calves are sold to feedlots too soon, which almost automatically leads to diseases. All too often, piglets get diarrhoea when they are weaned. As a consequence, these animals often require treatment with antibiotics. The problem of killing cockerel chicks in laying hen production also remains to be solved. To address these problems, FiBL is working intensively on solutions that not only include veterinary medicine and prophylactic approaches based on herbal remedies, but also rearing systems, feeding and marketing. A new competency at FiBL, the young animals core area is still relatively young itself. Young FiBL researchers are very dedicated to the subject, and it has a bright future.

Do not take calves away

Herbal supplements for strengthening the immune system and for prophylaxis of pneumonia have been tested for calves. Accompanying these tests are the evaluation of scientific literature and the preservation and processing of traditional farmers' know-how on plant-based therapies for animals. In calf rearing, we are studying the importance of a long and intensive milk feeding time and of mother-bound rearing, i.e., nursing from the cow rather than from a feeder bucket. We are also conducting research to determine whether it is possible to raise healthy and productive calves without feed concentrates (contrary to what the textbooks teach) and thus contribute to the sustainability of livestock feeding.

The fattening of calves on the dairy farms where they were born is one approach in our plan for preventing the sale of organic calves into conventional fattening systems. We are also working on marketing strategies that provide greater incentives to organic farms to raise bull calves from dairy cattle production themselves, and fatten them in a species-appropriate manner and on pasture. We will pursue a similar approach as a possibility for putting an end to chick killing.

Do not castrate piglets

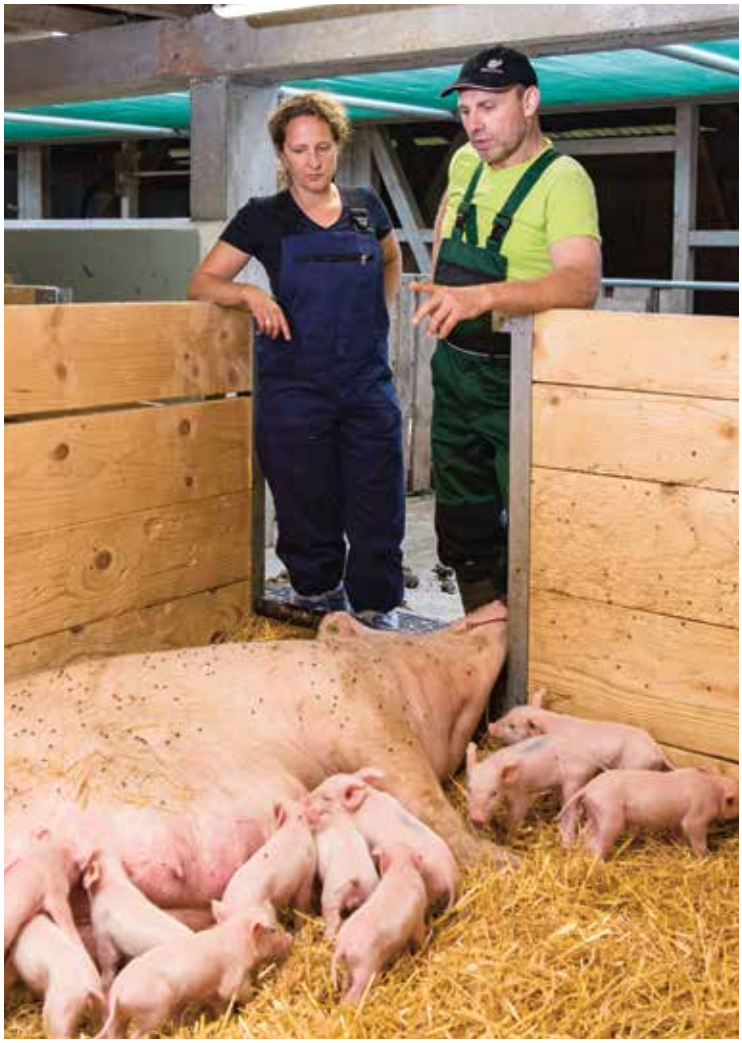
FiBL also wants to promote herb-based disease prophylaxis for piglets in order to avoid the use of antibiotics. We have successfully tested garlic for strengthening piglets during the sensitive phase of weaning from mother's milk. FiBL is also developing feeds consisting of 100 % organic constituents for piglets, since the 5 % conventional constituents in organic feed will likely soon be banned.

To avoid the castration of male piglets, in the last three years we have been researching feeding systems that may help in raising uncastrated boars in a stress-free and healthy manner. As FiBL was able to show, roughage plays a significant part in this. Not only is it a suitable material for keeping the animals occupied, but it also has a positive effect on gastrointestinal health.

Do not kill chicks

There are essentially three approaches to avoid killing cockerel chicks: technology for early sex determination in the egg, after which the male eggs are no longer incubated; rearing and fattening cockerel chicks from laying strains; breeding so-called dual-purpose breeds that make good laying hens as well as acceptable broilers. Good arguments can be made for all of these approaches. However, none of them frees us outright from all dilemmas regarding ethics, sustainability and productivity. FiBL will therefore continue pursuing all of these approaches so that it can advocate more than just one solution.

Florian Leiber, Head of the Livestock Sciences Department, FiBL Switzerland



Top left:
FiBL veterinarian Hannah Ayrle and Demeter farmer Bronya Dehlinger test herbal extracts for strengthening the immune system of calves.

Left:
FiBL pig specialist Barbara Früh and organic farmer Lori Spuhler test organic feeds for piglets.

Longer suckling makes for healthier piglets

Organic piglets are allowed to suckle from their mothers for 40 days before being given solid feed. However, they often develop health problems during the transition phase. These can be reduced if the suckling period is extended to 49 days. FiBL Austria is exploring how this can be put into practice.

In organic pig farming piglets are weaned from their mother's milk after the statutory minimum suckling period of 40 days. However, at 40 days the piglet's digestive system is not yet adapted to solid food, little of the passive immunity conferred by the mother's milk remains and the piglet's own active immunity is not yet fully developed. Many farms therefore encounter weaning problems that can have a serious impact on the piglets' health and growth.

Piglets on a model farm enjoy their longer suckling period as part of a project run by EIP-Agri und FiBL.

Extending the suckling time works in practice

A study by Germany's Thünen Institute shows that the problems associated with weaning can be reduced by extending the suckling period. To discover whether the longer suckling period of at least 49 days is practical, FiBL Austria is working with project partners in a participatory project involving an extended suckling period on organic piglet farms. Practitioners, extensionists and researchers are working together to identify how weaning problems can be reduced and the animals' welfare improved. As well as producing new advisory documents, the team is evaluating the economic impacts, analysing the effects on the piglets' welfare and checking that the feeding of sows and weaners is nutritionally appropriate. In addition, farms have been helped to make the switch to an extended suckling period and model farms have been set up for the purposes of the study. Preliminary results from the project are expected in 2019.

It is already clear that farms benefit from an extended suckling period. As a result of the longer transition from mother's milk to solid feed, the piglets are already absorbing solid food very well by the time they are weaned. In consequence, weight gain is strong, especially in the seventh and eighth weeks, and this is accompanied by increased vitality. Participating farmers are already reporting that they now encounter fewer problems during weaning and that they therefore intend to continue with the extended suckling period after the conclusion of the project.

Elisabeth Klingbacher, Communications, FiBL

Participatory project and knowledge transfer

Contact: anja.eichinger@fibl.org

Funding: The European Union, Austrian federal and provincial governments – rural development programme (LE 14-20), European Innovation Partnership (EIP-AGRI)

Cutting costs with farm-sourced feed

Milk prices are under pressure. How dairy farms can reduce their production costs, boost the quality of meadow and pasture fodder and where possible avoid buying concentrated feed was the subject of a five-year project coordinated by FiBL's branch in western Switzerland.

Between 2013 and 2017 the Swiss Romande team, as FiBL's branch in western Switzerland is called, provided detailed support and advice to thirteen farms in Canton of Vaud. Seven farms, including two organic ones, produce milk for Gruyère cheese; six produce milk for the milk industry using silage as feed.

The aim: Feed autonomy

"Progrès herbe" is a project that aims to show how farms can produce milk using feed that they have also produced themselves, rather than buying imported feedstuffs. The system is known as grassland-based milk and meat production and it is promoted by the Swiss government through its GMF ("Grasland-basierte Milch- und Fleischproduktion") programme. Although Switzerland is exceptionally well-placed to practice grassland-based feeding of this sort, feed imports are rising. At the same time, the price pressure on Swiss producers is increasing as a result of international trade. Farmers must therefore look to new strategies.

"Progrès herbe" explored ways of reducing per-litre milk production costs. The project focused on improving the quality of meadow and pasture feed and on alternatives to buying concentrated feed. Producers were advised and supported by experts in connection with issues of fodder production, fodder conservation, feeding management, economics and animal health. Data was collected from the farms and analysed in order to identify economic, environmental and social impacts and effects on animal health.

Sharing knowledge via videos, courses and fairs

A major plus point during the project phase was undoubtedly the exchange of ideas between the farmers during the project meetings. At the same time, to ensure that the benefits extend beyond the group of participating farms, the knowledge is passed on in courses and training sessions for farmers and agricultural advisors. FiBL has also set up a website (see below) containing a series of videos in which farmers talk about their experience of the project. Each year the most popular video on the website of "Progrès herbe" was shared more than 50 times and reached more than 16,000 people. The results of the project were presented to members of the agricultural community at the first Salon Romand des Herbages in September 2018. More than 700 guests attended this grassland management fair.

Nathaniel Schmid, Agricultural Advisor, FiBL

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www.progres-herbe.ch

Contact: nathaniel.schmid@fibl.org

Project management: FiBL Suisse Romande team

Partners: Prolait, Prométerre, Agroscope Changins-Wädenswil, School of Agricultural, Forest and Food Sciences HAFL, Planungsbüro Montanum,

Funding: Vaud Canton DGAV (Direction générale de l'agriculture, de la viticulture et des affaires vétérinaires), Prolait, Prométerre

"We decided to practice intensive rotational grazing. That enables us to keep the Alpine dock under control without overgrazing. On a new pasture the young dock is immediately eaten by the cows."

Christian Hockenjos, organic farmer in Palézieux in Vaud Canton, in a video on www.progres-herbe.ch

Mathias Ludwig tests a new substance on FiBL's vines.

Plant extracts as copper substitute

Organic practitioners and researchers are working hard on alternatives to the use of copper, which is a potent plant protectant. But the task is not an easy one. It involves breeding robust cultivars and developing new cropping systems. Alternative substances are also needed – organic laboratories currently have a handful of promising active ingredients in the pipeline.

Copper is one of the oldest plant protectants. European growers of wine, fruit, vegetables and potatoes were already using it to control plant diseases in the 1880s. Vast quantities of copper were used in viticulture between 1920 and 1960; some vintners applied 80 kilos or more per hectare per year. In Switzerland the use of copper is now limited to four kilos per hectare annually.

Need for copper reduction recognised

While copper is an essential trace element for plants, animals and us humans, it accumulates in the soil and high concentrations can harm earthworms and other soil organisms. Large quantities of copper are still being applied in viticulture and fruit-growing; in Switzerland the total quantity is about 50 tonnes per year, five to ten per cent of which is used by organic farmers. Actors in organic agriculture have long recognised the need to use copper only very sparingly and to adopt alternative strategies where possible. For more than twenty years practitioners, advisors and researchers have therefore been striving to reduce dependence on copper without jeopardising yield reliability. The majority of the fungicides used in agriculture are applied to control downy mildew on vines, apple scab and late blight in potatoes. Copper can be used against a vast number of fungal and bacterial diseases in these and other economically important crops. The consistent finding of situation analyses is that copper currently makes a decisive and crucial contribution to yield security.

Organic agriculture is reducing copper

Strategy papers produced by Germany, France and Switzerland show that organic farmers are adopting a multi-pronged strategy to minimise the use of copper. This involves growing resistant or tolerant cultivars, adapting crop management practices, optimising copper use and trialling alternative products. Surveys from Switzerland show that organic farmers are keenly aware of their responsibility and are making full use of the available reduction strategies. In consequence the amount of copper they use is generally below the permitted maximum.

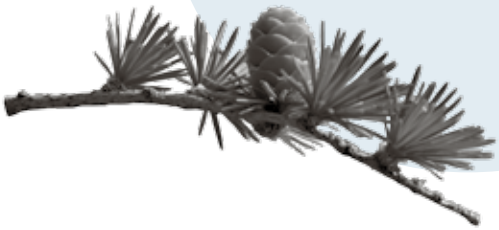
Research starts to bear fruit

Since the year 2000 an estimated 30 million euros has been invested in national research schemes – mainly in Germany, Switzerland, Italy and France – and in EU-funded projects (Blight-Mop, Repco, Co-Free). This does not include research into plant breeding and the development of new resistant cultivars. Other projects are currently out to tender; some, such as RELACS, which was launched in 2018, are getting under way. Research has concentrated on preventive, system-stabilising elements such as cultivar choice, cultivar mixtures and agroforestry systems. Concurrently, significant funds are going into the development of alternative products and into smarter application techniques for direct plant protection. Many findings have been quickly translated into practice and are already being acted on. Practices such as strip-cropping of potato cultivars work relatively well from an agronomic point of view but are initially technically difficult to implement. They contrast with cultivation systems such as EcoOrchard (page 28) and Agroforst (page 50), which, despite being progressive and highly promising systems, do not represent a breakthrough in copper reduction.

It is clear that in addition to such system-based approaches it is also essential to develop alternative highly effective and affordable plant protectants that

2100 substances
were tested

Larch extract
was the most effective



will enable an ambitious copper reduction strategy to be implemented. However, the search for effective alternatives is turning out to be unexpectedly challenging, lengthy and expensive. This is partly because of copper's very broad activity spectrum. Environmentally friendly substitutes are more selective in their action. A whole range of products will therefore be needed to cover the diverse applications of copper and they will be more expensive than copper, which is very cheap.

Six promising substances

Now, after ten years of intensive development work by a variety of institutions and industries, four to six substances have reached the stage at which two or three of them are likely to be licensed for use within a few years. Over the past eight years, FiBL and its partners at the universities of Surrey, Helsinki and Basel have tested more than 2100 plant and microbial extracts as potential replacements for copper. The most promising product is currently the larch extract Larixyne®. Once researchers had discovered that the raw extract was effective against various plant diseases, they were able to identify the key active substances, larixol and larixyl acetate. Processes for extracting these substances from waste wood were then developed. Effectiveness under field conditions was steadily improved by optimising the extraction process and altering the formulation, with the result that highly effective prototypes are now being tested.

While product development in organic agriculture will make an important contribution to the Swiss government's overall aim of reducing the use of plant protectants, the main pillars of copper reduction will still be resistant cultivars, sustainable plant nutrition, and top-quality seed and planting material.

Lucius Tamm, head of FiBL's Crop Science Department; Hans-Jakob Schärer, Mathias Ludwig and Barbara Thürig, crop researchers at FiBL

Research into alternatives to copper

Contact: lucius.tamm@fibl.org

FiBL Switzerland's copper substitute projects are funded by the Swiss Federal Office for Agriculture (FOAG), the European Union and the Coop Sustainability Fund, which invested one million Swiss francs in this research between 2011 and 2018. There are still many technical obstacles to be overcome and time-consuming and expensive licensing procedures to be gone through, but a copper replacement should be ready for the market by 2024.

Barbara Thürig tests plant extracts in the FiBL laboratory.

Wildflowers instead of organic pesticides

The more diverse the flowering plants between fruit trees, the greater the number and diversity of insects – including those predating on fruit pests. Thus there is a reduction in fruit damage, lower use of organic pesticides and increased profitability for growers, as FiBL has been able to show.

Organic fruit growers repeatedly suffer loss in quality and crop failure due to pests, because the plant protection products available in organic growing do not always succeed in keeping the pests in check. This is where the strategic use of hedges, fallow ground and flowers can help. This functional agrobiodiversity (FAB) can significantly promote pests' natural enemies. In addition, more beneficial insects can improve other ecosystem services such as pollination.

Europe-wide trials in organic orchards

As part of the three-year European project EcoOrchard, FiBL cooperated with other research institutions to develop and trial suitable strategies and measures to promote FAB in organic apple growing.
In seven European countries newly-prepared flower strips consisting of 30 to 39 species of wild plants were sown in the alleyways between rows of apple trees to test cultivation techniques and effects.

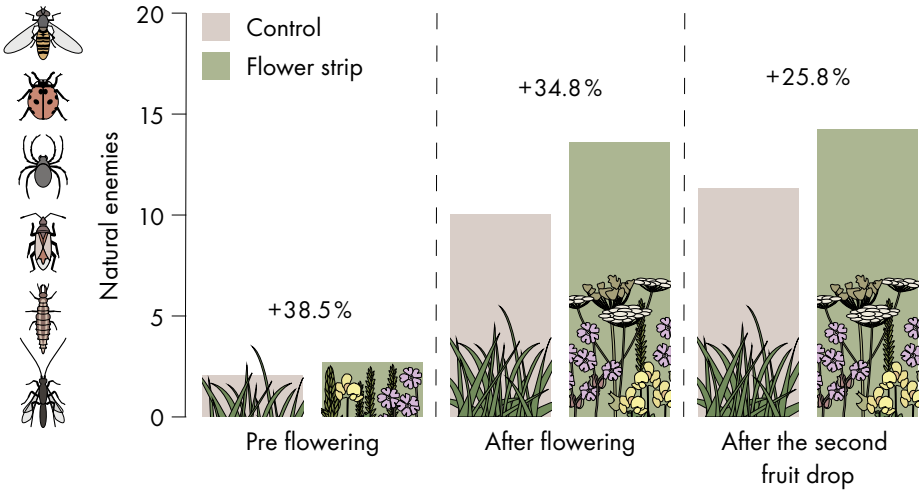
Fewer pests – less need for organic insecticides

Flower strips increase plant diversity in orchards immensely. As a result, the diversity of insects increases too, as the evaluation of the data from the EcoOrchard project showed. The natural predators of the rosy apple aphid (Dysaphis plantaginea) and the codling moth (Cydia pomonella) were attracted in such numbers that there was a demonstrable reduction in these two major pests and the fruit damage caused by them. Therefore, in practice, this would ideally save one to two sprayings with organic insecticides each year.

Wildflowers in organic orchards attract so many beneficial insects that the aphid population is kept below the threshold of economic damage.

More natural enemies of aphids during the vegetation period

Results of a Europe-wide field study in the EcoOrchard project



Timing and height of cutting is crucial

The evaluation of the data showed that, as well as the soil and climate at the site, cultivation technique and optimal care are the main factors determining the quality of flower strips: the times and height of cutting are important parameters for a long-lasting abundance of flowers.

Technical guide

In order that flower strips could be put into practice successfully, fruit growers were questioned about their interest in and knowledge of functional agrobiodiversity. It was evident that, despite their interest, the gaps in their knowledge and inadequate extension services could hinder implementation.

Some of these gaps were plugged in 2018 with the publication of the technical guide on "Perennial flower strips", which has already been translated into nine languages. Follow-up projects are being planned as well: flower strips are to be optimised in apple growing and trialled for the first time in cherry orchards.

Lukas Pfiffner, FiBL Agroecologist

Perennial flower strips technical guide

The results of the EcoOrchard project have been published in a Technical Guide: "Perennial flower strips – a tool for improving pest control in fruit orchards" can be ordered at www.shop.fibl.org or downloaded free of charge.

EcoOrchard project

Contact: lukas.pfiffner@fibl.org

Funding: European Union, Swiss Federal Office for Agriculture (FOAG)

Promoting organic plant breeding and organic seed throughout Europe

Healthy seed and suitable varieties are crucial to harnessing the full potential of organic farming. That is why two teams from FiBL are working within the EU LIVESEED project to expand the production of organic seed and boost organic breeding.

Using organically propagated seed is a fundamental principle of organic farming. That is why, according to the EU Organic Regulation, 100 per cent of seed must be propagated on organic farms. This is not yet possible, however, since the production of organic seed is agronomically complex and requires considerable skill. Moreover, fluctuating or too little demand for organic seed can make its propagation uneconomic, which is why the organic seed market is unattractive for many seed suppliers.

Growth in the organic seed sector is too slow

The organic seed sector is still performing at well below its potential in many EU countries. Owing to the continuing use of conventionally propagated seed, albeit untreated, demand is barely rising; the European organic seed market is stagnating. The exemption certificates issued by the ministries of EU countries are also partly responsible for this stagnation.

Improving national databases

In order to boost the seed market, FiBL Germany is working within the EU LIVESEED project on making the organic seed market more transparent, standardising the implementation of the Organic Regulation for the use of organic seed throughout Europe and improving national seed databases. This is because the national seed databases are a key factor in the development of the seed market: the more entries for organic seed of a particular cultivar that are available, the lower the number of exemption certificates – this is the aim of the legal framework. Thus, improving the quality of national databases and increasing the volume of entries are important goals that FiBL has been pursuing for many years. For this reason FiBL has established its own database, OrganicXseeds. Thanks to a modular system, it is the most-used organic seed database in the whole of Europe. Practitioners who buy or sell organic-quality seed and plants can already use the database in Belgium, Britain, Germany, Ireland, Luxembourg, Sweden and Switzerland.

Central EU router database for organic seed

As well as national databases, what is needed is a holistic plan for achieving better integration between national seed markets and improving their transparency.

70,000 people used the FiBL seed database in 2017, **90,000 in 2018**

That is why FiBL Germany is developing an EU router database as part of the LiveSeed project. This will link national databases with each other, improve organic seed marketing structures and provide farmers with a broader range of organic seed and organic varieties.

Working together to breed new organic varieties

The ambitious LIVESEED project, which the EU has allocated funding of nine million euros, aims to support not only organic seed production but also organic breeding throughout Europe. For example, innovative and socially responsible breeding programmes and selection tools for breeders are to be developed. In addition, networks are being established to cooperate in breeding new varieties of legumes (lupins, peas), cereals (wheat, barley), vegetables (tomatoes, brassicas), fruit (apples) and fodder crops (alfalfa/grass mixtures) for organic growers. Central to this is breeding for increased diversity in the form of species mixtures, population varieties that demonstrate genetic diversi-

Lupin seeds are examined for disease in the FiBL laboratory.

ty, or varieties from line breeding with more uniform characteristics. Breeding for resistance using molecular markers and taking microbial communities in the soil into account are important aspects of this.

Testing and producing organic varieties

Various testing procedures and organisational methods are being used to find out whether a variety is suitable for organic growing. These are shared between countries and documented as part of the LIVESEED project. In view of the new EU Organic Regulation, proposals are also being drawn up for the EU Commission for how the licensing of organically bred varieties and the characterisation of less uniform population varieties might look. Furthermore, new strategies for seed quality are being developed and treatment methods to control seed diseases in wheat (stinking smut), carrots (Alternaria leaf blight) and lupins (lupin anthracnose) are being trialled.

Promoting organic seed and breeding

The LIVESEED project is also investigating the socioeconomic aspects of the use and production of organic seed, and their interaction with EU provisions. Wide-ranging surveys identify shortages in the supply of organic seed, and local workshops with national authorities, stakeholders and farmers are developing tools and incentives for the production and use of organic seed. Economic case studies for wheat, carrots and alfalfa are developing new models for sustainable financing of organic breeding and seed production.

Monika Messmer and Freya Schäfer, Plant Breeding, FiBL

Projekt LIVESEED

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Project coordination: IFOAM EU
Research coordination: FiBL Switzerland
Funding 2017 to 2021: EU as part of Horizon 2020, Swiss State Secretariat for Education, Research and Innovation (SBFI)
Partners: 49 organisations in 18 European countries. Research institutes, breeding companies, seed firms, organic associations (farmers, processors, retailers) and national authorities

Europe-wide organic seed database

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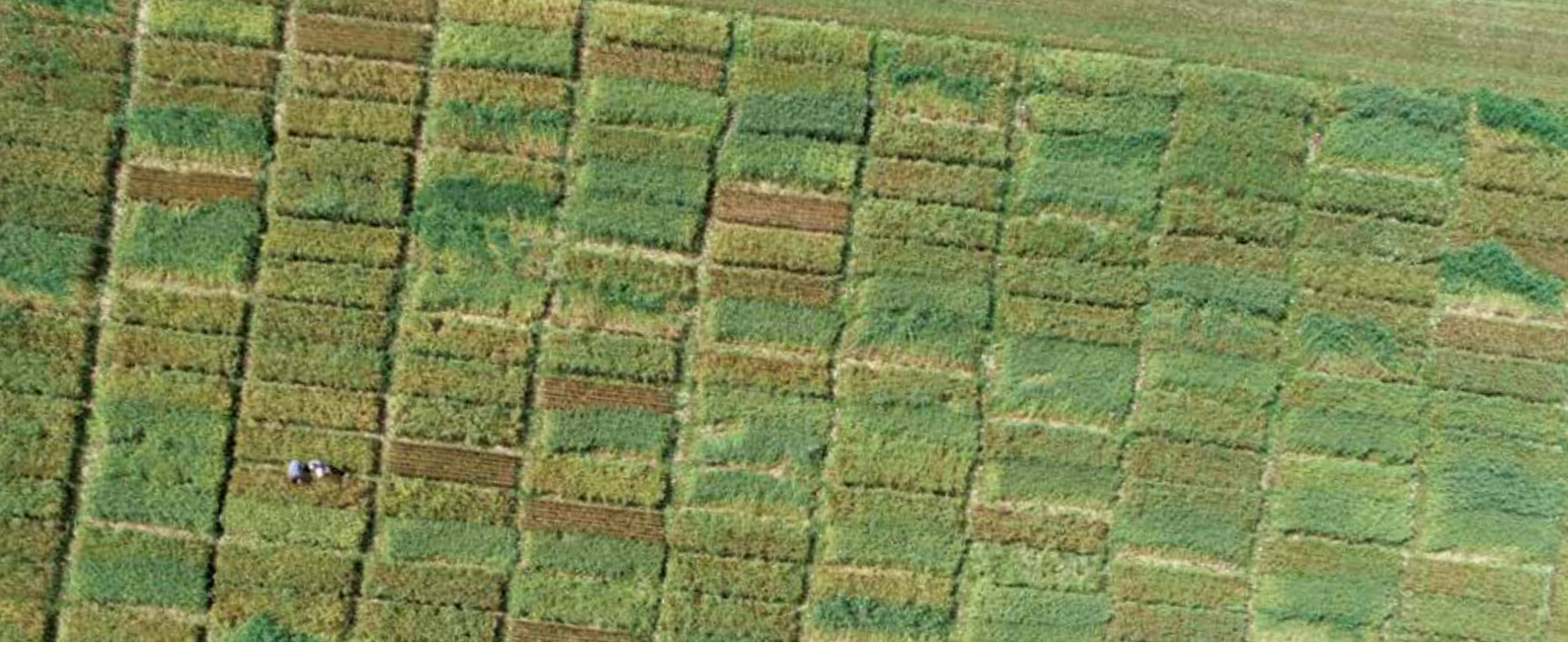
Project partners: FiBL Germany, Europe and Switzerland

The breeding expert Agatha Leska (left) from Getreidezüchtung Peter Kunz (GZPK) and Christine Arncken from FiBL check the health of narrow-leaved lupin leaves.



FiBL Switzerland is testing mixtures of 33 pea varieties and 8 barley varieties on 286 plots in the ReMIX field trials.

Food security through mixed cropping

We need new growing methods to provide us with food security. This is where intercropping comes in, because it delivers environmental and economic benefits. In the Europe-wide ReMIX project, FiBL is optimising mixed cropping through breeding and cultivation techniques.

Mixed cropping is a key element in feeding the growing world population sustainably, as mixed crops increase productivity, conserve resources and are more resilient to fluctuations in climate, weeds, pests and diseases. However, to date very little mixed cropping has been practised in Europe, mainly owing to a lack of suitable varieties, knowledge about cultivation and processing facilities.

That is why FiBL has been successfully promoting mixed planting of grains and legumes for years and is stepping up its efforts in the context of the EU ReMIX project. Demonstration plots are planted and regular working group meetings held with farmers, farm machinery manufacturers and feed mills. FiBL is also looking at various strategies for breeding and selecting particularly efficient crop combinations.

The pea variety determines overall yield

It is important in mixed crops that, as far as possible, the partners use different resources, in order to avoid too much competition. To this end FiBL Switzerland is testing different combinations of 33 pea varieties with 8 barley varieties as well as monocultures of each at several sites over several years. A particular cause for excitement is the effect of intercropping on yield stability and on plant and soil health, which is why FiBL is also looking at soil microorganisms. Initial results suggest that the yield potential of the pea variety used significantly determines the yield of the overall mix. However, characteristics such as the leaf surface of a specific pea variety also seem to affect its yield in a crop association with barley.

Better options for weed control

Interesting observations have already been made in terms of weeds: in the field trials there was between 14 and 18 per cent less late weed growth than in the corresponding monocultures of peas or barley. That is because barley and peas sown alone do not develop fully at all sites, which can result in more weed growth. Mixtures withstand this effect, since they increase the probability that there is a crop variety in the field that is well suited to the specific soil and the prevailing weather conditions, and which can put on dense growth and provide good ground cover.

Pierre Hohmann and Benedikt Haug, FiBL Plant Breeding

EU promotes mixed cropping in the ReMIX project

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Funding 2017 to 2021: European Union, Swiss State Secretariat for Education, Research and Innovation SBFI
Coordination: INRA Toulouse, France
Partners: 23 partners in 11 EU countries, Switzerland and China. Research institutions, extension services, farming cooperatives, breeders, farm machinery manufacturers and small and medium-sized businesses

Spotlight on organic vegetables

The Austrian organic vegetable scene is very active, and the "Bionet Vegetable" project is playing its part. Its particular strength lies in the fact that practical problems are tackled collectively and activities are coordinated.

The Bionet training project was launched in 2005, with its focus on arable farming. As a result of its successful development, the project was extended in 2009 to include vegetables. From the outset cooperation and networking between growers, advisers and scientists formed the cornerstone of the project and are a significant reason for its success. The Bionet project has been coordinated by FiBL Austria for almost ten years.
The core group meets once a year to discuss key topics for the project. However, at the heart of the project are the focus groups, small groups that are convened for specific issues and who network regularly to flesh out and implement new project ideas.

Fungi to control wireworm

For example, one focus group is addressing the problem of wireworm in potato cultivation. Depending on the site, weather conditions and time of harvesting, the beetle larvae can cause major damage and loss of yield. Owing to the very dry weather in 2018 many growers had to contend with a rise in wireworm infestations.
In the search for control strategies the potato focus group carried out trials at two sites with various fungal preparations and their effect on the pest. "The results show some effectiveness against wireworm from the fungal controls although, with seven per cent more potatoes free of wireworm at the Marchfeld site and ten per cent at the Waldviertel site, the effect was minimal", says FiBL project leader Benjamin Waltner. "In future experiments we must be especially careful to achieve an optimal moisture content in the soil, in order to encourage the fungal growth to germinate."

Testing methods for the prevention of mildew and flea beetle

The fruiting vegetables focus group examined biological sprays for tomato leaf mould, while the onion focus group tested a fungal preparation for false mildew. A third group looked at various possible ways of controlling flea beetle in radishes, testing two biological controls and basalt rock dust, as well as insect-proof mesh.

Results published online and in booklets

All the results from the work of the focus groups, as well as other current issues in vegetable growing, are published in the organic vegetable handbook, produced annually, in various booklets and on the Bionet project website. The annual Bionet Vegetable Conference offers a further opportunity for networking and exchange of ideas.

Elisabeth Klingbacher, Communications, FiBL

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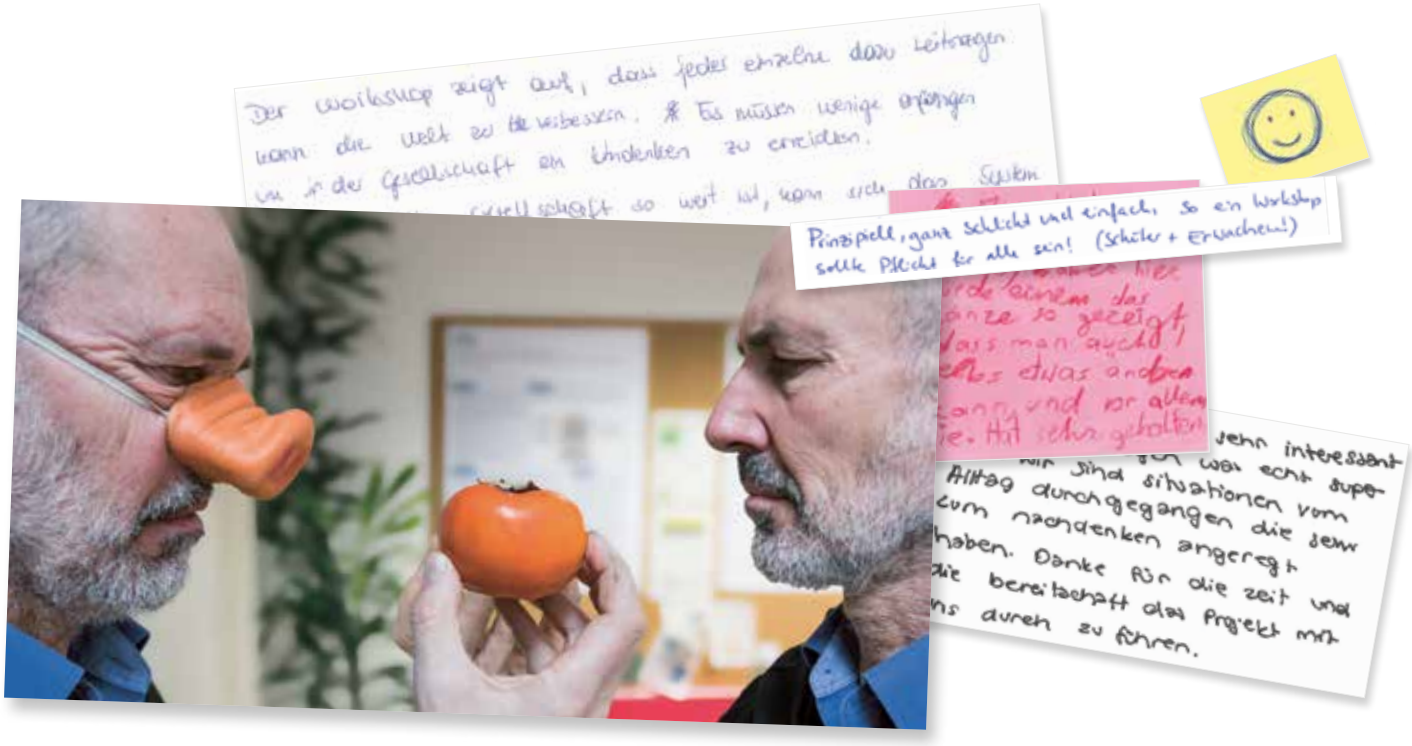
www.bio-net.at
Contact: benjamin.waltner@fibl.org
Funding: Austrian Rural Development Programme 2014–2020

FiBL agronomist Benjamin Waltner tests fungal preparations for wireworm in potatoes.



"Should I really pay more for organic food?" Lothar Greger (left and right) deals with the conflict with one's lack of willpower in his workshops for young people. The feedback shows that they are happy to be there.

In pursuit of happiness

Young people want farm animals, workers and the environment to be well looked after. But changing old consumption and eating habits seems to be hard. FiBL workshops at Austrian schools show that change can also be a happy experience.

A FiBL workshop for young people picks up where teaching about "organics" usually leaves off. As a rule, although pupils go home after those lessons knowing more about the need for a sustainable style of consumption, they return to their old habits on the second visit to the supermarket – at the latest.

Embark on a "hero's journey" of one's own

Every child is familiar with the basic pattern of the hero's journey from films and books. It provides young people with a universal narrative structure for human processes of change. In this case it is a fictitious journey of adventure, which allows tomorrow's organic consumers to have a sort of practice session in developing and undergoing their process of change. With knowledge about the added value of organic food as a starting point, young people work in small groups of three or four to write their script for the change. In this they are themselves the heroes and heroines who set out from the world they know.

First recognise the conflicts ...

The students arrive at a new style of eating and consumption by way of all sorts of imagined experiences. At the heart of the process is the recognition that all heroes and heroines see themselves faced with conflicting inner voices: on one hand we want to hang on to our old eating and consumption patterns, on the other we know that, given the progressive destruction of the environment, it is high time to make changes. However, a finger-wagging "you should" is an almost inaudible call for change in the face of countless everyday temptations.

... then find the way to be happy

Young people learn in a fun way that our acquired eating and consumption habits help us to manage our everyday life without expending a lot of extra energy and enable us to feel secure. If we want to alter these habits, we must first be clear why we want to give up this security. Do we really want to invest energy in our own process of change, and overcome psychological, social and structural obstacles to arrive at the end of the journey at a new style of eating and consumption in which "organics" are an integral part?

Lothar Greger, Consumer Research, FiBL

"Hero's journey" workshop

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The FiBL Austria workshop "Heroes and heroines on their journey to a sustainable style of living and eating" has already run eight times. It consists of twelve lessons over three days and is promoted as part of the EU "System(at)ic" project for more organic production.

Visitors were able to examine crops on some 300 plots.

Organic Field Days – Germany's first big meet-up for organic practitioners

The Organic Field Days are a new two-day event for Germany, linking stakeholders in the organic scene and showcasing their activities – and attracting many visitors from the conventional sector. The success of the first Organic Field Days sets the bar high and presents a challenge for FiBL Projekte GmbH, which is organising the event again in 2019.

The Organic Field Days, launched in 2017, unite practice with research. They provide an ideal platform for demonstrating innovations and engaging with researchers, farmers, policy-makers and businesspeople. Unlike traditional field days, the issues covered in the Organic Field Days are not restricted to crop production; animal husbandry is also a key topic, because closed material cycles are a crucial aspect of organic farming. In 2019 the German black pied cattle breeders' conference will mark its tenth anniversary at the Field Days. "We cast a spotlight on the whole organic farming system in all its diversity," explains FiBL project manager Carsten Veller. "This includes innovative farm management approaches, new production systems and modern forms of animal husbandry."

Many "conventional" visitors

It is not only organic farmers for whom the Organic Field Days are of interest. Farmers can view the whole spectrum of current developments in organic agriculture. "Even at the first event, a quarter of the visitors were from the conventional sector and another eleven per cent were transitioning," says Carsten Veller. "This demonstrates that organic methods such as mechanical weed management and animal welfare issues such as avoiding the castration of piglets are important topics for all farmers. Similarly, current challenges including climate change, species diversity conservation and breed preservation need solutions that apply to everyone involved in farming." These key issues were highlighted and discussed in forums and with the help of practical examples on the trial and demonstration plots.

Platform for the scene

At the 2017 Organic Field Days more than 8000 visitors saw how organic farms can develop. The highlights included demonstrations of innovative new machinery and demonstration plots for almost every conceivable crop. Two special shows were dedicated to animal husbandry and to compost.
Almost 300 businesses, associations and organisations displayed their wide range of offerings for organic farmers. Most of the exhibitors dealt in agricultural technology, farming inputs or seed and plant material. Representatives of eleven other categories, from advice, research and monitoring to animal husbandry and marketing, expanded the range.

The ideal venue

For the event venue, the Hessische Staatsdomäne Frankenhausen, dialogue between practice and research is nothing new. The Staatsdomäne is a teaching, research and transfer centre for organic agricul-

The Organic Field Days in numbers:

70 crops on
300 plots
8000 visitors

ture and sustainable regional development. It is also a working farm that produces and sells goods such as milk, eggs, meat, carrots and potatoes. The farm plays a key role in the Organic Field Days.

Fruitful cooperation

In the spirit of the slogan "Competition is good for business", FiBL works with the German Agricultural Society (DLG), whose DLG Field Days have for the past 30 years presented the position of the conventional sector. FiBL Projekte GmbH therefore contributed to the "organic special" forum and podium discussion at the 2018 DLG Field Days, while the DLG supported the machinery demonstrations at the Organic Field Days.

2017 Organic Field Days were just the start

Following the successful launch in 2017, FiBL Projekte GmbH will again be organising the Organic Field Days in 2019. FiBL intends to hold the Field Days every two years and develop them as a platform that practitioners and researchers can use to exchange knowledge and ideas and communicate with policy-makers and businesspeople.

Hella Hansen, Communications, FiBL

Organic Field Days

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Website: www.oeko-feldtage.de
Details: Following the launch in 2017 the next Organic Field Days will take place on 3 & 4 July 2019; the venue will again be the Hessische Staatsdomäne Frankenhausen near Kassel, Germany. The Organic Field Days will be held every two years, alternating with the DLG Field Days.
Organiser: FiBL Projekte GmbH
Co-organisers: Hessian Ministry of Agriculture (HMUKLV), Hessische Staatsdomäne Frankenhausen, University of Kassel, Stiftung Ökologie & Landbau (SÖL), Landesbetrieb Landwirtschaft Hessen
Patron: German Federation of the Organic Food Industry
Cooperation agreements with: Organisers of similar events in Switzerland (Organic Arable Farming Day), Austria (Organic Field Days) and Hungary
Funding: Exhibitors' stand fees, visitor entrance charges, Hessian Ministry of Agriculture, donations from sponsors

Agricultural technology is a big draw: some 80 exhibitors displayed their machinery and equipment.

DOKumented: Organic systems are more efficient and host more life

The long-term DOK trial, the oldest and most important of its kind worldwide, in which the three farming systems biodynamic, organic and conventional are being compared, is celebrating its birthday. Paul Mäder, head of the Soil Sciences Department at FiBL Switzerland, summarises the most exciting results from 40 years of the DOK trial.

Did you know that a handful of soil harbours as many living organisms as there are people on the planet? These organisms keep our soil fertile, release nutrients for plants and form stable particles that protect the soil from wind and water erosion.

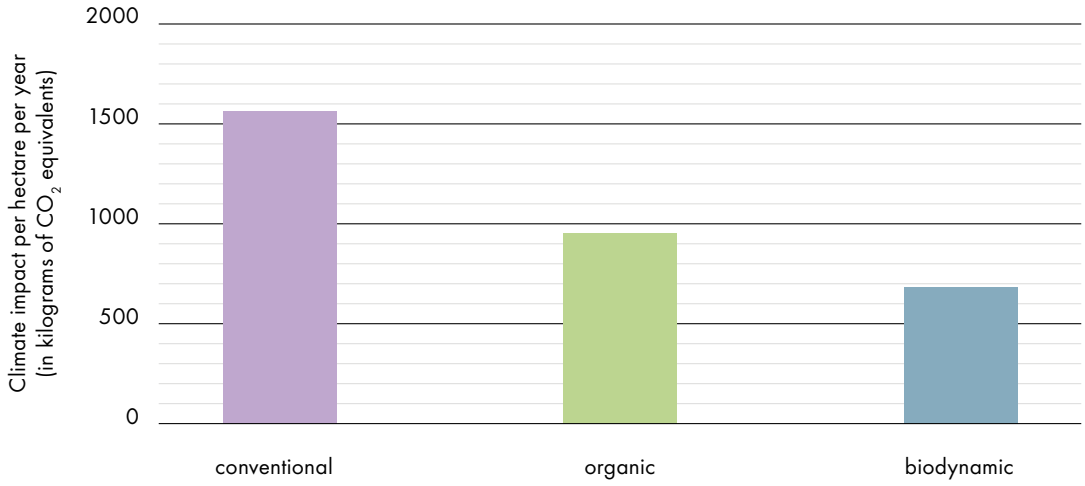
Our planet's skin needs protection

The humus layer arose through the decomposition of plant remains over thousands of years. In the fertile regions of our planet Earth, it covers the subsoil as a dark mantle, much like skin. Through modern intensive agriculture with large quantities of chemical fertilisers and plant protection products as well as heavy machinery, we are destroying our soils. Around a third of the fertile agricultural soils worldwide have already been lost through erosion. In Switzerland, our soils are indeed less intensively farmed thanks to well-educated farmers and an ingenious direct payment system for ecological performance.
Nevertheless: Organic and especially biodynamic soils have more humus, are more vital, are richer in species, and release less greenhouse gas. Moreover, they are more efficient at converting energy and nutrients into yields. This is substantiated by results from the DOK trial in Therwil in the Canton of Basel-Land, in which we have been comparing the biological-dynamic, biological-organic and conventional (German: konventionell) agriculture systems since 1978.

Visible differences

If you visit the DOK trial field after a heavy rain, you will notice that the organically managed plots are less muddy. You can get to the bottom of this mystery with a spade: In the organic soil you will find more earthworm tunnels, which drain the rainwater into the soil.
If you dig up some potatoes, you will notice that the conventional potatoes are much bigger than the organic potatoes. This is not just a coincidence: the conventional potatoes receive on average about twice as much fertiliser and get sprayed twelve times to control weeds, fungi and insects. If you continue through the trial site, you will notice that the organic wheat is very impressive and somewhat taller. This is so because it is not sprayed with chemical growth regulators to keep it short, as is done in conventional wheat to reduce lodging during wind gusts.

Organic cropping has a slim carbon footprint



Climate impact of different cropping systems in the DOK trial. The impact consists of nitrous oxide emissions, carbon changes in the soil (humus) and methane emissions.

Organic systems yield less but produce more efficiently

The conventional growing method wins as far as average yields over all crops are concerned. Around 20 per cent less on average is harvested in organic agriculture. The important thing is that the yield differences between organic and conventional have remained stable over the 40 years – the organic systems were able to maintain soil fertility. The organic variants produce with about 50 per cent less fertiliser and energy input, in other words they are more efficient and therefore gentle on the environment. The differences between the organic and biodynamic systems are also interesting. Although the potato yields in the organic system are about 15 per cent higher than in the biodynamic system thanks to the copper sprays, in recent years the biodynamic wheat yields have been approx. 20 per cent higher than in the organic system. This higher yield is likely attributable to the better soil structure and the greater biological activity, and also to the use of adapted organic cultivars of the cereal breeding company Getreidezüchtung Peter Kunz in the biodynamic system.

Clean drinking water thanks to organic

In the biodynamic method, the soils are fertilised with manure compost and biodynamic products, whereas in the organic method, the trial plots receive manure. Those in the conventional method receive both chemical fertilisers and manure. No plant protection products at all are used in the biodynamic plots, whereas the organically grown potatoes are treated with copper for disease control. Natural products (Bacillus thuringiensis) help control Colorado potato beetle in both the organic and biodynamic methods. This means that over the years, 95 per cent fewer toxic substances were sprayed in the organic system and 100 per cent fewer toxic substances were sprayed in the biodynamic system than in the conventional system. That is important not only in terms of the insect fauna but also in terms of uncontaminated food and clean drinking water.

More life and more humus in the organic soil

The long-term diversified management of the DOK plots has had lasting effects on the living conditions of microorganisms. Bacteria, fungi and protists seem to

Paul Mäder in a wheat plot of the long-term DOK trial in Switzerland.

thrive better in the organically fertilised plots. And a more diverse microbial community ensures that nutrient cycles are maintained, even under drought stress. As part of her dissertation, Martina Lori demonstrated

Soil lifeforms: organic + 30 % biodynamic + 60 %

in comparison to conventional agriculture

in a model study that under drought conditions, organic soils mineralise more nitrogen from a legume green manure crop and that the test crop ryegrass accordingly assimilated more nitrogen (page 14). Furthermore, organic agriculture is especially favourable to the diversity of mycorrhizae and beneficial ground beetles. Compared to the conventional plots, as a whole around 30 per cent more soil organisms were found in the organically managed soils and 60 per cent more in the biodynamically managed soils.

This fits the overall picture: In two large-scale reviews, FiBL evaluated all studies available worldwide on humus content and biological activity: Organic soils contain up to 3.2 tons more carbon per hectare in the humus and are up to 84 per cent more active. It is noteworthy that both the community of soil lifeforms and the associated field flora are more diverse in the organic and biodynamic variants. This is yet another example of how surface and subsoil diversity influence each other.

Organic agriculture is more climate friendly

Agriculture is not only affected by climate change, but also contributes to it. The measurements in the DOK trial have shown that the organic plots produce 36 per cent and the biodynamic plots 61 per cent less greenhouse gas. This is attributable not only to the reduced use of nitrogen in the organic and biodynamic systems, but also to the better soil structure, a stable pH and microbial communities which are capable of converting nitrous oxide into harmless elemental nitrogen.

The bottom line is that the biodynamic system in particular is more climate friendly because it is best able to sequester carbon in the form of humus in the soil.

Paul Mäder, Head of the Soil Sciences Department, FiBL

DOK long-term trial

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Core funding: Swiss Federal Office for Agriculture (FOAG);

Support: Swiss National Science Foundation (SNF), European Union, diverse national and international sponsors

Key figures: In the long-term DOK in Therwil (Switzerland), farmers and researchers have been collaborating since 1978 to generate key information for decision-makers in politics and society. Respected national and international institutes have authored some 120 scientific publications plus numerous technical articles and presentations based on DOK trial results. The DOK trial furthermore serves as a model for numerous system comparison studies around the world (see page 50). The Swiss State Secretariat for Education, Research and Innovation recently entered the DOK trial in the Swiss Roadmap for Research Infrastructures, which lists the experimental setups of national importance. FiBL Switzerland and the Swiss national research institute Agroscope are jointly responsible for the maintenance of the trial and the scientific collection and analysis of the data. Maize, winter wheat, potatoes, clover-grass and soybeans are grown in rotation.

Wheat harvest in the DOK trial.

Editor-in-chief Res Schmutz was one of the co-creators of the bioaktuell.ch website, the information hub for Swiss organic farmers who have practical questions of any sort.

A website for all practical questions

Res Schmutz has been managing the bioaktuell.ch website for more than a decade. We questioned him about this key source of information for Swiss organic farmers, which encompasses around 3000 pages and receives some 13,000 clicks per week.

Which page gets the most clicks?
Res Schmutz: The most frequently visited page is the organic marketplace, where animals, feed and fertilizer are sold. Otherwise there are no clear favourites. The clicks are distributed widely across the information categories.

As editor-in-chief you filter the daily flood of information. What makes it onto the website?
All practically relevant texts and videos from the FiBL advisory team and other organic advisors. Product managers at Bio Suisse also put the latest market analyses and prices on the marketing page. And all courses and events of interest to organic farmers appear on the website under "Agenda".

How has the website changed in ten years?
Over the years we have added categories of information, such as films and newsletters and the pages about converting to organic methods.
And originally the website was only in German. Two years later the French and Italian versions were added, with Maurice Clerc as editor of the French pages. For financial reasons the Italian version is unfortunately significantly pared down.

When and why was the website founded?
In the noughties Bio Suisse and FiBL established that many practitioners were not finding the information that they needed on the many websites that then existed. Although Bio Suisse and FiBL already had the printed monthly magazine Bioaktuell, they wanted a means of providing up-to-the-minute information on practical issues. So in 2007 we launched the internet platform.

Who had the idea for this website?
Lots of people contributed ideas. I was part of it from the start – initially with Gilles Weidmann, who set up the site. Since 2010 I have been editor-in-chief.

Can you tell me about one of your successes?
The President of the Swiss Farmers' Association phoned FiBL's senior advisor, wanting to know what could be done to combat Marssonina leaf blotch in fruit. The advisor entered "Marssonina" in the search box on the bioaktuell website and impressed the President with the information he was able to provide. Both were delighted. I had put the Marssonina page online just two days previously.

How long will you carry on with bioaktuell.ch?
Until I retire early in 2020. I'm definitely going to finish at that point. There are still some mountains that I want to climb.

How do you see the future of bioaktuell.ch?
It is useful for practitioners to be able to find all the organic information they need on one platform. However, keeping what will soon be 3000 web pages up to date will be a major challenge.
Interview: Franziska Hämmerli, Communications, FiBL

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www.bioaktuell.ch
Contact: res.schmutz@fibl.org
Funding: FiBL, Bio Suisse, advertising revenue

Organic farming can feed the world

Organic agriculture can feed the world – even the nine billion people that it is likely to be home to in 2050. In this interview Adrian Müller and Christian Schader, both sustainability researchers at FiBL Switzerland, explain how this can work. Their model calculations on this issue were published in the respected journal "Nature Communications" in 2017.

How can organic agriculture feed the world despite lower yields?

Adrian Müller: If we change our consumption habits, it can definitely do that. We need to eat fewer animal products and we must reduce food waste. If we ignore these two points and if, as the FAO predicts, the world has a population of nine billion in 2050, we would need about 30 per cent more land if all farming were organic; that is not feasible.

Why should we switch to organic?

Adrian Müller: It's not a question of whether we go organic or carry on as before. Carrying on as before isn't an option. So the question is: what alternative ways of preventing or reducing our problems are there? A crucial point to bear in mind is that when we think about sustainable agriculture, we must not ignore the consumption aspect.

Why can we not continue as before?

Adrian Müller: Problems such as pesticides, nitrogen surpluses and climate change are already starting to destroy our environment. We can see this in such things as the residues in lakes and rivers, the decline in insect numbers and our increasingly species-poor landscapes. And with the spread of vast "agricultural deserts", havens for wild plants and animals are also disappearing – in this respect even organic farming needs to improve.

100 % organic agriculture means
halving the use of farmland for animal feed and halving food waste

What would be the disadvantages of 100 per cent organic agriculture?

Adrian Müller: The disadvantage is that totally organic agriculture needs more land, because yields are about 20 per cent less. But because – for environmental protection reasons – using more land is not an option, we would have to reduce land use elsewhere. However, that is the only drawback of organic agriculture; in every other respect it has advantages. Conventional agriculture scores very well in terms of land requirements, but on every other front it does less well.

So we would have to cut back on livestock farming. Would there then be enough fertiliser?

Christian Schader: Livestock farming is not a particularly significant element in the nitrogen cycle. If you allow the nitrogen to pass through an animal in order to obtain dung or manure, up to 50 per cent of the nitrogen is lost by the time it reaches the field. Less nitrogen is lost if plants are used directly as fertiliser – provided that the correct techniques are used. What is important is the fact that in organic farming we are not allowed to use any synthetic nitrogen fertilisers. To ensure a good supply of nitrogen, we therefore need to use more legumes – they are plants that actively transfer nitrogen from the air to the soil. Our model calculations have in fact revealed a slight undersupply of nitrogen.

So organic farmland will starve?

Christian Schader: The first thing to say is that a bit less nitrogen than we have today would actually be good for lakes and rivers and for biodiversity. Furthermore, the model was based on very conservative assumptions: we put the proportion of legumes in the crop rotation at 20 per cent, even though the average in organic farming is around 25 per cent. And there were some factors that we were unable to take into account because of a lack of data. One such factor is the nitrogen that may be produced by nitrogen-fixing catch crops. Another important point is that most organic farmers need to handle their fertiliser more carefully. For example, nitrogen losses can be reduced by using the right composting techniques. Moreover, in future more recycled fertiliser must be returned to the cycle.

Does that mean that more know-how is needed if we stop using artificial fertilisers?

Adrian Müller: Yes – which means that it wouldn't be a good idea to go entirely organic overnight. But if we aim for production to be largely organic by 2050, that gives practitioners, advisors and researchers enough

The model calculations performed by FiBL socio-economists Christian Schader and Adrian Müller show what the future could look like.

time to develop and disseminate the know-how needed for agriculture to operate without artificial fertilisers and pesticides.

How can people be persuaded to halve the amount of meat they eat?

Christian Schader: Simply telling people to eat less meat will certainly have no effect. On the other hand, increasing the price of meat would achieve something. But what we really need is a shift in values. Here that has already begun: in Switzerland and Germany per-capita meat consumption is declining. It is no longer particularly fashionable to eat meat at every meal – quite the opposite, in fact. I am well aware of that myself, because I like to eat meat from time to time.

Adrian Müller: Yes, we can certainly hope for a shift in values. History shows that values – even fundamental ones – often change. A good example of that is smoking, which has fallen dramatically.

Christian Schader: And while we're on the subject – if one were to reduce the consumption of tobacco or alcohol, that would of course free up land for growing food. There are lots of things one could do. But you can't ban living.

Adrian Müller: In our study we ignored these aspects – in other words, people can still smoke and drink the same amount, even if agriculture is totally organic. They don't have to give up meat entirely either. We must only cut back a bit on meat from grazing animals; there has to be a bigger reduction in the use of meat from pigs and chickens, which need feed grown on arable land. The land used for animal feed has to be reduced by half.

According to your model, how much animal produce can people still eat?

Adrian Müller: If we apply the model that assumes that all farming is organic and that food waste, grass for ruminants and land for non-ruminant feed are all halved, it tells us that worldwide consumption of meat from ruminants such as cattle, sheep and goats needs to be reduced from the present figure of around 240 grams per person per week to around 133 grams, while milk consumption must be reduced from 1700 to 950 grams. With regard to products from non-ruminants such as pigs and poultry the change needs to be more drastic: consumption of meat from these animals has to be reduced from the current level of 540 grams per week to 50 grams, and egg consumption needs to fall from 160 to 15 grams. We would get the protein that we need from pulses such as peas, lentils and beans.

Christian Schader: My preferred scenario is a little different, because such a drastic reduction in meat consumption is likely to be difficult to achieve.

If the consumption of animal products were to be cut by a third rather than a half, it would still be possible for all farming to be organic – but we would have to be stricter about food waste and cut that by more than

just a half. In that case we could even manage to reduce the amount of land needed for farming.
That is the good thing about our model: it shows us how different scenarios work under different conditions.

What is your favourite scenario, Adrian?
Adrian Müller: I would make farming only 80 per cent organic, rather than 100 per cent. The remaining 20 per cent would still be farming without pesticides, but mineral fertilisers would be permitted. We could then avoid such a sharp reduction in meat consumption, and halving food waste would be sufficient.

What was the feedback on the study like?
Adrian Müller: Because we're not claiming that organic farming is the only way forward but instead are depicting it as one of many factors, the study was very well received and resulted in a lot of invitations to conferences and talks, such as at the World Bank.
Christian Schader: The Dutch University of Wageningen got in touch with us and since then we have been doing a lot of work together; for example, we supervise doctoral students who are doing research in this area.
Interview: Franziska Hämmerli, Communications, FiBL

The study in "Nature Communications"
Contact: adrian.mueller@fibl.org
Funding: Food & Agriculture Organization of the United Nations (FAO), FiBL Switzerland foundation contributions
The study was conducted in collaboration with scientists at the FAO, the University of Aberdeen, the University of Klagenfurt (AAU) and ETH Zurich. It was published in the journal "Nature Communications" in 2017 under the title "Strategies for feeding the world more sustainably with organic agriculture".

Pathways to roughage-based milk and meat production in Austria and Switzerland

If grassland-based beef and milk production were to be introduced on a large scale, that would cut both ammonia emissions and total greenhouse gas emissions from agriculture by about 10 per cent and reduce nitrogen balance surpluses by about a quarter. Reducing the cultivation of concentrated feed and forage maize on farmland makes it possible to grow more plant foods and minimises competition between food and feed production. It would also be possible to make production generally more extensive and expand ecological compensation areas and nature conservation. The fall in production of animal-based food would have to be offset either by imports that meet high sustainability standards or by changes in dietary habits.
These are among the findings of the project "The Alpine region: A model for sustainable land use and eating habits" conducted by FiBL Switzerland and FiBL Austria. The project received financial support from three foundations: the Bristol Stiftung, the Paul Schiller Stiftung and the Vontobel-Stiftung.
The findings have been published in book form:

"Chancen der Landwirtschaft in den Alpenländern. Wege zu einer raufutterbasierten Milch- und Fleischproduktion in Österreich und der Schweiz" ("Agricultural Opportunities in the Alpine Countries: Pathways to roughage-based milk and meat production in Austria and Switzerland") by Matthias Stolze, Rainer Weisshaidinger, Andreas Bartel, Othmar Schwank, Adrian Müller and Roger Biedermann.
CHF 36.–
Haupt Verlag, Bern 2019
ISBN: 978-3-258-08099-4

Ukraine: The organic message falls on fertile soil

The organic scene in Ukraine has changed in the last ten years: the country now has a strict organic certification body, more jobs in the organic sector and new vehicles for the exchange of knowledge. A lot of this is thanks to the work of the FiBL market development group on behalf of the Swiss State Secretariat for Economic Affairs, SECO.

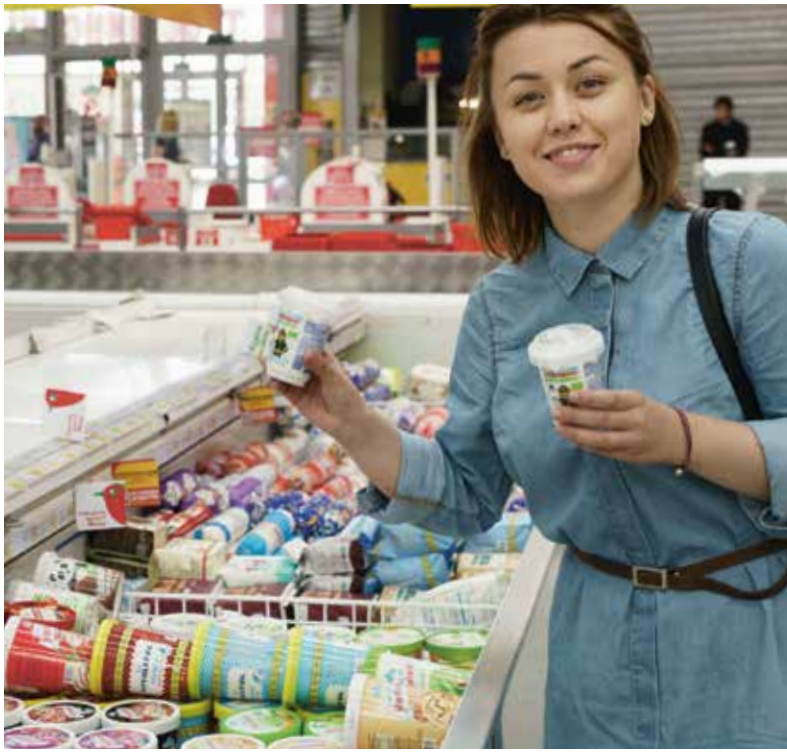
"FiBL and SECO have played a key part in the development of organic farming in Ukraine," says the country's Deputy Minister of Agriculture, Olga Trofimtseva. "FiBL equipped our organic pioneers with the knowledge needed for success."
Olga Trofimtseva belongs to a new generation of policy-makers who see organic farming as an opportunity to save exhausted soils and create jobs. They regularly discuss ideas with the FiBL project team. As a result, organic agriculture is now featured in two of Ukraine's eight new state strategies.

Channels for the exchange of knowledge

One of the organic pioneers mentioned by the Deputy Minister of Agriculture is the farmer Gleb Lukyanenko, who received advice from FiBL. He regularly shares his knowledge with interested farmers. The fifth Organic Farming Day was held on his land in central Ukraine in 2018. "This day is a vehicle for the exchange of knowledge, like the annual Organic Crop-growing Conference and the Organic Trade Conference," says FiBL project manager Tobias Eisenring. "After the project finishes in 2018 the Ukrainian partners will continue to run the events themselves."
The success of these activities is reflected in the growth of the sector. When the FiBL project was launched in 2005 there were 72 certified organic farmers. By the end of 2016 there were almost 300, and they are coping without any direct payments. Between them they farm more than 420,000 hectares – about one per cent of Ukraine's farmland.

A strict and independent certification body

The establishment of Organic Standard, Ukraine's independent and self-supporting certification body, fulfilled another important objective of the FiBL project. The Organic Standard certifies mainly small and medium-sized farms, covering about 50 per cent of the country's organic farmland and 75 per cent of its organic farms. The company can also certify products under the "Bud" (Knospe) scheme if necessary. Producers regard it as a very strict certification body.



Anastasiia Pivniuk of FiBL's Ukraine team shows that local organic products are starting to appear in Ukrainian supermarkets – thanks to a FiBL market development project.

Only five per cent know what "organic" means

FiBL assists small organic shops with public relations activities – because currently only about five per cent of consumers know what "organic" means. FIBL also helped set up facilities to process products for the domestic market. A FiBL study shows that this has been effective: during the project, which ran from 2005 to 2018, new jobs were created, especially in processing and retailing.

Franziska Hämmerli, Communications, FiBL

FiBL market development

Contact: thomas.bernet@fibl.org
FiBL's organic market development service is used by governments, private donors and local organic operators worldwide who want to set up sustainable production and marketing systems.
www.fibl.org > Search > Market development

How sustainable is my production system? Farmer Nicholas Mutanga (left) discovers the answer with the help of the SMART analysis and advisors Angeline Mwikali (centre) and Maina Gichaga (right).

Boosting sustainability throughout the world: The SMART method

An organic label specifies the environmental level at which a farm operates. However, it does not reveal whether the farm's social and business practices are also sustainable. To address this issue FiBL has developed the SMART method, which provides an all-round assessment of sustainability.

The word "sustainability" is often used inconsistently or as a term of embellishment. This make it increasingly difficult to gauge what sustainability really means. To counteract this, the Food and Agriculture Organization of the United Nations (FAO) has produced the SAFA Guidelines. These sustainability guidelines cover 58 areas relating to environmental integrity, economic resilience, social wellbeing and good governance. Using SAFA as a starting point, FiBL worked with scientists and practitioners for eight years to develop the software-supported SMART Method, or Sustainability Monitoring and Assessment RouTine. More than 4000 farms in 19 countries have now been assessed using SMART.

In order to cover as many aspects of sustainability as possible, SMART collects information on more than 300 indicators. This wealth of information enables farms and other businesses in the food sector to be comprehensively assessed and if necessary compared. For example, long-term viability can be measured by means of business figures. Soil quality is assessed using factors such as the number of crop rotation elements. Animal welfare is evaluated on the basis of parameters including the frequency of outdoor grazing, the size of lying areas, air quality and light availability. FiBL researchers have now refined SMART so that a farm analysis takes just three hours. A spider chart depicts a farm's strengths and weaknesses at a glance, while a written report provides further details.

A FiBL team of 14 people is responsible for further development of the SMART method. SMART is the property of the FiBL subsidiary SFS (Sustainable Food Systems GmbH).

Olivia Keller, Project Manager at SFS

4000 farms in 19 countries
have already been assessed using SMART

The SMART method

Contact: moritz.teriete@sustainable-food.com
Website: www.sustainable-food-systems.com
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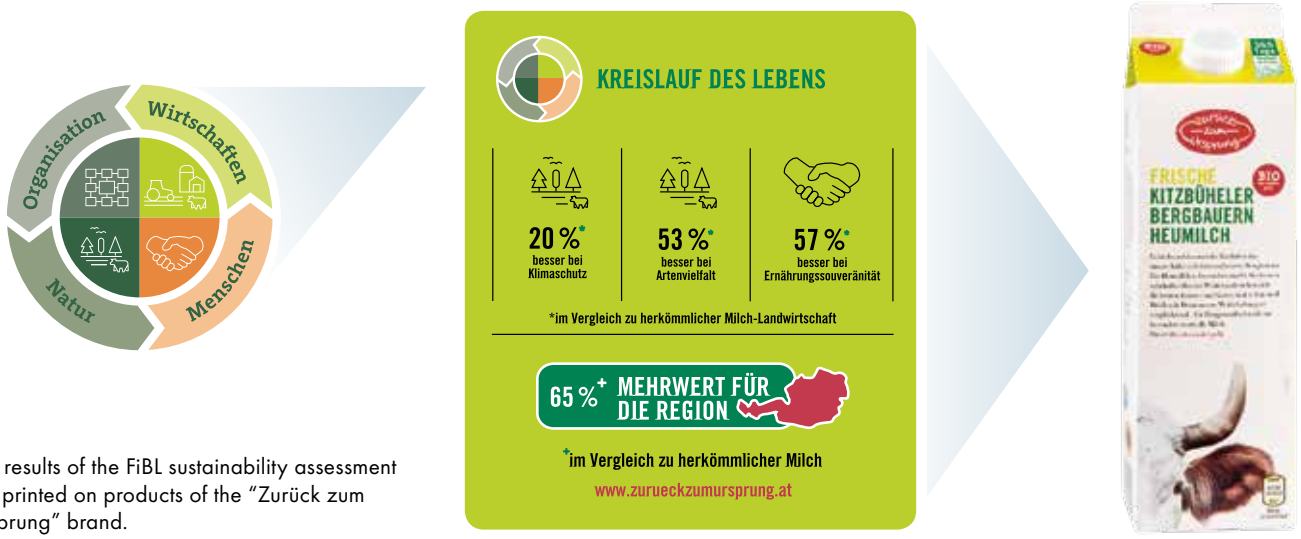
Partners: FiBL Switzerland, Germany and Austria



The results of the FiBL sustainability assessment are printed on products of the "Zurück zum Ursprung" brand.

Africa: Tracking down sustainable production systems

The SMART method is currently being used to evaluate the productivity, profitability and sustainability of organic farming in Africa. Through the Ofsa and Pro-EcoAfrica projects, data on the production methods of 2000 smallholders in Uganda, Kenya and Ghana is being collected. On the basis of the findings, measures are then put in place that enable local stakeholders to act in sustainability-oriented ways. This involves not only farmers but also advisors, scientists, policy-makers and representatives of the food industry.

Anja Heidenreich, Sustainability Group, FiBL

Promoting organic production systems in Africa
Contact: irene.kadzere@fibl.org
Website: www.proecoafrica.net
Funding: Stiftung Mercator Schweiz, Humanist Institute for Cooperation Hivos Netherlands, Swiss Agency for Development and Cooperation (SDC)
Partners: Agro Eco – Louis Bolk Institute Ghana, University of Ghana, Ministry of Food and Agriculture (MOFA) Ghana, Kenya Agricultural and Livestock Research Organization (KALRO), International Centre of Insect Physiology and Ecology (icipe) Kenya, International Federation of Organic Agriculture Movements (IFOAM)

Austria: Product assessments for consumers

If farmers endeavour to manage their operations sustainably, consumers should know about it. FiBL has therefore developed a simple and straightforward information system. The information on the packaging of organic foods of the "Zurück zum Ursprung" ("Back to the Origin") brand tells consumers how a farm rates in terms of sustainability. On behalf of the supermarket chain Hofer KG, which owns the "Zurück zum Ursprung" product line, FiBL Austria has since 2009 been assessing the sustainability of foods sold under this label and comparing their performance with that of corresponding conventional products. The assessment covers greenhouse gas emissions, water requirements, biodiversity potential and added value for the region.

As the SMART method has been refined, these calculations are now being replaced by a holistic sustainability assessment. More than 300 "Zurück zum Ursprung" farms specialising in many different products have now been analysed and assessed according to the SMART criteria. This involves visiting each farm and using a detailed questionnaire to collect data on all the relevant criteria. The results are displayed on the organic products. They take the form of scores that compare the results of "Zurück zum Ursprung" organic farms with those of typical and comparable conventional farms producing products of the same type. The comparison farms are modelled using literature research and expert surveys, with the SMART methodology functioning as a guide.

The results of the SMART analyses are already displayed on milk, milk products, fruit and cereal products from "Zurück zum Ursprung", thereby providing consumers with reliable and scientifically based guidance on sustainable shopping.

Each of the participating organic farms receives its own comprehensive and personalised assessment in the form of an individual SMART report. The result is an improved evaluation of the farm's strengths and weaknesses in various sustainability areas – and the opportunity to take action if necessary. In addition

The SMART method yields **300 sustainability scores in 3 hours**

In what areas is sustainability particularly good and where does it need to improve? Swiss organic farmer Markus Lehmann (left) goes through the SMART analysis with Richard Bircher.

there are plans to hold group discussions with farmers in 2019. The groups, which will be formed on the basis of production priorities, will serve as a forum for presentation and discussion of the SMART results; inputs from external experts on particularly important issues are also planned. A SMART assessment is therefore not only an important tool for depicting the sustainability performance of organic farming transparently and identifying risks and potential for improvement – it also provides a basis for clear and credible communication of sustainability information.
Elisabeth Klingbacher, Communication, FiBL

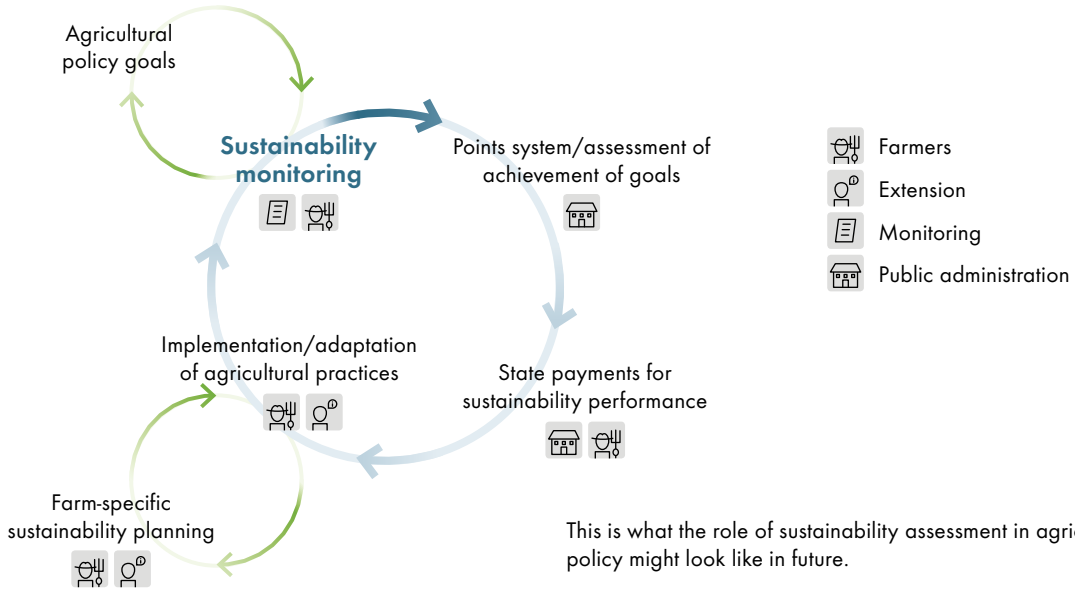
Sustainability assessment of food
Contact: thomas.lindenthal@fibl.org
Funding: Hofer KG

Good to very good sustainability on Swiss organic farms

Bio Suisse, the umbrella organisation of organic producers in Switzerland, wants to know more about the sustainability of farms that bear its "Bud" (German: Knospe) label. Over the past three years Bio Suisse has therefore had some 180 representative farms assessed by FiBL using SMART. The initial findings show that the vast majority of Bud farms obtain good to very good scores on most of the sustainability criteria. The SMART analysis confirms that the environmental performance of Bud farms makes an important contribution to society. In addition, the fact that farms achieve good scores in the area of social wellbeing is particularly pleasing: all the farm types that were studied do well on the criterion of quality of life. The farms that were analysed generally achieve good profitability and are able to undertake investment; around 15 per cent have created jobs in the last five years. Half of the farms that grow special labour-intensive crops have increased the number of jobs they provide since 2014. The SMART analysis report gives farmers a comprehensive overview of the extent to which their farms meet sustainability targets. Strengths and opportunities for improvement are identified.
The overall evaluation will show Bio Suisse what aspects of sustainability need to be targeted during implementation of the association's new "Avanti 2025" strategy. However, it is not only individual farmers and the Bio Suisse organisation that benefit from the SMART analysis – it also promotes the further development of Swiss agriculture. Bio Suisse is performing a pioneering role in the sustainability assessment of farms.
Lukas Baumgart, Sustainability Assessment, FiBL

Bio Suisse sustainability assessment
Contact: lukas.baumgart@fibl.orgFunding: Bio Suisse

Gearing agricultural policy to sustainability performance



This is what the role of sustainability assessment in agricultural policy might look like in future.

Agriculture needs to be sustainable – environmentally, socially and economically. FiBL is working on models that show how sustainability assessment tools could be used in European agricultural policy and how attainment of the goals that are set could be verified.

Although agricultural policy has in the past twenty years taken greater account of ecological issues, the defined environmental goals have not yet been met. Various stakeholders are therefore calling for agricultural policy to be reoriented, with a greater emphasis on sustainability performance.

Three dimensions of agricultural policy

In Switzerland efforts are being made to gear the existing system of state direct payments to sustainability performance. FiBL Switzerland was consulted about how this could work in practice. In a project we therefore produced models that take account of all three dimensions of sustainability, namely the promotion of biodiversity on farmland (the environmental dimension), the payment of appropriate wages (the social dimension) and collaboration with other stakeholders in the value chain (the economic dimension). At the same time, agricultural support payments need to be made more effective and more efficient so that they are more widely accepted by the population.

A points system measures performance

The diagram above depicts how sustainability assessment could be used in agricultural policy under the new model. The sustainability performance of an individual farm is first assessed by means of regular monitoring. This performance is then rated using a points system. Finally, these points are used to determine the amount of the direct payments that the farm receives.

Farmers decide what happens next

Farm-specific advice and general sustainability planning enable farmers to continuously improve their performance. The emphasis is on skills, flexibility and entrepreneurship. Farmers are free to choose what practices to adopt in order to improve their farm's sustainability performance, and their decisions can be tailored to their particular location.

In future projects FiBL plans to work with various stakeholders to translate this system into a tool that can be used in agricultural policy. It will then be field-tested.

Rebekka Frick, Socioeconomist at FiBL

The project "Neue Wege zur nachhaltigen Landwirtschaft" (New Pathways Towards Sustainable Agriculture)

Contact: christian.schader@fibl.org
Funding: Swiss Federal Office for Agriculture (FOAG)
Partners: School of Agricultural, Forest and Food Sciences (HAFL), Agroscope

Smallholders win with organic

Farmers in the tropics who adopt organic practices save on fertiliser and pesticide costs and often increase their earnings, as FiBL's long-term SysCom trials show. For ten years SysCom has been comparing the performance of organic and conventional production systems.

In the tropics – as elsewhere – weather conditions, pest pressure and market prices vary from year to year. To obtain robust data that can be used to compare different production systems, there is therefore a need for long-term trials such as SysCom.

A long-term approach is particularly important for agroforestry systems, because trees have yield cycles that extend over decades. For example, the FiBL long-term trial in Bolivia found that the yield of cacao was about 40 per cent higher in monocultures than it was in agroforestry systems, but that over the years the revenue from the secondary crops in the agroforestry system increasingly balanced out this difference economically. As a result, earnings per working hour are higher in the agroforestry systems than in the monocultures.

More humus in the agroforestry system

The long-term trial in Bolivia also shows that soil fertility in agroforestry systems and organic systems is better than in monocultures and conventional systems. This highlights the climate change mitigation potential of organic and agroforestry systems. Interestingly, the FiBL studies also reveal that organic management does not involve more effort than conventional methods; this contrasts with the findings of other studies.

The challenge of soil fertility in Kenya

Ongoing calculations from the long-term trials in Kenya currently indicate that soil fertility improved in the organic systems, but only with good irrigation and large inputs of organic fertilisers. Organic matter is one of the key factors in soil fertility. Building up this organic matter remains a prime challenge in Kenya.

Organic: Fewer vegetables, fewer residues

In the SysCom long-term trials in Kenya, the most important crop is maize, a staple food. The results show that yields of maize and beans were similar in organic and conventional systems, while yields of potatoes, cabbage and leaf vegetables were lower in organic systems – largely because of pest infestation and disease. However, organic vegetables are far less contaminated with insecticide residues. Evidence of this comes from samples of the white cabbage harvest that were collected in the spring of 2018 and tested for various residues. The insecticide chlorpyrifos was found to be present in conventional cabbage at a rate of 200 micrograms per kilo, whereas organic cabbage contained only 0.1 micrograms per kilo. The insecticide is only permitted in conventional farming. In Germany it has been banned since 2009 but in Switzerland it is still permitted, with a limit in vegetables of 100 micrograms per kilo.

Organic in India: Lower yields, higher profits

In India the SysCom results show that yields of organic and conventional soya beans are similar, but that in the organic system harvests of cotton and wheat are lower. Nevertheless, profit margins are comparable in the two production systems – because of savings on sprays and fertilisers and higher prices for organic goods.

In cotton growing, plant protection is still a major issue for Indian organic farmers. The FiBL project is therefore refining and standardising methods of producing traditional pest control agents from plant extracts.

David Bautze, Researcher, Tropical Agriculture, FiBL

SysCom long-term trials in the tropics

Contact: beate.huber@fibl.org
Project: SysCom, 2007–2022 (continued)
Website: systems-comparison.fibl.org

Bolivia: Long-term trial of organic and conventional agroforestry systems and monocultures (principal crop: cacao); participatory on-farm trials of various cacao varieties

India: Long-term trial of organic and conventional systems (principal crop: cotton); participatory trials on working farms of nutrient availability, pest control and cotton varieties

Kenya: Long-term trials of organic and conventional systems in two intensities (principal crop: maize); participatory on-farm trials of composting, pest control and biomass management

Funding: Swiss Agency for Development and Cooperation (DEZA), Liechtenstein Development Service (LED), Coop Sustainability Fund, Biovision
Partners: bioRe India, Ecotop S.R.L., University of San Andres, PIAF-El Ceibo Foundation, Institute of Insect Physiology and Ecology icipe

The figures support cacao growing in agroforestry systems. Such systems allow a Bolivian farmer earnings of about 7.70 US dollars per hour, compared to monoculture earnings of about 4.60 US dollars.

With the right production techniques organic farms in Kenya can achieve yields of maize and beans similar to those obtained on conventional farms.

Maize yield per hectare in the high-input system in Kenya

organic 5100 kg

conventional 4900 kg

In India organic farming results in lower yields of wheat than conventional systems. However, the organic smallholders have higher incomes. Humus build-up and further training in organic farming techniques are still major challenges.

Farmers select the best cotton plants. Six varieties have already been bred in this way.

150 smallholders
are testing new organic cotton cultivars on their fields

Organic cotton breeding in India

Organic cotton production is under threat because almost all the available seed is genetically modified. To restore the autonomy of Indian smallholder families, FiBL has been assisting organic farming organisations since 2011 with breeding, variety testing and seed propagation.

Half of our clothing is made of cotton. Cotton is grown on more than 30 million hectares worldwide and provides an income for more than 100 million people. Although cotton accounts for only 2.4 per cent of the world's farmland, 6.7 per cent of all pesticides and 16 per cent of all insecticides are used in its production. Less than one per cent of all cotton is organically grown; most organic cotton comes from India.
Despite growing demand for organic textiles, organic farmers are under enormous pressure because virtually no organic seed is available and there is a major risk of contamination by genetically modified plants – 80 per cent of all cotton seed is genetically modified.

Native species ensure reliable yields

Seventy years ago, 92 per cent of cotton was produced from native species; now, 95 per cent comes from F1 hybrids of genetically modified American cotton. Although F1 hybrids often have higher yields, native cotton species have many important advantages: they need fewer nutrients, are better at tolerating drought and flooding and are resistant to sucking insects. They thus contribute to yield security. FiBL therefore promotes the conservation and breeding of traditional cotton species and reproducible varieties. For the new varieties to be accepted by smallholder families and textile processors, boll size and fibre quality still need to be improved. Hence it is important that everyone is involved in the selection process.

Farming families learn to breed their own seed

FiBL strives to enable the smallholders' organisations to breed their own seed so that they are no longer dependent on seed companies. A multi-disciplinary team involving five growers' organisations, two universities and organic advisors and processors is working on the issue in six Indian states. Farmers are being encouraged to play an active part in selection. Each year between 30 and 50 varieties are tested under various local organic conditions; the best individual plants are used to produce new crossings, from which the best offspring are selected. The most promising cultivar candidates are tested by 150 smallholders in their fields. The first crossings have already resulted in six varieties that are now being propagated by the organic organisations themselves.
Amritbir Riar, Tropical Agriculture, FiBL and Monika Messmer, Group Lead, Plant Breeding, FiBL

Organic cotton projects
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Websites: www.greencotton.org, www.fibl.org > Themes > Organic cotton
Projects: Green Cotton II, Seeding the Green Future
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