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agroscope

Agroscope good food, healthy environment



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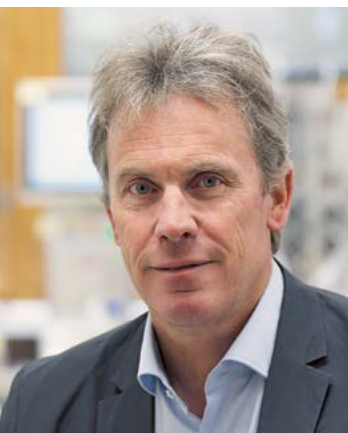


In 'Grassland Switzerland', foods of animal origin are part of a sustainable and balanced diet. Agroscope researches along the entire value chain for healthy and economical products.



Dear Readers,

Agri-photovoltaic (agri-PV) facilities, whose aim is to combine agricultural production and electricity generation on the same site, are springing up in Switzerland and Europe. Agri-PV is thus emerging as a promising response to two major challenges of our era: the risk of energy shortages and the proliferation of extreme weather episodes, both of which are driving the construction of protective structures in fruit and berry production. Agroscope is collaborating in several pilot projects in Switzerland. Its work focuses on the agronomic evaluation of the crops grown in these facilities, and on the quality of the products.



At the crossroads of technology, agronomy, the electricity market and spatial planning, agri-PV requires the expertise and collaboration of various stakeholders. Last November, numerous agri-PV professionals in Switzerland and Europe met up to share their experience (article on p. 4). The event was organised by the Competence Network for Fruit and Berries (KOB). The KOB collects information on agri-PV use in Swiss fruit crops and makes it available to farms.

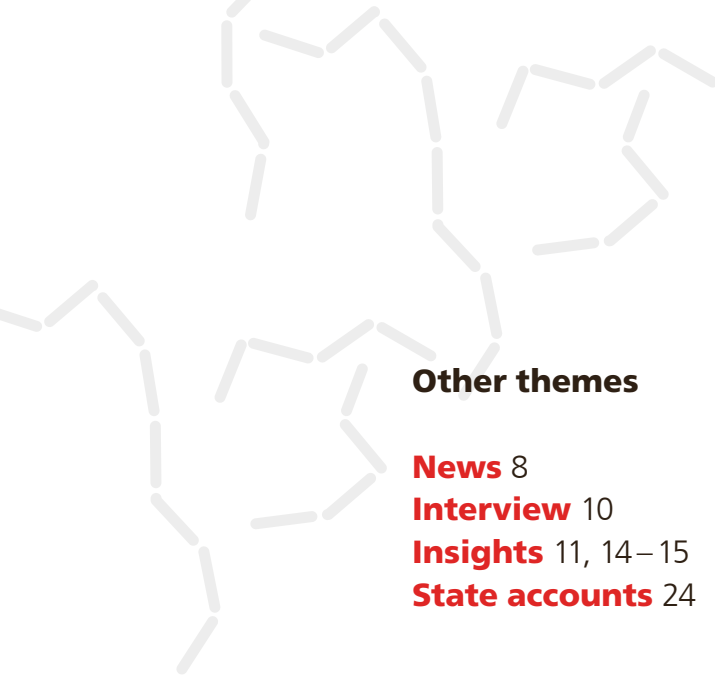
Global warming also impacts the distribution of insects in Switzerland. The first findings of the project 'INSECT', in which Agroscope, The Swiss Federal Institute for Forest, Snow and Landscape Research WSL, the Research Institute of Organic Agriculture FiBL and Info Fauna collaborate, were published in the specialist journal Nature Communications. These findings show that rare species are dwindling further, whilst common species are becoming increasingly numerous (article on p. 16).

Apart from the implications of global warming, the Swiss agricultural sector must limit its impact on the environment yet further. Our research teams are working intensively to achieve this objective, both in the field and in the barn. In this regard, a recent Agroscope study shows that, contrary to received wisdom, environmentally friendly agricultural production often generates more revenue than conventional production (article on p. 22).

Wishing you an enjoyable read!

Christoph Carlen

Head of the 'Plant Production Systems' Strategic Research Division



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Agroscope is the Swiss Centre of Excellence for Agricultural Research, and is affiliated with the Federal Office for Agriculture (FOAG). Agroscope makes an important contribution to a sustainable agriculture and food sector as well as to an intact environment, thereby contributing to an improved quality of life.

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Events

20 April 2023, Agroscope,
Swiss National Stud Farm SNSF

Annual Conference – Swiss Equine Research

20 – 21 April 2023,
ETH Zurich, Lindau ZH

51st Annual Conference of the Swiss Society for Agricultural Economics and Agricultural Sociology (SGA)

'Transformation of agri-food systems –
sustainability and digitalisation of food
value chains'

28 April – 7 May 2023,
BEA Bern, 'Grünes Zentrum'

Special Potato Show: Highlights of potato research

Agroscope research for sustainable
potato cultivation

4 June 2023, Agroscope
Stone Fruit Centre Breitenhof

Agroscope Breitenhof Conference 2023

The meeting place for the stone-fruit
sector

20 June 2023, Agroscope Reckenholz
**13th Life Cycle Analysis
Platform for the Agriculture
and Food Sector**

[All Agroscope events which are
open to the public are advertised
on our website.](#)

Agri-PV and Fruit Crops: Pilot Studies in the EU and Switzerland

The Competence Network for Fruit and Berries (KOB) hosted presentations and discussions on several agri-PV pilot projects last 4 November in Martigny, Switzerland.



The presentations were followed by a tour of the facilities at Agroscope's Conthey site



Several agri-PV pilot projects currently underway in Germany, Austria, the Netherlands, France and Switzerland were the subject of an information and experience-sharing day held last 4 November in Martigny (Canton of Valais), Switzerland. Discussion centred on the results obtained thus far as well as on the main challenges associated with the practical application of agri-PV technologies. The event brought together some 70 participants and finished with a tour of the pilot facilities on Agroscope's Conthey site.

A KOB event

The day was organised by Agroscope and the Swiss Fruit Association within the Competence Network for Fruit and Berries (KOB). The KOB is one of Agroscope's experimental stations where researchers and practitioners together develop solutions for sustainable agriculture. The KOB is responsible for coordinating current and future information concerning the use of agri-PV in fruit crops in Switzerland to facilitate the effective transfer of this information to farms.

[Competence Network for Fruit and Berries](#)

[Agri-PV: Dual Use of Agricultural Land](#)

News from the other experimental stations

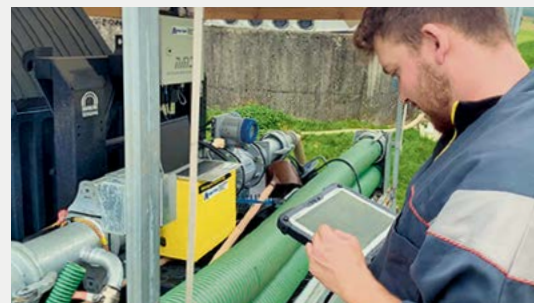
► Development of Closer Ties between Agroscope and the Canton of Vaud for Wine Research

The building that houses the experimental wine cellar in Changins now belongs to the Canton of Vaud. The development of closer ties between Agroscope and the Canton signals their common desire to strengthen synergies and thereby increase the efficiency of wine research activities.



► Data Collection on Nutrient Flows: an Exchange between Scientists and Practitioners

A network of 26 pilot farms is taking an active part in the data-collection programme conducted by the 'Nutrient Flows' Experimental Station (Canton of Lucerne). In mid-December 2022, scientists and practitioners met up for a first experience-sharing session.

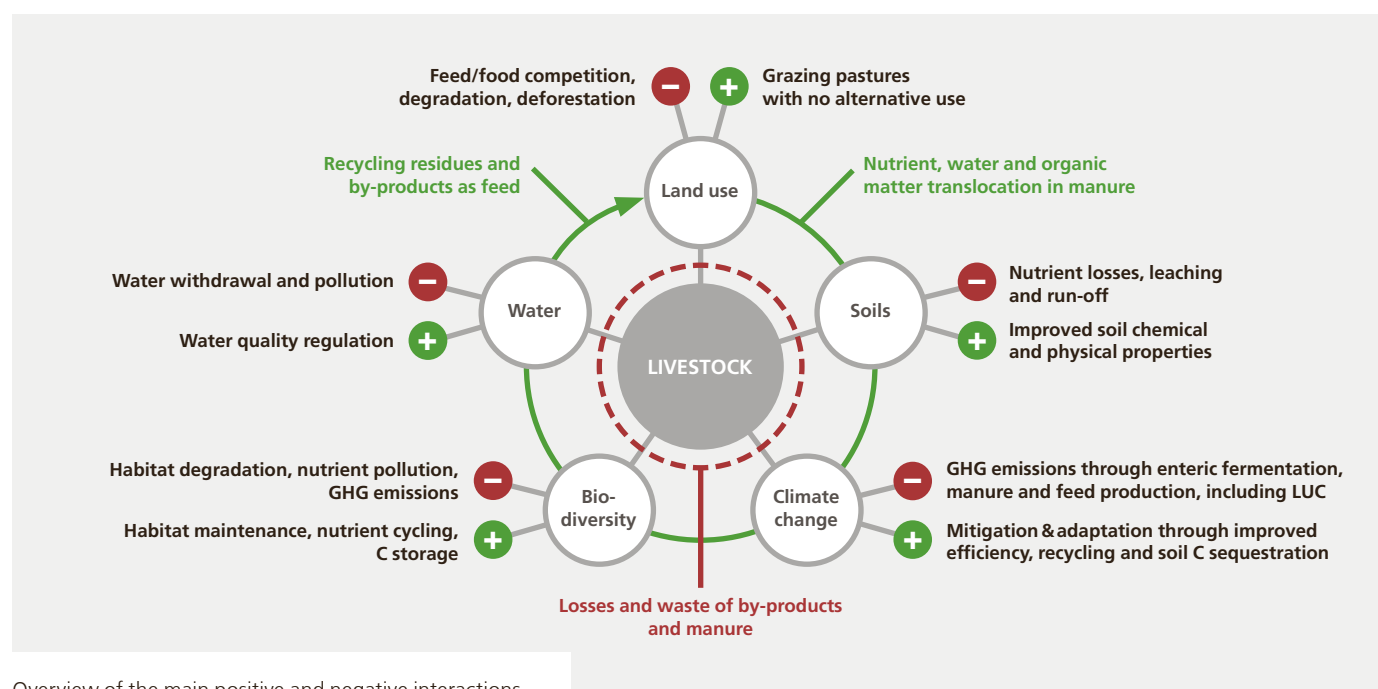


[Experimental Stations – Research Linked to Practice](#)

How Foods of Animal Origin Can Contribute to a Healthy, Sustainable Diet

Foods of animal origin – friend or foe? It all depends on the needs of consumers and on local production conditions, as shown by a major review in which Agroscope took part.

Ty Beal, Christopher D. Gardner, Mario Herrero, Lora L. Iannotti, Lutz Merbold, Stella Nordhagen, Anne Mottet



Foods of animal origin – friend or foe? It all depends on the needs of consumers and on local production conditions, as shown by a major review in which Agroscope took part.

High nutritional value of foods of animal origin

An important advantage of foods of animal origin – which include meat, eggs, dairy, fish, molluscs and crustaceans – is their content of readily bioavailable nutrients such as iron, zinc, calcium, vitamin B12, vitamin D, choline, omega-3

fatty acids and essential amino acids. Malnourished populations, for example in sub-Saharan Africa and in South Asia, would benefit from increased consumption of foods of animal origin. So would pregnant and breast-feeding women, infants and young children, adolescents and older people, all of whom have increased nutritional needs.

Health risks of excessive consumption

However, overconsumption of processed meat, red meat and saturated fat can adversely affect health. Where consumption is excessive, there needs to be a focus on moderation. Meat that has been preserved by salting, curing, fermentation, smoking or other processes is particularly problematic. The more a person consumes these foods on average, the higher their risk of developing cardiovascular disease, cancer or diabetes. Consuming excess red meat can also adversely affect health, especially when it is not within the context of a balanced diet; and consuming excess saturated fats, which are present in animal-based foods, especially red meat, increases the risk of cardiovascular disease.

Environmental impacts are strongly dependent on management

It is not just the health ramifications of consuming foods of animal origin but also the environmental impacts that are vehemently discussed in research, policy-making and social circles. We examine five spheres in detail: land use, climate change, soil, water, and biodiversity. There are positive as well as negative environmental impacts in each of these spheres.

Enhancing positive impacts via circularity

The Food and Agriculture Organization of the UN, the FAO, has identified three main strategies for counteracting the negative impacts of livestock farming on climate change:

1. Improve the efficiency and productivity of livestock farming.
2. Integrate ruminants into the closed-loop management system.
3. Increase soil carbon content through adapted grazing.

Priority is placed on the circularity strategy to enhance positive interactions between animal husbandry and the environment. For this, the large-scale, specialised plant- and animal-production sectors must be linked with one another via the trade in farmyard manure and animal feed. This means, for example, a higher proportion of grass and food-production residues in the feed ration of ruminants and the use of farmyard manures for fertilisation and power generation.

Considering the local context and including those affected

Thus, if we are to bring about sustainable and positive changes in the production and consumption of foods of animal origin, we should consider the local context with its corresponding dietary and environmental conditions, and include the interest groups affected by the changes. —

Conclusions

- ▶ Animal- and plant-based foods have complementary nutritional profiles. A balanced diet containing both of these food groups lowers the risk of nutrient deficits.
- ▶ Population groups that consume large quantities of meat, particularly processed meat, would in general benefit from a lower consumption. This could also have environmental benefits.
- ▶ Production of foods of animal origin can have negative environmental impacts in terms of land use, climate change, soil health, water volume and quality, and biodiversity. In all these spheres they can also have positive impacts that can be enhanced by using best practices.
- ▶ Linking animal and plant production within the context of circular management can conserve resources and reduce negative environmental impacts.

[Scientific publication:](#)
[The Journal of Nutrition, 2023](#)

► **Swiss Farmyard-Manure Market: Transports on the Rise**

To balance their nutrient cycles, Swiss farms export surplus farmyard manure to farms with free uptake capacities or to composting and anaerobic digestion facilities. Between 2015 and 2020 the volumes of organic manure and recycled fertilisers transported rose significantly, with a consequent increase in transport costs.

► **Beneficial Soil Fungi for Sustainable Plant Production**

Arbuscular mycorrhizal fungi are important for healthy soils and good crops. A pan-European study shows that plant-protection products adversely affect these fungi, reducing their ability to supply plants with phosphorus via their roots.

► **Plant-Protection Products in Field Crops: Which Alternatives Have Potential?**

Which measures are suitable for significantly reducing pesticide use in field crops? In the PestiRed project, farmers rate the implemented measures as largely positive, with a differentiated result for economic efficiency.

→ [Video](#)



► **Agroscope Obtains Patent for New Cheese Ripening Method**

The European Patent Office has granted Agroscope a patent for its new cheese-ripening method. The patent entered into force with the announcement of its granting in the European Patent Bulletin on 25 January 2023. It is now being registered in selected countries.



► **Nitrous Oxide Emissions from Cow Pastures Lower than Expected**

Agriculture emits very large amounts of environmentally harmful nitrous oxide. Agroscope researchers have now shown that grazing cows are responsible for far less of this gas than previously assumed.

→ [Video](#)



► **For Higher Yields: Breeding Plants that Cooperate**

A simple breeding experiment combined with genetic analysis serves to identify which crops 'cooperate' with one other. This cooperation could lead to higher crop yields.



► **Agroscope Sustainability Conference 2023**

On 26 January 2023, the 10th Agroscope Sustainability Conference took place on the topic of 'Healthy and sustainable nutrition: we have the choice 3 times a day'. The presentations and impressions of the conference are online.

→ [Presentations](#)



► **From Niche Crop to Mainstream Success**

Oats, triticale, hull-less barley, lupin, fava beans and buckwheat are rarely cultivated. The EU project CROPDIVA intends to change that. Agroscope analyses the value chains of four of these crops in order to promote their cultivation and processing.



► **New Merlot Clones for the Swiss Certification Sector**

Five Merlot clones bred in Switzerland are currently being distributed by the certification sector. A multi-year trial conducted by Agroscope in Gudo (Canton of Ticino) has made it possible to compare them with French and Italian reference clones and to highlight their very good performances.



► **Brandies from Old Apple Varieties**

The potential of old apple varieties often remains untapped. Agroscope and Fructus are testing which old apple varieties might stage a comeback as the raw material for distilling brandy.



► **Swiss Soils Analysed to Detect Harmful Alkyl Substances**

ZHAW and Agroscope have for the first time conducted a soil analysis for the Swiss Federal Office for the Environment to detect per- and polyfluoroalkyl substances.

→ [Video](#)

→ [More information on these topics](#)

Robust Potato Varieties and a Mix of Measures against Potato Diseases

Agroscope will be presenting its research for sustainable plant protection in potato cultivation at the BEA trade fair in Bern. Potato late blight remains the greatest challenge in potato cultivation. The highly contagious pathogen (*Phytophthora infestans*) is kept in check with a package of measures.



Patrice de Werra of the Arable Crops Extension Group explains how Agroscope supports the successful cultivation of potatoes.

What is Agroscope presenting at BEA 2023?

We'll be using videos to explain the progression of potato late blight disease and its weather dependence (the sporangia of this fungus-like microorganism spread quickly on the wind during muggy weather). In the case of susceptible potato varieties, a population in which no plant-protection measures have been applied can be completely destroyed

within a few days. That's why we'll be presenting robust varieties that get by with far less fungicide protection. Plants with mosaic virus and potato beetle also form part of the exhibit.

How is Agroscope helping to control these plant diseases?

Thanks to the PhytoPRE forecasting system, loci of infestation in Switzerland can be identified early on and the potato fields can be protected in good time. The cultivation of healthy seed, robust varieties and the control of volunteer potatoes are recommended as preventive measures. Several countermeasures are also called for in the case of mosaic virus, which is transmitted by aphids. In addition to intercropping, straw mulch in combination with mineral-oil treatments substantially reduces aphid pressure.

Agroscope inspects the planting material used in Switzerland and guarantees that only certified potatoes are used for production.

How does Agroscope promote the cultivation of resistant varieties?

Most of the potato varieties currently grown are susceptible to leaf blight; however, robust plants can survive the disease. These robust plants could help achieve the reduction in plant-protection product use called for by the public.

Agroscope and the School of Agriculture, Forest and Food Sciences HAFL are testing the susceptibility, agronomic properties and marketability of selected potato varieties. The best will then be recommended for cultivation. In order for robust varieties to catch on, they must become commercially established. —



1 Agroscope tests various species of cereals, particularly wheat, spelt, barley, rye, oats and triticale. | 2 Agroscope studies chemical and physical soil contamination in its high-tech laboratory. | 3 Agri-photovoltaics aims to use agricultural land for the simultaneous generation of renewable electricity and cultivation of crops.



Archive image:
microscopy.





1



2

1 A modern, animal-friendly paddock in St. Aubin (FR) for Swiss National Stud horses. | 2 Beef production in the mountain region can be combined with landscape conservation. | 3 Sampling new grape varieties that are disease-resistant and hence require lower applications of plant-protection products.



3



4 Agroscope researches for sustainable soil use. Experts sample different soil types on a regular basis. | 5 Egg of a green lacewing, a beneficial insect. Once they hatch, lacewing larvae feed on aphids, and are thus suitable for biological pest control. | 6 Agroscope tests the popularity of new apple varieties. | 7 Global warming impacts insect fauna: some benefit, while others suffer habitat loss.

Global Warming Causes Changes in Insect Fauna

How has the distribution of insects in Switzerland changed over the past 40 years? The range of many species has expanded, while that of a similar number has contracted. In particular, cold-adapted species have lost ground.

Felix Neff, Felix Herzog, Eva Knop

Various studies conducted in Switzerland and elsewhere give cause for concern that climate- and land-use change are causing significant adverse effects to insect fauna ('insect decline'). For this reason, the research institutes Agroscope, WSL, FiBL and the Swiss information centre for fauna, 'info fauna', have launched the project INSECT. The project analyses why and how the distribution of insects in Switzerland has changed over the past 40 years. The researchers present their first findings in the journal *Nature Communications*. For this, they analysed 1.5 million records collected throughout Switzerland from 1980 onwards by insect-savvy laypersons and experts on the distribution of butterflies, grasshoppers and dragon- and damselflies.

No general decrease noted

The findings reveal that there are both winners and losers in Switzerland among the insect species studied. The species that have spread the most have managed to extend their habitat by over 70% on average, whilst those that have suffered the greatest declines have lost an average of just under 60% of their range. The study does not

make any statements concerning the quantity (biomass) of the observed insects, however.

Rare species continue to decline

In particular, specialised, cold-adapted species from the Swiss pre-Alps and Alps have lost ground. Warm-adapted species from lowland areas have been successful in maintaining or expanding their ranges. "The upshot of this is that rare species become even rarer, and species that are already widely distributed continue to expand their range", commented the lead author of the study, Felix Neff from Agroscope. According to the researchers, the results also suggest a trend reversal: while habitat loss and changes in land use were previously the main reasons for the local disappearance of insect species, global warming now also exerts a significant impact on the insect fauna of Switzerland.

Global warming explains many changes

The combination of the two factors – climate- and land-use change – can be especially unfavourable for the insect fauna, as evidence found by the researchers suggests. For



A common damselfly species on the Swiss Central Plateau, the Willow Emerald Damselfly (*Chalcolestes viridis*) has slightly extended its range in higher elevations.

example, the intensification of grassland use with increasing summer drought appears to have an especially negative effect on insects. Statistically, global warming was found to be particularly linked with the long-term changes in Swiss insect fauna observed over the past 40 years. The researchers therefore expect that with the advance of global warming, insect populations will continue to change over large spatial scales. —

[INSECT – A Research Initiative on the Changes in the Insect Fauna of Switzerland](#)

[Scientific publication:](#)
[Nature Communications, Volume 13, Article number: 7611 \(2022\)](#)

Conclusions

- ▶ The species that have spread the most managed to extend their habitat by over 70% on average. Those that suffered the greatest declines lost an average of just under 60% of their range.
- ▶ Rare species became even rarer, while common species managed to further expand their ranges.
- ▶ Although habitat loss and changes in land use were previously the main reasons for the local disappearance of insect species, global warming now exerts a significant impact on Switzerland's insect fauna.
- ▶ The researchers expect that with the advance of global warming, insect populations will continue to change over large spatial scales.

Mountain Milk Production with Dual-Purpose Cows: Outdated Tradition or Modern Moneyspinner?

Although milk-production oriented (MPO) cow breeds have also become established in the mountain region, farms with the dual-purpose 'Original Simmental' breed are proving to be economically viable, with lower costs and higher direct payments making up for lower revenues from milk.

Christian Gazzarin, Thomas Blättler, Alain Bütler, Bruno Durgiai, Dierk Schmid



Despite their low milk yields, Original Simmental cows boast several economic advantages.

Thanks to advances in breeding, milk-production oriented (MPO) cattle have increasingly been bred in the Swiss mountain region, whilst dual-purpose breeds have fallen behind in popularity. With this trend, secondary traits such as fertility, health and useful life have been deemed less important. Lower beef conformation has resulted in the dwindling of body reserves which are useful in meagre forage conditions, for example in the summer-grazing areas.

The study investigated the economic efficiency of the old 'Original Simmental' (OS) dual-purpose breed. To this end, 19 randomly selected (OS) farms underwent a detailed farm-branch analysis based on multiyear accounting data (2018–2020) and interviews and were compared to a reference group of 56 FADN (Farm Accountancy Data Network) farms (Agroscope).

Higher ancillary income, lower costs, less work

In the study, an Original Simmental cow produced 5559 kg milk per year, almost 2000 kg less than the MPO-type cow of the FADN farms (7384 kg). However, on the OS farms the corresponding lower income from milk was more than offset by higher ancillary income from the sale of the animals and direct payments, with significantly less milk being diverted for the calves for about the same numbers of cows and calves. The higher direct payments were due in particular to significantly higher biodiversity payments. At –22 % and –12 % respectively, both the absolute direct costs and the structural costs were lower for the OS farms than for the reference farms, with the OS farms investing on average 52 fewer hours per cow and year (–19 %).

Original Simmental well adapted to the mountain region

With a similar gross margin, the OS farms achieved a 60 % higher annual income from dairy farming in absolute terms. They also generated a 34 %-higher area income

(CHF 2954 vs. CHF 2198), and a 76 %-higher labour remuneration per hour of work (CHF 18.70 vs. CHF 10.60). The better results are also – at least indirectly – related to the breed, since lower individual animal performances with simultaneously good fertility and fitness traits enable site-adapted production with extensive forage production, pasture feeding and seasonal calving. In this manner, successful economic use was obviously made of the available local resources such as summer grazing land and biodiversity. —

Conclusions

- ▶ The major difference in individual animal performances between a milk-production-oriented and a dual-purpose breed of cow suggests that in the mountain region today an MPO cow no longer in and of itself contributes to greater economic efficiency.
- ▶ The dual-purpose breed 'Original Simmental' appears to be an economically worthwhile option, given that its good adaptation to the site ...
 - allows for labour-saving management;
 - allows for more extensively managed land, which triggers biodiversity payments;
 - keeps direct costs low.
- ▶ Secondary performance traits such as health and fertility should be preserved or even further strengthened in breeding selection, and an eye must also be kept on cow weight in view of topographical factors.

Scientific publication:
[Swiss Agricultural Research 13, 190–197, 2022.](#)

Vegetable Production: Striking Reduction in Nitrate Leaching without Crop Residues

In vegetable production it is usual to leave crop residues on the field. Measurements carried out by Agroscope researchers show that removing these residues significantly reduces nitrate leaching.

Ernst Spiess, Clay Humphrys, Frank Liebisch, Volker Prasuhn, Reto Neuweiler

Excessively high nitrate concentrations measured in many places throughout Switzerland, including the Gäu–Olten region in the Canton of Solothurn, led to the implementation of the 'NitroGäu' research project, one of whose main aims was to develop measures for reducing nitrate leaching. The project was supported by the Federal Office for Agriculture, the Canton of Solothurn and the Federal Office for the Environment.

In a subproject, nitrate leaching in vegetable crops was measured in a trial conducted in a lysimeter facility at Agroscope's Zurich-Reckenholz site. Lysimeters are vessels filled with soil at the bottom of which the percolating soil water is collected. Over the course of the five-year lysimeter trial, two methods were compared in terms of nitrate leaching: (1) the leaving of crop residues on the field, which is usual in vegetable production, and (2) the removal of these residues.

Removing crop residues reduces nitrate leaching

The trial showed that leaving crop residues on the fields resulted in the leaching of considerably more nitrate, viz., an average 20% more than when plant residues are removed (127 versus 106 kg nitrate per hectare and year).

However, the total surplus of the nitrogen balance when crop residues were left on the field as opposed to being removed was much higher than the additionally leached amount: 146 kg instead of 21 kg per hectare and year. The majority of this nitrogen is stored in the soil and is mineralised over the following years and decades, with subsequent repeated leaching of nitrogen being possible. Leaching losses therefore increase over the years, although at a slower and slower pace over time.

Nitrogen input via soil blocks

It turns out that the soil blocks in which commercial vegetable producers start off and plant their seeds are a further source of nitrogen. Soil-block content analyses showed that they release non-negligible amounts of N into soils (9–35 kg nitrogen per hectare of a set). Hence, this input quantity should be taken into account in farm



Nitrate leaching in vegetables with and without harvest residues was measured on an Agroscope lysimeter facility in Zurich-Reckenholz.

nutrient balancing – something that has previously not been done as part of the Proof of Ecological Performance.

Excessive amounts of nitrate contained in leachate

In general and over all years and trials, lysimeter leachate contained on average more than four times more nitrate than permitted by the Swiss standard for groundwater used as drinking water: 110 versus 25 mg per litre. The trial was fertilised with mineral fertilisers according to Agroscope recommendations (PRIF, 2017), which currently advise reducing the nitrogen requirement of the following crop by 20% when leaving crop residues on the field.

Rethinking fertilisation recommendations and the handling of plant residues

In view of the sometimes-very-high amounts of nitrogen in crop residues, the handling of these plant residues should be improved. Practical methods for removing and further utilising the residues or for increasing the nitrogen utilisation of plant material left on the field need to be developed. For the fertiliser recommendations, we must consider whether the amount of nitrogen imputed in the residues of the previous crop should be increased. —

Conclusions

- ▶ When vegetable producers leave crop residues on the field, large amounts of nitrogen enter the soil which over the years are leached in the form of nitrate.
- ▶ Commonly used in intensive field vegetable production, the soil blocks in which the crops are sown and planted are an additional source of nitrogen that should be taken into account during farm nitrogen balancing.
- ▶ Practical methods for removing and further utilising residues and for increasing the nitrogen utilisation of the plant material left on the field should be developed.
- ▶ The fertiliser recommendations should take better account of the nitrogen input from the plant residues of the previous crop.

Scientific publication:
[Agroscope Science No 142, 1 – 27, 2022](#)

Great potential for environmentally friendly and profitable production

Do farmers who produce in environmentally friendly ways earn less income?
As an Agroscope study shows, this needs not be the case, and farmers can actually
generate more revenue by protecting the environment.

Dario Pedolin, Pierrick Jan, Andreas Roesch, Johan Six, Thomas Nemecek



Producing in both an environmentally compatible and profitable manner need not be a contradiction in terms.

In the NRP 73 project 'Interaction of economy and ecology in Swiss farms', Agroscope researchers set out to discover whether and how farmers can produce in ways that are both environmentally friendly and financially profitable. For this, they used 239 farm datasets from the Life Cycle Assessment – Farm Accountancy Data Network (LAC-FADN). Based on this data, they studied the relationship between income and environmental impact for different farms and product groups. The analysis focused specifically on dairy and beef production as well as cereal, potato and sugar beet cultivation. A life cycle assessment was carried out using the tool SALCA (Swiss Agricultural Life Cycle Assessment).

Major differences between farms

Environmental efficiency showed substantial variability for all product groups studied. For profitability, assessed on the basis of earned income per family work unit, the differences were even more marked. Production region (valley, hill or mountain region) and type of farming

(organic or 'proof of ecological performance', PEP) account for some of the differences.

Except in cereal production, organic farms had 5 to 10% higher environmental efficiency and 5 to 26% higher earned income than PEP farms.

Inter-farm differences in environmental efficiency were lowest in sugar beet cultivation. This is because sugar beet is grown mainly in the valley region and its cultivation is highly standardised and mechanised.

Dairy and beef production showed the greatest variability in terms of environmental efficiency. This is because cattle farming takes place in different regions, production systems and intensities. Milk yield per cow in mountain areas is slightly lower than in valley farms, but the higher proportion of meadow and pasture forage brings benefits for the environment.

In the case of organic dairy and beef farms, the higher prices commanded by organic products and the subsidies paid for producing under more difficult conditions allow good profitability.

Conclusions

- ▶ Both environmental efficiency and profitability vary widely for all farms and product groups studied.
- ▶ Production region (valley, hill or mountain) and production method (organic or PEP) account for some of the differences.
- ▶ The farms with the highest environmental efficiency are situated in the valley region.
- ▶ Earned income per family worker shows higher variability than environmental impact.
- ▶ On average, organic farms achieve slightly higher earned incomes than PEP farms.
- ▶ The differences show that there is considerable potential in Switzerland for improving environmental efficiency and profitability.
- ▶ Better environmental efficiency and higher profitability are not adversely correlated. It is therefore possible in Switzerland to farm in a way that is both environmentally friendly and profitable.

Good incomes do not have to come at the expense of the environment

For dairy and beef production, there is a positive relationship between profitability and environmental protection. In cereal, potato and sugar beet cultivation, environmental efficiency and economic performance are not significantly interrelated. However, even in the latter product groups, there is no evidence that income increases at the expense of the environment.

The wide inter-farm variation in environmental efficiency and profitability indicates a great potential for optimisation on many farms, allowing them to become both more environmentally friendly and more profitable.

This study shows that it is possible in Switzerland to produce in ways that are both financially sound and environmentally sustainable. Good incomes are not necessarily achieved at the expense of the environment. —

Scientific publication:
[Journal of Cleaner Production, 388, 135851.](#)

	2021 CHF	2022 CHF	Divergence CHF	Divergence in per cent
Functional Earnings				
Financially impacting	21 621 191	22 240 114	618 923	2.9 %
Non-financially impacting	2 478 091	2 590 356	112 265	4.5 %
Total revenues	24 099 282	24 830 470	731 188	3.0 %
Functional Expenditure				
Financially impacting	143 898 173	147 577 856	3 679 683	2.6 %
Non-financially impacting	5 268 108	4 930 181	–337 927	–6.4 %
Service accounting between offices	43 700 532	41 859 985	–1 840 547	–4.2 %
Total functional expenditure	192 866 813	194 368 022	1 501 209	0.8 %
Statement of Investments				
Investment income	–13 025	–45 937	–32 912	252.7 %
Investment expenditure	4 336 217	4 182 987	–153 230	–3.5 %
Reserves				
Creation of earmarked reserves	3 426 638	5 033 130	1 606 492	46.9 %
Use of earmarked reserves	2 241 505	3 221 450	979 945	43.7 %
Third-Party Funds				
Acquisition of third-party research funding	15 399 930	16 297 882	897 952	5.8 %

1592
lectures and posters

1805
lessons (universities, technical colleges, vocational schools
and courses)

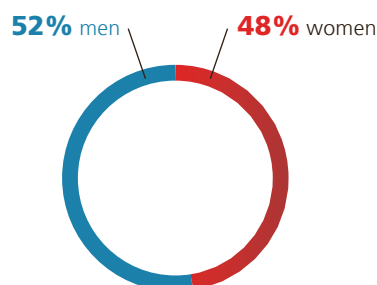
110
supervised dissertations

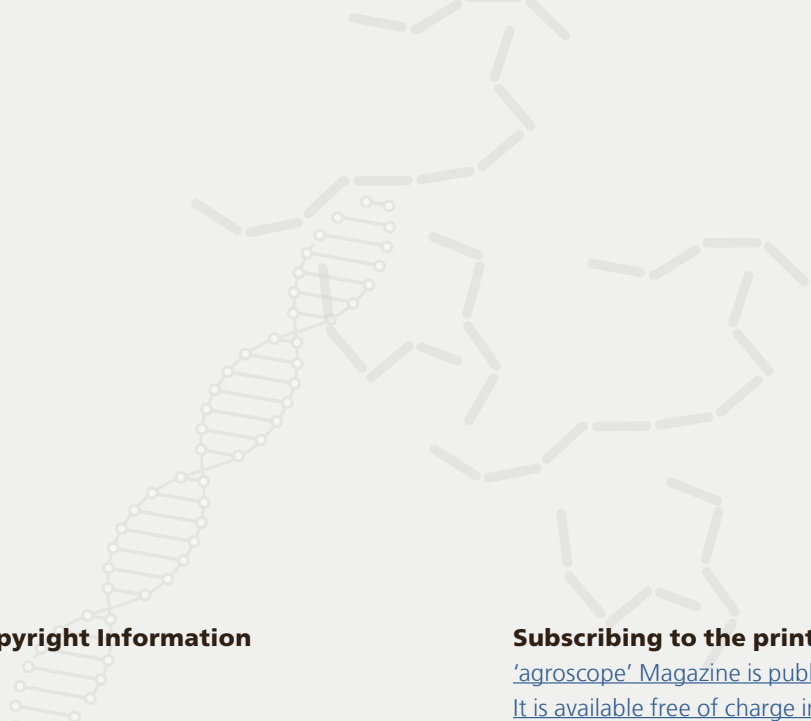
94
supervised semester, bachelor and
master theses

1445
publications, including 840 practice-oriented publications;
625 scientific publications

944 full-time positions (FTE) with
1111 employees

67 doctorates
33 trainees
31 internships
39 postdoc





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‘The availability of robust varieties could enable a reduction in the use of plant-protection products in potato crops, as called for by the public.’

Patrice de Werra, Member of the Field Crops Extension Group at Agroscope

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