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agro scope

Agroscope good food, healthy environment



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Confédération suisse
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Federal Department of Economic Affairs,
Education and Research EAER
Agroscope



Agroscope is studying the use of beneficials for the preventive biological control of pests in plant protection ([see article, pp. 20–21](#)).



Dear readers,

In this issue we examine several possible solutions to climate change and resource scarcity with a focus on Switzerland.

With the progressive transformation of our agriculture and food system, alternatives to meat and dairy products that are often resource-intensive to produce are being examined more closely. The article 'How are Plant-Based Alternatives to Dairy Products Perceived and Who Consumes Them?' gives an indication of the reception of these products among consumers ([page 6](#)).



At the same time, the livestock sector is looking for suitable sustainable solutions for replacing feed concentrates. Pasture fattening is one approach to reduce resource consumption and greenhouse-gas emissions. Read more on this in the article 'How Cost-Efficient is Organic Pasture Fattening?' ([page 10](#)).

On the topic of livestock production, however, the social and agro-ecological aspects must not be forgotten: in many regions of the world, including the mountain regions of Switzerland, animal husbandry is the only option for farmers. Thus, positive side-effects of grazing animals, including the preservation of a diverse and species-rich landscape, are of particular importance.

In addition to the previously mentioned adaptations, modern technologies such as agrivoltaics will in future play a key role in clean-energy generation and resource conservation. Their use and potential in agriculture are explored in the contribution 'What Are the Most Promising Crops for an Agrivoltaic System?' ([Page 18](#)).

Climate change and the reduced use of plant-protection products mean that old and new pests are posing additional challenges for agricultural production. The quest for natural antagonists is one of Agroscope's core tasks. Hence, I can warmly recommend the article 'Pre-emptive Selection of Natural Enemies of Invasive Pests' ([page 20](#)).

In summary, individual solutions must be considered in a wider context, and combine enhanced agricultural efficiency with reduced environmental impact. The article 'Heading towards a Regionalised Nitrogen Balance' ([page 22](#)) deals holistically with this issue.

Wishing you an interesting read,
Lutz Merbold

Head of the 'Agroecology and Environment' 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

26 September 2024,
Grangeneuve-Fribourg

Conference on Animal Production Agroscope 2024

Joint Conference with Agridea

22 October 2024,
Agroscope Reckenholz and online

14th Life Cycle Analysis Platform for the Agriculture and Food Sector

19 November 2024,
Agroscope Tänikon

47th Agroscope Agricultural Economics Conference

28 November 2024,
Agroscope Tänikon

5th Food Sector Innovation Forum

Intelligent solutions for practice

23 January 2025,
Agroscope Reckenholz and online

12th Agroscope Sustainability Conference

All Agroscope events that are open to the public are advertised on our website.

Alpine and Mountain Agriculture: Adapting to a Rapidly Changing World

For three years now, the Alpine and Mountain Agriculture Experimental Station has been helping farms at higher altitudes deal with increasingly demanding production conditions.

Corinne Boss

Climate change affects the quantity and quality of forage available for ruminants. The experimental station develops forage mixtures that combine increased drought tolerance with good yields. Agroscope researchers are currently investigating nine new forage mixtures at five different sites in our partner Cantons (Bern, Graubünden, Ticino, Uri and Valais).

Initial results encouraging

The forage mixtures consist of a high percentage of productive, widely distributed forage plants, supplemented by different percentages of drought-resistant species. Initial results have been promising: even in drought conditions, the mixtures with the resistant species produced up to 44 % more forage than the reference mixtures.



A drought simulation will be conducted in the summer months of 2024 and 2025 on the Bern site to gain a better understanding of the drought resistance of the forage mixtures. One half of the mixtures will receive the local rainfall, whilst the other half will be exposed to extreme drought, simulated with the help of polytunnels from vegetable production.

Fourteen alpine pastures examined

A five-year project currently underway is evaluating inter alia the yield and quality of forage on 14 alpine pastures in the alpine region and Jura. The sites reflect geoclimatic diversity. Observations show a rich variety of alpine plants, with over 300 species listed in 2023. This diversity is also vulnerable, however: two-thirds of the species only occur on a small number of parcels, and one-third were observed just once.

There is a long tradition of alpine and mountain agriculture in Switzerland. The sector fulfils important functions despite the challenges it faces. Mountain agriculture contributes to the preservation of unique ecosystems. By keeping the landscape open, it increases the latter's touristic appeal. In addition, it enriches the food chain with authentic, high-quality products. These services create a direct added value, contribute to the economic vitality of the regions and enhance their image.

According to the Swiss Farmers' Union (SBV), around 20,000 farms or 41 per cent of all farms in Switzerland operate in the mountain region, utilising over 405,000 ha agricultural land in the mountain zones.



Potential and profitability of new technologies for herd management

The experimental station also analyses the potential of modern technologies for optimising herd management in the mountain region, at the same time as it investigates profitability.

For example, drones can considerably simplify the monitoring of herds on steep ground by reducing the time and work involved in checking the animals. Equipped with cameras and sensors, the UAVs should enable precise and rapid monitoring. —

[Link to the 'Alpine and Mountain Agriculture' Research Station:](#)

[Further information on the experimental stations](#)

How are Plant-Based Alternatives to Dairy Products Perceived and Who Consumes Them?

The range of plant-based alternatives to milk continues to rise.

Agroscope and the SMP (Swiss Milk Producers) conducted an online survey to find out what products are being consumed and how they are perceived.

Barbara Guggenbühl, Angela Grande, Jeanine Ammann

The consumption of high proportions of animal products contributes significantly to harmful greenhouse gas emissions and ultimately to climate change. A more plant-based diet could counteract this. The wide range of plant-based alternatives to milk and dairy products supports this transition. Consumption of these products has increased in recent years.

Survey on the consumption of plant-based alternatives to milk

An online survey conducted in the German- and French-speaking parts of Switzerland aimed to examine in detail which products are consumed by whom and for what reasons. A total of 1204 people were asked about their consumption or non-consumption of plant-based alternatives to milk, yoghurt and cream products.

Flexitarians frequently consume plant-based alternatives to milk

The survey showed that consumers of plant-based alternatives tended to be young, well-educated, urban flexitarians – in other words, people who are interested in eating less meat. The findings suggest that plant-based alternatives to dairy products are often consumed in conjunction with animal products.

Taste, health, sustainability and animal welfare are the main reasons

The most frequently consumed plant-based alternatives to cow's milk were soya, almond and oat drinks. The main reasons given by participants for consuming these products were taste (26%), health (34%, including allergies and intolerances), dietary variety (12%) and animal welfare and sustainability (16%). People who did not consume plant-based dairy alternatives cited a lack of interest in these products (38%) or stated that they did not like the taste (25%).



Consumption of plant-based alternatives to milk and dairy products is steadily increasing.

The results of this survey have important implications for research and practice and provide a better understanding of the growing group of consumers who use plant-based alternatives to support a more sustainable diet. —

Scientific Publication:
Swiss Agricultural Research 15, 109–118, 2024

Conclusions

- ▶ Consumers of plant-based dairy alternatives tend to be young, well-educated, urban flexitarians.
- ▶ The most frequently consumed alternatives to cow's milk are soya, almond and oat drinks.
- ▶ Main reasons for consuming plant-based dairy alternatives are their taste, contribution to health (including allergies and intolerances) and positive impact on the environment.
- ▶ Plant-based dairy alternatives are often consumed in combination with animal products.



► **Grazing Dairy Cows Adapt their Behaviour to Heat Stress**

Heat stress is a growing threat to the welfare, health and productivity of dairy cows, especially on the pasture. Commercial farms need simple indicators that enable farmers to detect heat stress at an early stage.

► **Endangered Heritage Grape Varieties in the Vineyards of Valais**

Twelve heritage grape varieties grown in Valais and at risk of extinction have been added to Agroscope's grape varieties collection and studied. This action is linked to the National Action Plan for the Conservation and Sustainable Use of Plant Genetic Resources.

► **Microalgae as an Alternative Protein Source for Livestock?**

Microalgae have great potential: they contain a lot of protein and other important nutrients, and can be produced locally. Agroscope is testing whether they are suitable as a livestock feed.

→ [Video](#)



► **Reviving Arable Farming in the Mountain Region**

For centuries, cereals and legumes were cultivated for self-sufficiency in the mountains, before they had to give way to grassland. The 'Alpine and Mountain Agriculture' Experimental Station is keen to revive these traditional crops and promote their processing into high-quality regional specialities.



► **Promoting Crop Diversity and Securing Yields**

In the CROPDIVA project, Agroscope aims to promote the mixed intercropping of lupins and lentils with oats or hull-less barley. The goal is to increase biodiversity and crop yield in the face of extreme weather events.

→ [Video](#)



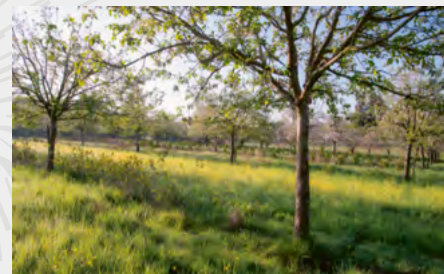
► **Alternative Crops for Waterlogged Arable Land in Switzerland**

Swiss bogs are often threatened by desiccation and eutrophication. Agroscope was therefore tasked by the Federal Office for the Environment with investigating sustainable forms of management for adjacent land. The results are now available as informative factsheets.



► Rice Farming Is Taking Off in Switzerland

Agroscope's idea of growing wet rice in flooded fields is becoming economically attractive. In addition to successful brands such as 'Aare Riis', natural paradises for rare wading birds, dragonflies and frogs are being created on drained land in need of rehabilitation.



► Agroforestry's Contribution to a Sustainable Agricultural Policy in Switzerland

Future agricultural policy will aim at innovative and sustainable production systems. Using the example of agroforestry, an assessment method based on an expert survey and the literature has now been tested. The results show that agroforestry can support the transformation into a more sustainable agricultural sector.



► Preventing Fungal Diseases with Fungi from the Stratosphere

Pathogenic fungi populate the stratosphere and fall back to earth with the rain. To learn more about them, Agroscope will be taking samples with the help of a weather balloon. The aim is to optimise the risk-prediction models in order better to anticipate the growth of fungal diseases in crops.



► Susceptibility of Pome Fruit Varieties

Robust varieties and targeted maintenance measures offer the greatest protection against fire blight. Agroscope has now updated the list of susceptible and robust apple and pear varieties, in which it outlines how disease can be kept in check.



► Interconnected Ecological Focus Areas Are Particularly Valuable for Species Richness

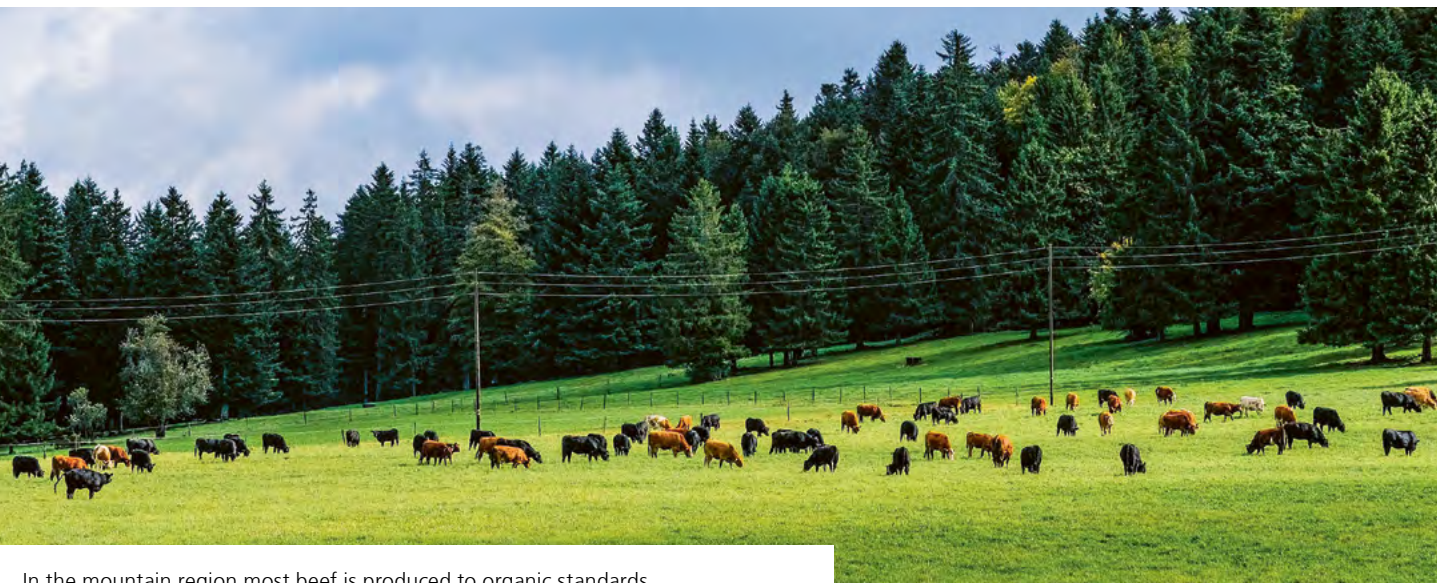
Agroscope studied various categories of ecological focus areas and showed that the presence of these in connectivity projects makes a major contribution to large-scale species richness in the agricultural landscape.

→ [Further news topics](#)

How Cost-Efficient is Organic Pasture Fattening?

Beef can be produced in various ways. Intensive fattening is more productive and extensive organic pasture fattening achieves higher prices – but which is more profitable? Agroscope compared the two production systems to learn the answer.

Christian Gazzarin, Alain Bütler



In the mountain region most beef is produced to organic standards.

Most beef comes from specialised cattle-fattening farms whose animals for the most part originate from dairy farms. These so-called weanlings are usually males, often with a sire from a specialised fattening breed. They are raised either on the dairy farm or on specialised weanling farms. Weanlings are the greatest cost factor on a specialised cattle-fattening farm.

Here, intensive and extensive fattening systems part ways: pasture beef according to Bio Suisse standards is based on meadow forage, while intensive beef fattening uses energy-rich supplementary fodder such as maize silage or concentrates, and the animals are kept indoors year-round.

Agroscope researchers investigated how the two production systems performed in terms of productivity, cost structures and cost-efficiency.

450kg slaughter weight per hectare with pasture fattening

The researchers randomly selected ten specialised pasture-fattening farms from the 'Bio-Weidebeef' and 'Silvestri Bio-Weiderind' programmes. Requirements for participation were a minimum delivery of 20 fattening animals per year, no suckler-cow production, and location in the plain region. The data on intensive beef fattening stem from the

same accountancy year (2019) and related to 11 farms operating to IP-Suisse standards surveyed according to the same methodology in a previous study. The pasture-fattening farms and the IP cattle-fattening farms had an average of 51 and 57 fattening places, respectively. Based on the IP cattle-fattening farms, an extrapolation to a conventional intensive cattle-fattening farm with 100 places complying with the minimum legal standards (Swiss Animal Protection Ordinance) was also performed.

The pasture-grazing system produced around 450 kg slaughter weight (SW) per hectare main forage area almost exclusively with meadow forage. Nevertheless, at 1200 kg per hectare, the productivity of the intensive fattening system was almost three times higher.

Good economic efficiency with organic pasture fattening

The working hours per fattening place and year were 31 hours for organic pasture fattening farms and IP-Suisse intensive fattening farms, while the conventional model farm required only 20 hours per fattening place owing to the larger herd and simpler housing system (slatted floors). The use of forage grasses and the purchase of concentrates allow for larger cattle herds on less surface area as well as higher daily weight gains, which essentially explains the high area productivity and labour productivity of the intensive fattening system. Whereas organic pasture fattening incurs an average cost of just CHF 0.20 per kg SW for supplemental feed, this figure is 12 times higher (CHF 2.46) for the intensive fattening system. Added to this is the high use of maize silage in the intensive fattening systems, which is also reflected in the higher machinery costs (contractor's costs). Higher structural costs owing to higher animal welfare standards combined with smaller herds lead to moderate economic efficiency for IP-Suisse farms, with a return to labour of just over CHF 11 per hour. For pasture fattening, lower costs, higher direct payments and higher prices lead to distinctly better results with just under CHF 21 return to labour despite lower productivity. The

model farm with 100 fattening places performs even better, however: owing to its high productivity it would achieve almost full cost recovery with just over CHF 26 labour utilisation, while also producing the least expensive beef.

Meat from grass

The production of organic pasture-raised meat does not create competition for land that could be used directly to grow food for humans. This feature could gain importance in future, as resources grow scarcer. However, the market share of specialised organic pasture-raised meat is extremely small, although it is cheaper to produce than meat from organic suckler-cow production. The lack of availability of weanlings seems to be an important reason for this. Furthermore, owing to lower productivity, a pasture-fattening farm incurs 64% higher costs for weanlings per kg SW – an unfavourable premise when competing with the intensive-fattening farms. —

Conclusions

- ▶ Organic pasture fattening with weanlings is an economically attractive proposition. Specialisation and substantial simplification of the production system contribute to very good labour efficiency, which makes comparatively high return to labour possible.
- ▶ Intensive cattle fattening is substantially more productive and produces meat more cheaply, but only achieves a good level of economic efficiency with larger herds.
- ▶ The availability of weanlings seems to be a pinch point for increasing the market share of organic pasture fattening. This bottleneck could be eliminated if the entire organic cattle sector were better coordinated through the inclusion of dairy farms, resulting in more weanlings from organic dairy farms being sold to organic pasture fattening farms.

Scientific Publication:
Swiss Agricultural Research 15, 77–88, 2024

IMPRESSIONS

Impressions of current applied-research projects
for the agriculture and food sector.



- 1 Field with triticale | 2 Microalgae production
3 Demonstration on diseases in plant production | 4 Fertilisation trials in wheat
5 Data acquisition in the field | 6 Suckler-cow herds
7 Microbiological collection for food research



4



5



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Archive photo apple harvest



- 1 Extensive meadow in the Engadine
- 2 Hands-on work for cereal research
- 3 Research on the constituents of milk



Agrivoltaics in Switzerland: How Do Berry Crops Respond?



Jocelyn Widmer is a member of the 'Berries and Medicinal Plants' Research Group at Agroscope.

Projects combining agricultural production and electricity generation are multiplying in Switzerland. Agroscope is responsible for the monitoring and agronomic evaluation of berries in several pilot projects.

Agroscope is involved in several innovative projects that aim to combine agricultural production and photovoltaic power generation (agrivoltaics) on the same land. Jocelyn Widmer outlines the main ongoing initiatives and shares some initial observations.

What agrivoltaics projects is Agroscope monitoring?

Three installations, each with its own distinctive features, were set up on our experimental site in Conthey in 2021, 2022 and 2023, occupying areas ranging from 165 m² to 3600 m². The crops studied are off-soil production of strawberries and raspberries (everbearing and non-everbearing varieties), and since 2024, blueberries. Our partners are Insolight, CSEM and Migros. We also monitor the crops of two producers, our collaboration with whom provides us with invaluable feedback.

What does the agronomic monitoring of these crops involve?

The agronomic monitoring comprises several aspects:

- ▶ **Yield and quality of fruits:** Evaluation of fruit yield and quality (sugar, acidity, firmness) compared to traditional crops.
- ▶ **Development and adaptation of plants:** Analysis of parameters such as plant development, leaf area and volume, as well as specific leaf area.
- ▶ **Plant protection:** Observing the state of health of the plants.

What are the initial results obtained compared to traditional crops?

- ▶ We are observing a reduction in strawberry and raspberry yields due primarily to a still-insufficient light supply.
- ▶ The strawberries need more light than the raspberries, and significant differences between varieties can be observed.
- ▶ The average weight of the raspberries is generally similar or slightly higher under PV.
- ▶ Fruit acidity is similar and the effect on firmness is nil or low, whilst sugar content tends to be lower under the panels.
- ▶ No clear-cut trend has emerged in terms of plant development, but strawberry growth appears to be inhibited by the lack of light, whilst raspberry growth at times appears to have been stimulated. —

What Are the Most Promising Crops for an Agrivoltaic System?

Agrivoltaics combines energy generation and agricultural production on the same land. Although this system is eliciting increasing interest, its success depends on numerous factors and the most compatible crops have yet to be identified.

Jocelyn Widmer, Bastien Christ, Jan Grenz, Lindsey Norgrove



Agri-PV combines energy generation and agricultural production on the same land.

Climate change and global population growth are posing challenges for both the energy generation and agricultural production sectors. Photovoltaic installations are a sustainable source of electricity but require land, leading to increased competition with agriculture.

Combining energy generation and agricultural production on the same site

Agrivoltaics was put forward in the 1980s as a solution to this dilemma. Combining energy generation and agricultural production on the same land, the system is based on the fact that plants use only a part of the solar spectrum and light they receive daily.

We do not yet have the necessary agronomic knowledge to judge the efficacy of agrivoltaics and determine the most compatible agricultural crops and the system's potential for development. Agroscope researchers have therefore conducted a systematic review of the literature, analysing around fifty studies on the combination of electricity generation and agricultural production throughout the world.

Place, season, variety and system design determine success

The majority of the studies were concerned with lettuce and tomato crops. Others focused on cereals, maize, potatoes, fruits, or even cattle or sheep production. Are crops grown in agrivoltaic systems more or less successful than those grown in conventional systems? The literature review highlights the lack of a strong trend. Results differ from one study to the next: yields are sometimes higher, sometimes lower. This is explained by their dependence on a number of factors: local climatic conditions, the season, the variety being cultivated and the design of the photovoltaic system, in particular the rate of roof coverage by solar panels.

[Scientific Publication:](#)
[Renewable and Sustainable Energy Reviews,](#)
[Volume 192, 2024](#)

A system compatible with demanding crops

At the end of the day, livestock production and potato production seem to be possible on a large scale. In certain conditions, even light-hungry crops like tomatoes and maize appear to be amenable to cultivation in combination with energy production.

On the other hand, it is not possible to define a shade threshold which crops can tolerate with no negative impact on their yields. Scientists therefore instead propose that an optimal daily amount of light be defined for each species.

Experiments on larger areas of land and over several years are still needed to identify the most promising crops and promote the development of agrivoltaics without adversely affecting crop yields. —

Conclusions

- ▶ Agrivoltaics is a novel production system being developed worldwide which is eliciting increasing interest.
- ▶ Analysis of the studies conducted to date shows that the success of this approach depends on numerous factors: local climatic conditions, season, the variety being cultivated and system design.
- ▶ Experiments conducted on larger areas of land and over several years are needed to provide us with agronomic data and to develop agrivoltaics without adversely affecting agricultural production.

Pre-emptive Selection of Natural Enemies of Invasive Pests

Pre-emptive biological control involves the evaluation of the benefits and risks of the natural enemies of an invasive pest in advance of its arrival, allowing the swift approval and deployment of the natural enemies in an emergency.

Gonzalo A. Avila, Kiran Horrocks, Ramona Maggini, Jana Collatz et al.

Invasive species cause enormous damage in both agriculture and the environment. The release of natural enemies or biological control agents (BCAs) from the area of origin of a pest can be a sustainable control solution.

As a rule, studying the biological basis of BCAs, clarifying their potential risks and obtaining final regulatory approval before their use can take several years. If such programmes are not initiated until the arrival of the pests, valuable time is lost during which damage accumulates. It is therefore important to be able to predict which invasive species could pose a problem in future, and how these can be controlled.

Guidelines for evaluating potential BCAs

An international consortium including Agroscope has developed guidelines for evaluating whether the natural enemies of a pest are suitable for its pre-emptive biological control. The process involves investigating the gravity of the threat posed by the pest and the likelihood of an invasion, and determining the existence or otherwise of sufficiently effective natural enemies.

Key considerations here are:

- the climatic suitability of the organisms for the target area;
- their reproductive and dispersal potential;
- their synchrony with the target pest.

Climate modelling can be particularly helpful in this regard.

Clarifying the risks to native species

To ensure biosafety, there must also be sufficient information available on the specificity of the natural enemy, as well as the risk posed to native species as potential prey, competitors or hybridisation partners of the BCA. Unresolved safety issues can be resolved in bioassays in the country of origin or in the target country under quarantine conditions.

Practicality criterion

Finally, practical hurdles must be identified. These may consist in limited opportunities for obtaining and breeding both the BCA and the potential non-target organisms for biosafety experiments. Suitable premises for handling exotic organisms and the regulatory environments for the importation, keeping and release of exotic BCAs are also important.



Natural enemies of the the emerald ash borer were deemed suitable in principle.

Case studies

Various case histories in the European context were then evaluated using the guidelines that had been developed. Natural enemies of the potato psyllid and the emerald ash borer (*photo*) were deemed suitable in principle. In both cases, however, biosafety and establishment ability issues have yet to be clarified conclusively.

By contrast, a natural enemy of the two-lined chestnut borer was rated as unsuitable because it is very difficult to breed, and there is currently no chance of obtaining sufficient individuals to investigate biosafety or conduct releases. —

Conclusions

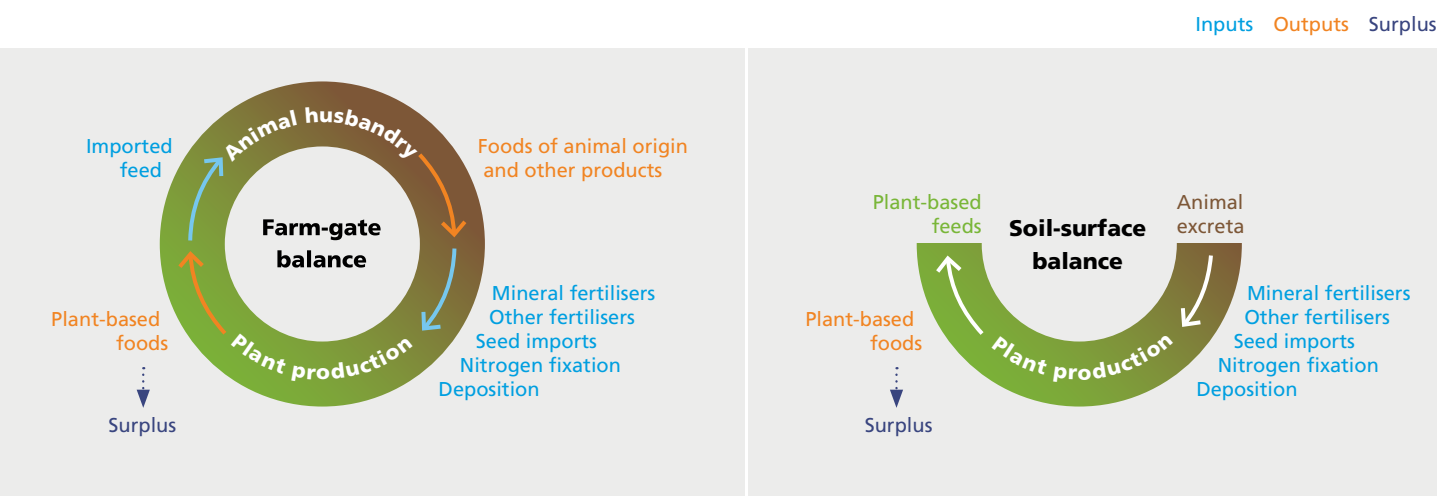
- ▶ Invasive species cause enormous damage in both agriculture and the environment.
- ▶ Pre-emptive biological control involves the study of potential natural enemies in advance of the arrival of an invasive species.
- ▶ A set of key considerations helps to identify crucial issues and to distinguish between suitable and unsuitable target organisms and natural enemies.
- ▶ Biology, efficiency and biosafety, as well as practical considerations, are important.
- ▶ Pre-emptive selection can save crucial time in the approval and release of natural enemies in the event of an emergency.

Scientific Publication:
[Biological Control, Volume 187, 2023](#)

Heading towards a Regionalised Nitrogen Balance

The newly designed Swiss agri-environmental monitoring programme 'MAUS' aims, as far as possible, to determine environmental impacts for regions and farm types with existing data. The first MAUS report deals with the regionalised nitrogen balance.

Simon Baumgartner, Ernst Spiess, Frank Liebisch, Anina Gilgen



Difference between a farm-gate balance and a soil-surface balance.

Since 2009, Agroscope has used indicators to record the environmental impacts of agriculture for different regions and farm types on behalf of the Swiss Federal Office for Agriculture (FOAG). Until 2023 the environmental indicators were calculated using the data from 300 farms (Swiss Agri-Environmental Data Network, SAEDN). In 2023 the monitoring programme was renamed MAUS (based on the German acronym for 'Monitoring of the Swiss Agri-Environmental System') and it is now based as far as possible on existing data sources. Any data gaps are filled with specific surveys.

One of the environmental indicators calculated in MAUS is the soil-surface balance for nitrogen (nitrogen balance). This describes the difference between the amount of

nitrogen supplied to the soil and the amount of nitrogen withdrawn from the soil in the form of agricultural products. A positive nitrogen balance shows a nitrogen surplus, which can have negative effects on the environment (e.g. eutrophication of ecosystems, greenhouse-gas effect) and on the health of the population (e.g. nitrate content in drinking water, formation of particulates).

Nitrogen balance calculated using existing data

The nitrogen soil-surface balance for 2021 was calculated in MAUS to test the methodology and highlight any need for improvement. Data from the Agricultural Policy Information System (AGIS), from the programme for farmyard manure and recycled fertiliser transfers (HODUFLU), geo-

referenced usage data from the Cantons and data from various sectoral organisations served as the primary information sources here. These were used to calculate the nitrogen balances at farm level for all Swiss farms, after which the results were aggregated at the desired level (e.g. regions, agricultural zones).

Results varied significantly between Cantons: those with intensive animal husbandry had higher nitrogen surpluses, whilst mountain regions had lower ones. As a rule, surpluses showed a downward progression from the low-land region to the hilly region to the mountain region to the summer-grazing area.

Comparison with other balances

To validate the method, results were aggregated at national level for comparison with the national soil-surface balance of the Swiss Federal Statistical Office (SFSO). The MAUS calculation yielded an average nitrogen surplus of 40 kg nitrogen per hectare across the entire agricultural area of Switzerland (utilised agricultural area and summer-grazing area), or 57 kg nitrogen per hectare utilised agricultural area (UAA) excluding summer-grazing area. These figures are markedly lower than those of the SFSO (66 kg nitrogen per hectare of agricultural land, 90 kg nitrogen per hectare UAA). The findings are the same when one compares MAUS calculations with Agroscope's national farm-gate balance.

Like Agroscope, the SFSO also calculated regionalised balances, but using a different approach: whilst Agroscope calculated values at farm level and then aggregated these at a higher level (e.g. at cantonal or national level – i.e. a 'bottom-up' approach), the SFSO broke the national figures down into those of the different Cantons (i.e. a 'top-down' approach). Thus, although the absolute values differ between the two approaches, the percentage distribution of the inputs and outputs between the Cantons are largely in agreement.

[Scientific Publication:](#)
[Agroscope Science 185, 2024](#)

[Monitoring of the Swiss Agri-Environmental System \(MAUS\)](#)

Mineral fertiliser use calculated differently

The lower figures for the MAUS calculations can largely be explained by the fact that MAUS underestimates the nitrogen inputs from mineral fertilisers (27 % lower figures than those of the SFSO). MAUS determines mineral fertiliser use by calculating the nitrogen input at farm level based on crop-specific average fertiliser values. By contrast, the SFSO estimates mineral fertiliser use based on import figures.

The next few years will see the continuous refinement of the method for calculating the nitrogen balance in MAUS. Thanks to additional data surveys (satellite data, data from farm-management information systems, online surveys) – including surveys on mineral fertiliser use – data gaps will be filled, and more accurate data will be available. The aim over the next few years is to highlight and gain a better understanding of the reasons for the differences between the regional and national input and output figures as well as the differences between Cantons. —

Conclusions

- ▶ Regional nitrogen balances for 2021 were calculated using existing data sources in the new Swiss agri-environmental monitoring programme, MAUS.
- ▶ The results show that existing data resources can be used to calculate regionalised balances – albeit with certain restrictions.
- ▶ To test the method, a national nitrogen balance was also calculated and compared with that of the Swiss Federal Statistical Office. The figures of the MAUS balance are markedly lower than those of the SFSO, primarily because mineral-fertiliser use is underestimated in MAUS.
- ▶ Specific data will be gathered over the next few years to obtain more-accurate results. The aim is to highlight and gain a better understanding of the reasons for the differences between the regional and national figures, as well as between Cantons.

Miriam Baumgartner: Committed to Optimal Horse- keeping



Veterinarian Miriam Baumgartner is studying horse behavior at the National Stud. Initial results show the advantages of paddock trails.

A specialist in the behaviour of group-housed horses, Miriam initially spent five years in a veterinary practice in which she treated equids. She had always wanted to go into research, however, since she finds it more motivating to discover the root causes of symptoms in order to help improve the living conditions of horses. These sensitive animals are particularly prone to behavioural disorders.

In her research projects Miriam uses sensors to measure different parameters that help to determine the health and wellbeing of the animals. One of her projects is conducted in Saint Aubin at a unique experimental research facility where horses are housed in so-called paddock trails. In these structures the animals move about more, and Miriam is keen to investigate the impact of this housing system on their health, particularly on the quality of their locomotion. Although the project is still at the data-gathering stage, initial results seem to suggest that horses housed in these structures are healthier, suffering less from lameness and pain.

Sensors for better assessment of wellbeing

This researcher also conducts other projects in which the animals are fitted with sensors to gather data on their behaviour and state of health. For example, she is interested in horses used in equestrian sports and kept in boxes most of the time. Data from AI-based camera systems and measured physiological parameters keep her informed of the animals' condition.

In Miriam's opinion, it would be a very positive development if technological progress eventually also enabled horse owners to equip their animals with such monitoring systems, or with specific sensors, so that they too could keep tabs on the welfare of their animals.

Originally from Germany, Miriam counts herself very lucky to be able to conduct her research in Switzerland as part of a motivated team of scientists with access to high-quality, internationally renowned infrastructure. Few countries, she explains, are as well-endowed as Switzerland in terms of equine research. —



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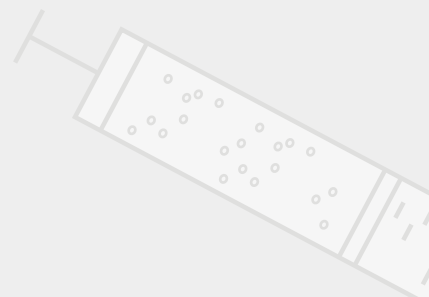
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‘In many regions of the world, including the mountain regions of Switzerland, animal husbandry is the only option open to farmers. Here, the positive side-effects of grazing animals, including the preservation of a diverse and species-rich landscape, are of particular importance.’

Lutz Merbold, Head of the ‘Agroecology and Environment’ Research Division

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