Cleantech ALPS
Western Switzerland Cleantech Cluster

Agritech in Switzerland

The panacea that squares the circle of productivity and climate protection?

In partnership with

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AGROPOLE
ACTING FOR TOMORROW | BOOSTING INNOVATION IN AGRI-FOOD

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Association Réseau Innovation
Suisse Occidentale

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CLEANTECHALPS

CleantechAlps is Western Switzerland's cleantech cluster. Its mission is to foster collaborative innovation, bringing together players who are contributing to ways of using our natural resources sustainably and developing new forms of renewable energy. As the pre-eminent exponent of the innovation ecosystem, CleantechAlps is Switzerland's cleantech enabler. Created by the cantons of Western Switzerland, this inter-industry platform facilities interaction, stepping up and accelerating the capacity for innovation and the digital transition of Swiss enterprise. CleantechAlps increases the visibility of the region's cleantech businesses, positioning Western Switzerland as a centre of excellence at international level.
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Study authors
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«Innovation in agricultural enterprise is absolutely crucial.»

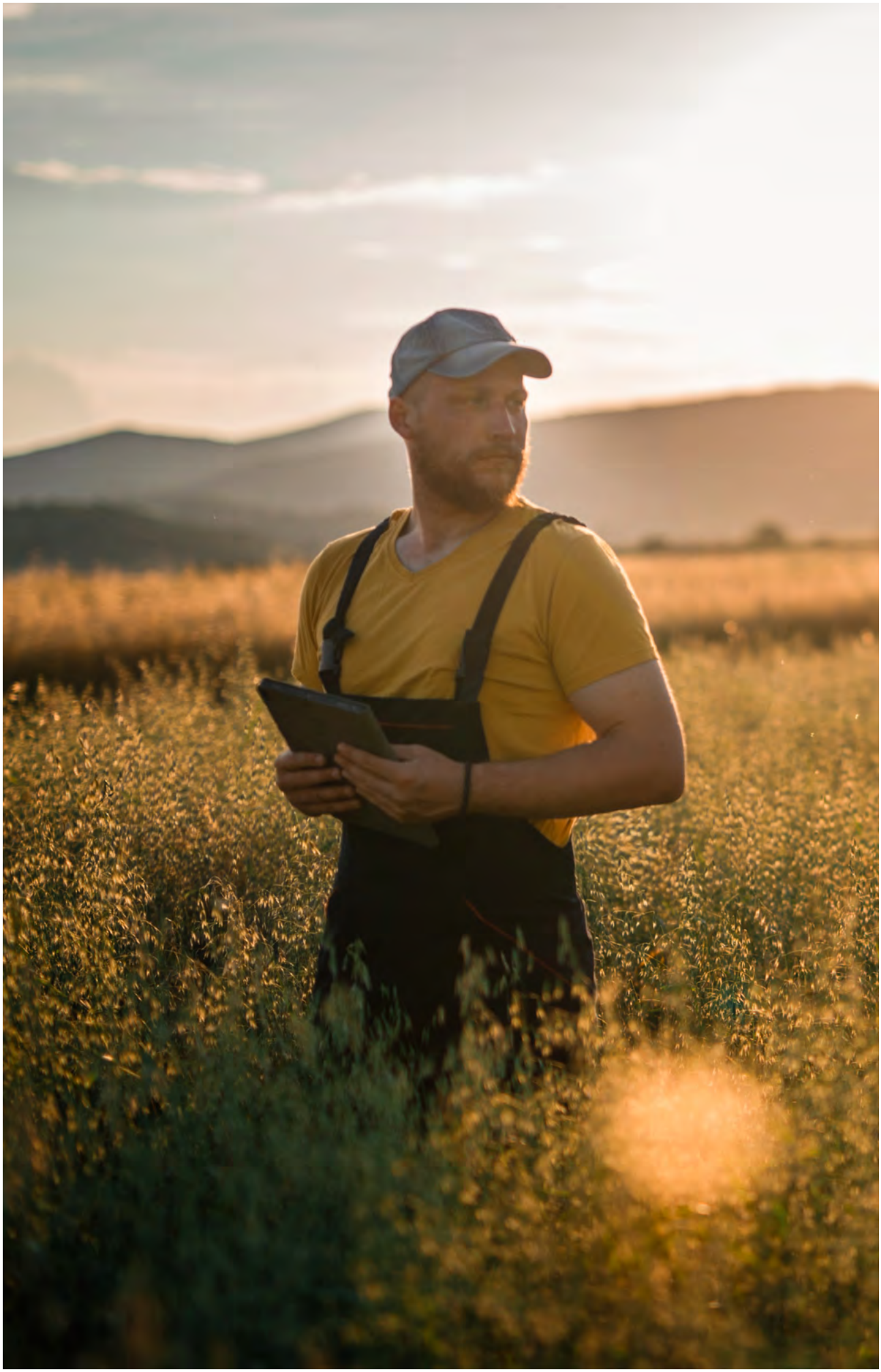
GUY PARMELIN
President of the Confederation
Head of the Federal Department of Economic Affairs, Education and Research

Swiss agriculture must adapt, on the markets, on farms and when it comes to the environment. To deal with the changes we face, agricultural businesses are constantly called upon to be flexible. In this situation, innovation – in products, services and production – is absolutely crucial. This is why Switzerland's Federal Council is backing the farming and food industries in their efforts to improve quality and sustainability and to exploit the potential for innovation and technological development that is out there.

The changes we are seeing in our environment – particularly climate change –, technological progress and the will of the people, expressed, among other things, through ever more pressing popular initiatives, are all challenges that Switzerland's political class must rise to meet. Our politicians must provide the framework conditions that will enable agriculture to adapt to and fully exploit the new opportunities that are opening up. Alongside our policies on energy, the environment, research and innovation, in my view, a new agricultural policy that is fit for purpose is essential if we are to meet these objectives.

The Federal Council believes in the market-led entrepreneurship, individual responsibility and capacity for innovation demonstrated by our farmers. We must encourage even more environmentally friendly farming practices and technologies. The Federal Council is committed to improving energy efficiency, facilitating measures to protect the climate and promoting the use of energy from renewable sources. The Federal Office for Agriculture, which is part of my Department, is in a position to support the introduction of new technologies and the development of knowledge-sharing platforms. It is also a recognised centre of reference for the different players involved in this change.

I sincerely hope that the special report you have in your hands will help to facilitate and spread the use of new technologies that are clean, efficient and environmentally friendly throughout not only Switzerland's farming industry but its food industry too. Humankind and nature will thank us for it.



Introduction

Our planet's living natural heritage is essential to the development of ecosystems and the biosphere. This is more commonly known as biodiversity. In its own way, biodiversity helps mitigate the effects of climate change, and it is no accident that these concepts are explicitly referred to in the 2030 Agenda Sustainable Development Goals launched by the Swiss Confederation.

It can legitimately be claimed that farming can help minimise the impact of climate change, particularly in mountainous areas. For example, grazing livestock on summer pastures at high altitude helps reduce the general avalanche risk in winter because the snowpack adheres better to grazed slopes. On the other hand, livestock farming and a global food culture centred on large-scale meat consumption are a significant source of greenhouse gas emissions and have a major impact on water reserves, and it is not disputed that agriculture exerts a huge pressure on our climate. This pressure also affects biodiversity because of extensive crop cultivation and an increased risk of water pollution.

At the same time, humanity needs to keep pace with the global population explosion, ensuring access to food for all. We therefore face a dilemma, and this is where innovation comes in, ensuring sufficiently intensive farming and guaranteeing food security worldwide while maintaining biodiversity and protecting the environment.

A KEY ROLE FOR TECHNOLOGY?

As it does in other industries, technology plays a key role in the food production sector. This sector is worth more than 7.8 trillion dollars, feeding the planet and employing some 40% of the global population[1]. The rate of innovation in the food industry has not kept pace with other industries and – according to McKinsey – up to now, farming has adopted digitalisation less widely than any other major industry.

Compared to other industries, the industrial food production sector is today plagued by widespread inefficiencies and encumbered by a growing number of constraints. In food production and agriculture in general, the need for technological innovation is more pressing than ever. This need presents plenty of opportunities for entrepreneurs who are keen to challenge existing industry players and create new ways of producing differently and more effectively at every stage of the supply chain.

The approach we adopt can no longer be limited to a particular sector, in this case agriculture. Its challenges and problems are inextricably linked with others, and this calls for a concerted, systemic approach. With this in mind, in this special report, we examine possible solutions that apply to the whole of the agriculture value chain, including not only production – where farmers play a predominant role – but also the processing of agricultural products and the advent of new food concepts and even new products.

We will therefore also be looking at the related business sectors of food production and the bioeconomy (see page 35), and not forgetting digitalisation and the contribution that artificial intelligence can make.

THE ENVIRONMENT AND INNOVATION: PART OF SWITZERLAND'S DNA

Switzerland has long been a pioneer in passing legislation to protect the environment, and innovation is in our blood. With favourable framework conditions in place, Swiss enterprise has been encouraged to develop solutions, tools, products and services that support society's evolution towards ever greater sustainability and resilience. This state of affairs contrasts with the day-to-day experience of a large number of farmers, who are struggling to survive and still deliver quality produce. Meanwhile, nationally, biodiversity is unsatisfactory, with half of Switzerland's countryside and a third of its species under threat.

But there are ways to improve this situation and redress the balance, and one of the solutions lies in what we call agritech. This is the subject of this special report, an exposé of Switzerland's know-how in the matter. In this report, we also attempt to provide concrete examples of the concepts of agritech and innovation in the farming world in the broader sense.

What is agritech?

CONTEXT AND DEFINITION

In Switzerland, as elsewhere, agriculture is under pressure. Economic pressure first of all, with increased competition from abroad. And spatial pressure too, with the amount of land available to farming declining due to the rapidly increasing population and growing urbanisation. And lastly, popular pressure, with repeated demands from the Swiss population to reduce the environmental impacts of agriculture, particularly regarding the use of crop treatments.

In this context, every avenue for optimising or improving land use must be exploited to protect the agri-environmental conditions, ensure that farms remain competitive and safeguard the country's food security. Agritech – or agricultural technology, in particular smart farming applications – is one solution that meets all these challenges.

The term agritech can be defined as the use of technology in agriculture, often combined with the use of digitalisation and data processing. This potentially includes every aspect of agricultural production: land-use planning and soil management, irrigation, crop management, plant protection, herd management, animal health, mechanisation and many other areas.

It is important to realise that agritech is not limited to the production link in the agricultural value chain (see page 42). Production is typically where farmers are involved, but agritech also comes into play much further down the value chain, in the processing technology used in food production and the use of local short-circuit retail for crops, for example. In short, agricultural technology is designed to facilitate the work of farmers while enabling them to make a better living and reduce their environmental and energy impact.

A REVOLUTION… ALL ALONG THE FOOD CHAIN

This new technology is likely to revolutionise not just agriculture but the entire food chain. And this is the fundamental point that we are keen to share with you in this special report.

Agritech is bound to have an effect on agriculture and production methods, but its impact is set to be considerably broader than that. Agricultural technology applies to the entire value chain, including areas that come into play before production, such as equipment, seed, fertiliser, legislation and funding. This is why agritech is also sometimes referred to as agrotech or agrifood. The boundaries between these different applications are blurred, in a world where the issues need to be tackled through a systemic approach and their interpretation often depends on the viewpoint from which the analysis is made.

The agritech revolution has clearly begun, at every level. But surprisingly, agricultural production, which in the long term will be the area most profoundly affected by this revolution, is for now only tangentially involved in the developments we are currently seeing. We therefore urgently need to spread the word about the state of the art in agritech to ensure that the players in the agricultural sector can contribute, bringing their expertise to deciding on and developing the tools of tomorrow.

SMART FARMING, THE PROMISE OF HITHERTO UNSUSPECTED SOLUTIONS

The subject of smart farming is very important to agritech and deserves closer attention. Smart farming adds information and communication technology to the mix, encompassing a whole array of possible technologies, as illustrated in the Figure 1 in page 11 Sensors, software, communication systems, data analysis, and more: these new approaches are implemented via software or virtual platforms, and also via robots or drones. Combining these technologies opens the door to as-yet untapped potential, in particular with the advent of big data (the generation of vast amounts of data) and artificial intelligence (enhanced data processing that enables devices to 'learn' when and for how long to carry out automated actions, for example).

Integrating digitalisation throughout the agricultural value chain opens up a new dimension and creates additional catalysts for change. This interfacing between equipment and the digitalisation of processes goes far beyond the automation of production lines, encompassing aspects such as business procedures (controls, validation, etc.), computer-aided management and online monitoring and diagnostics.

This will enable the current agricultural ecosystem to transition towards one that incorporates the complete integration of digital technology in day-to-day operation. We are witnessing a shift away from a method of operating based on a sequential, quasi-static approach, characterised by a high degree of planning assisted by monitoring after the event, and towards a situation of anticipation and diagnostics, with a greater degree of online interaction and integration. As we shall see, the impact of this change is set to profoundly reshape the interfaces and activities throughout the agricultural value chain.

If they are to serve their purpose, these new technologies must increase the competitiveness and efficiency (both economic and environmental) of agriculture. They may also offer decision-making aids specific to farmers. The Federal Council's Digital Strategy sets great store by smart farming as a way of increasing competitiveness and sustainable development in the agricultural sector.

But whatever happens, these technologies cannot replace the experience, insight, training and expertise of farmers and professionals working in related sectors.

JAVIER MEYER
Marketing Director & Chief Sustainability Officer, AQUA4D

We must break old paradigms and learn to do things the right way. In that sense, water- and climate-smart technologies help us save our natural resources while improving yields and efficiency in a sustainable way.

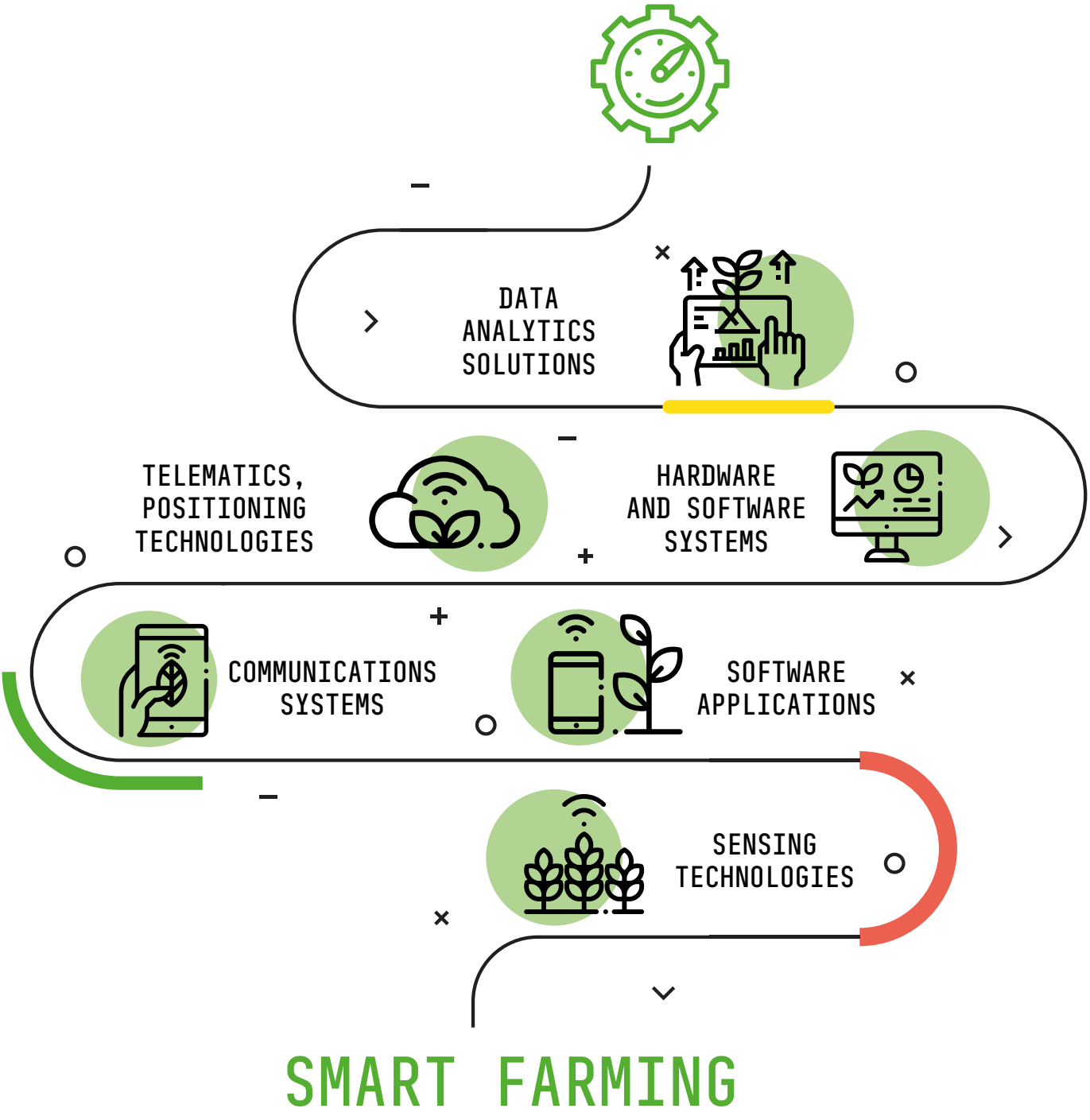


Figure 1
The technologies involved in smart farming
Source : Adva.com

THE OMNIPRESENCE OF DIGITAL

As mentioned above, digitalisation is a major component of agritech. Most of the new technologies arriving on the market today rely on computers, microprocessors, sensors, interfaces, applications and even AI. They are increasingly able to 'learn' autonomously and adapt to changing circumstances. And as in other domains, such as smart cities, big data is set to play a decisive role too.

Contrary to popular belief, agriculture is already quite some way down the road of adopting digital technology. Like every other part of the economy, digitalisation is already a feature of every farm. «Farmers get weather and pest forecasts on their mobile phones, and some of the paperwork they have to complete is on digital platforms,» says Professor Robert Finger, head of the agricultural economics and policy group at the Swiss Federal Institute of Technology Zurich[2].

PRACTICAL APPLICATIONS ALREADY IN USE

Various practical applications have been in use for years, including in Switzerland. These apps have, for example, improved the exchange of information, but the farming and food production sectors still need to communicate with each other much more effectively. It is also important to step up cooperation between all the parties who use agricultural data.

In 2018, the Federal Office for Agriculture (FOAG) launched a Charter on the Digitalisation of Swiss Agriculture and Food Production. Drawn up following a mass consultation process, this charter sets out the main principles of the digital transition in agriculture[3]. This partnership paves the way for the development of digital applications designed to make better use of agricultural data. Following conclusive tests carried out in the Canton of Fribourg, at the beginning of 2021, FOAG took a further step towards digitalisation by launching the portal www.agate.ch to make it easier for farmers to manage data. Using this app, farmers can authorise the sharing of their data at any time, for example with the organisations managing quality labels.

These digital management platforms will enable farmers to keep records of their resources and assets to hand so that they can make use of them. By carrying out a comparative analysis with other farms, they are able to identify more quickly their strong points and areas of potential improvement and put this information to good use. There are many examples of apps already in use throughout the country (see page 22).

AI IS ALREADY A REALITY

As it is in the rest of the economy, artificial intelligence is also being used increasingly in agriculture. AI can be used, for example, to identify the location of different varieties of plants and monitor their growth using satellite images. Commodity traders also find this data extremely useful since it has the potential to predict the prices of different resources based on precise information about the volumes of crops still in the fields. Some fear that this will lead to speculation, but others see it as an opportunity, enabling traders to anticipate and pick the best options at the right time.

The app www.pollenn.ch, designed to be used by the general population, completes the picture. It provides a means of decentralised information gathering from field observations, using geolocation data to consolidate this information.

Exchanging agricultural data: several projects under way

IP-Suisse and Agrosolution are developing the Ada-Eda agricultural data exchange project. Its aim is to set up an agricultural data exchange platform for the controllable, secure exchange of data from the different data pools.

The Confederation's project, dubbed DfD2, which involves the release of data to third parties and for third-party applications, will improve data exchange between public organisations (the Confederation and Cantons) and private bodies such as quality label organisations. The aim is to have a system where farmers need to input their data only once (in particular data about their farm) and where they can manage everything in one place, on the portal www.agate.ch.


ORGANIC
ORGANIC
ORGANIC
ORGANIC
CHEMICAL MIXES
HERBICIDES
NUTRIENTS

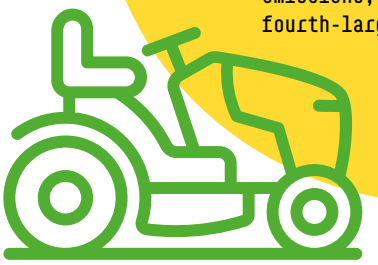
KEY FIGURES

Here, we present a few key figures that show how important agriculture is to Switzerland and the issues facing agritech in the country.

AGRICULTURE IN SWITZERLAND

13,2%

Agriculture accounts for 13.2% of Switzerland's total greenhouse gas emissions, making it the country's fourth-largest contributor.

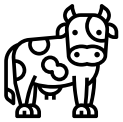


Switzerland is in the top 20 of countries with the highest level of investment in food production[6]

50'039

the number of farms in Switzerland in 2019, compared to 111,302 in 1975[4]

24%



the different sectors of the food production industry were responsible for 24% of the greenhouse gas emissions of the entire Swiss economy in 2019

70,2%

of the utilised agricultural area (UAA) is pastureland (13.6% is cereal crops)

59%

of the foodstuffs consumed in Switzerland are from domestic agricultural production

2X MORE START-UPS IN 2 YEARS

The number of agritech start-ups doubled between 2016 and 2019, and this growth is continuing, including in terms of funding campaigns

81 HA

the area of farmland covered by the Swiss Future Farm (SFF), dedicated to agritech experiments

The SFF at Tänikon (Canton of Thurgau), aspires to become the European smart farming platform.

33%

the CO_2 emissions reduction target for Swiss agriculture by 2050

11%

the fall in greenhouse gas emissions from agriculture between 1990 and 2017[5]

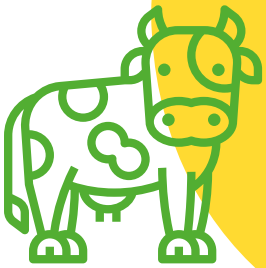
66%

the CO_2 emissions reduction target for the food production industry by 2050

As we shall see later, the food production sector is an extension of the agricultural value chain. It is helpful to quote some key figures from this sector here.

FOOD PRODUCTION IN SWITZERLAND

70%



Nearly 70% of arable land worldwide is used for animal production (pasture and fodder), this accounts for 30% of the planet's landmass*.

*According to Extenso, the University of Montreal's Nutrition Reference Centre

INDUSTRY

230'000

The food and agriculture sector includes nearly 50,000 business entities and 51,000 farms, accounting for more than 230,000 jobs, according to the Swiss Federal Statistical Office (FSO).

WASTE

2,8 MILLION

In Switzerland, food waste is estimated at 2.8 million tonnes per year, two-thirds of which is avoidable, according to the Federal Office for the Environment (FOEN).

43%

The food production industry is responsible for around 43% of the 1.7 million tonnes of avoidable food waste.

68%

Hotels and restaurants could reduce their waste by 68%.

INVESTMENT

2,6 BILLION

Every year, CHF 2.6 billion is invested in food innovation, according to Swiss Food & Nutrition Valley.

8,9 BILLION OF EXPORTS

In 2018, Switzerland exported CHF 8.9 billion worth of food and drink (FSO).

MEAT

36%

Livestock farming accounts for 36% of the total greenhouse gas emissions from food production, according to the IPCC.

50 KG

Worldwide, an average of around 35 kg of meat is consumed per person every year. In Switzerland, this figure is 50 kg.

THE CHALLENGES FACING AGRITECH

As we have seen, the many challenges facing agriculture will not be easy to solve. Agritech has been firmly established in Switzerland for some years, thanks to the efforts of research institutes, start-ups and SMEs working in the field. It must now be used to help farmers and the players in associated sectors to meet specific objectives. These include:

Improving profitability by reducing costs and increasing efficiency, both in the fields and in administrative work

Reducing the burden on farmers of routine work and/or work with little added value

Improving knowledge of crops and different types of production

Increasing **produce quality**

Improving **food security**

Optimising **treatments to protect water** supplies and other resources

Improving **energy efficiency**

Limiting food waste (during production and consumption)

Ensuring a **general improvement** in animal well-being and health

Managing the effects of climate change (drought, hail, frost, insect pests, shortages, etc.) **more effectively**

Reducing CO_2 and noise **emissions**

Reducing soil **compaction**

Improving **food traceability**

Providing nutrition that has a lesser impact on resources

The agricultural sector can look to businesses and research institutes to help meet these challenges. However, agritech is not a magic wand – it alone cannot solve all these problems. But it can make a major contribution. How? This is what we shall see in the following chapters.

AGRICULTURAL POLICY, STILL A MATTER OF DEBATE

The Federal Council has outlined the evolution of Swiss agricultural policy beyond 2022. This strategy is described in AP22+, which sets out 13 environmental goals relating to areas such as pesticide use, biodiversity and protection of the landscape, soil and climate. This project has been under consultation for several years, an indication that the stakes are high and the overarching policy decisions are hard to make. This is because future agricultural policy will have to take into account the demands of both society and farmers, and the two do not always make good bedfellows.

In December 2020, the Council of States returned the strategy to the Federal Council. The senators want the Federal Council to look at measures designed to maintain the country's current level of self-sufficiency and to ensure the use of closed cycles for all nutrient sources throughout the value creation chain. The Council of States also wants to reduce the distortion of competition between domestic production and imports. This decision will mean a delay in the introduction of the new agricultural policy, which may not come into force until 2025.

The use of agritech to support farmers is explicitly mentioned in the Federal Council's initial strategy. This delay could encourage the government to incorporate it to an even greater degree. The federal strategy will also have to encourage innovation in the broader sense if new alternatives and ideas are to be found. This applies particularly to the subject of CO_2.

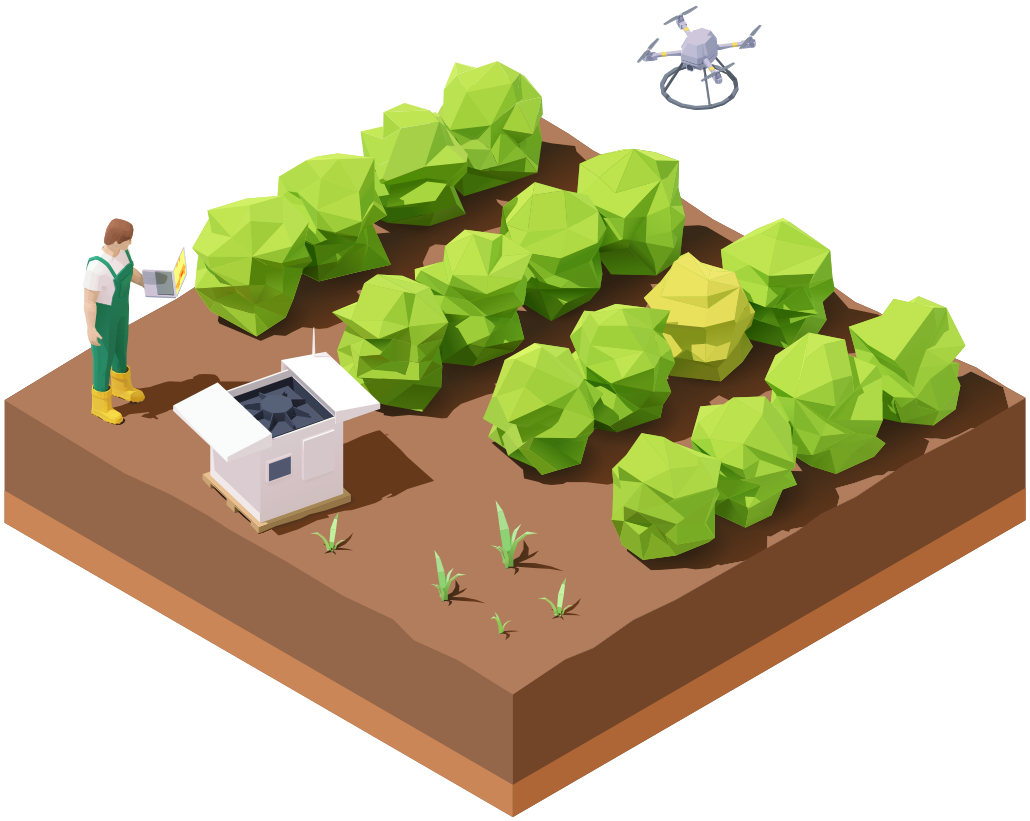
In the following chapters, we outline a number of practical solutions, some already mature and others still in the pipeline.

JACQUES BOURGEOIS
Member of the Swiss National Council
and former Director of the Swiss Farmers' Union

4.0 = facilitated business management, reduced bureaucracy and greater precision: opportunities that Swiss agriculture must seize.

Existing and future solutions

In the following pages, we explore the innovative agritech solutions being developed in Switzerland. For clarity, we have classified these in terms of the outcomes they are designed to achieve. To avoid repetition, we have chosen to present each solution under the outcome where, in our opinion, it is having the greatest impact. Making impact decisions is not always straightforward, particularly given the importance of the context we are dealing with. The many variables and changes in this sector mean that it is likely to evolve even faster in the coming years. The reader will, however, easily be able to decide for him or herself whether a particular product is better suited to solving a different problem.



INCREASING PROFITABILITY WHILE LIGHTENING THE LOAD FOR WORKERS

The automation of agriculture is already under way on a significant proportion of Swiss farms. A number of – mainly digital – solutions can be employed to increase profitability through greater use of more detailed crop analysis.

For example, **Gamaya** (Canton of Vaud) is developing high-tech cameras used to analyse the condition of a crop and assess what treatment it requires. Very high-resolution images provide valuable information about the physiological condition of the plants, which can then be used by autonomous agricultural machinery.

The robotisation of agriculture relieves farmers from repetitive and sometime unpleasant tasks. The rapid growth of **ecoRobotix** (Canton of Vaud) shows just how much interest there is in the use of robots. This fledgling company is developing a robot powered by integrated solar panels that can weed whole fields with pinpoint accuracy by injecting very small doses of herbicide precisely where they are required, entirely autonomously. ecoRobotix uses AI to recognise the weeds and disregard the other plants (see page 87).

Another example is **QualySense** (Canton of Zurich), which has developed an automated system that sorts grain and seed efficiently on the basis of criteria set by the farmer. This system can process around 30 grains per second.

In Romont (Canton of Fribourg), **JNJ Automation** is developing robots that handle cheeses during the maturing process. These devices are able to turn over, salt and move the rounds of cheese, saving the farmer valuable time (see page 73).

Still in the dairy sector, **Icube** based in Bulle (Canton of Fribourg) uses a digital payment system to pay milk suppliers. A connected weighing device with sensors compatible with all delivery methods (churns and tankers) measures the volumes delivered and automatically assigns them to the relevant farmers. Sampling for quality analysis purposes is also automated, making it easy to exchange data with analysis laboratories. In addition, **Icube** had developed a MilkPay app that manages the milk purchasing process, calculating the payments due and ensuring that producers are paid for the precise quantity they deliver. This system saves time for both the farmers and the producers of the finished products. It also improves transparency in the trading and delivery processes. In addition, Icube has developed software that not only automatically inspects and analyses cheese production but also generates digital manufacturing data sheets.

Secateurs specialist **Felco** has also invested in digital technology to improve the profitability of agriculture, and viticulture in particular, coming up with a digital unit that optimises vineyard management. Developed jointly with the University of Applied Sciences and Arts Western Switzerland (HES-SO), this device makes it easy to identify diseased vines and plan any necessary vineyard work.

Another example is the **Agrometeo** web platform developed by Agroscope. This site is designed for use by farmers, providing all sorts of useful plant protection information such as the spread of mildew, insect monitoring and the phenological development of wheat. The different applica-tions are used as decision-making aids in dealing with plant protection issues applicable to large-scale crops, viticulture and arboriculture. Here, technology – and digital techno-logy in particular – makes life easier for farmers and saves them valuable time to boot.

In a similar vein, **PreDiVine** (Predicting Diseases of Vine) is a web application designed to aid decision-making that uses networks of wireless sensors, weather stations and prediction algorithms to keep vineyards healthy. It monitors vineyard microclimate conditions with a view to predicting vineyard pests and diseases. PreDiVine was developed by **Dolphin Engineering** (Canton of Ticino), with support from the Swiss innovation agency InnoSuisse.

The **FarmX** platform (Canton of Jura) employs a smart-phone app to facilitate networking among farmers, enabling them to share often very expensive agricultural machinery. It also increases product traceability and is a good way of putting digital tech to use in improving the profitability of farms. Mighty oaks from little acorns grow… (see page 76)

AgriCircle (Canton of St Gallen) describes itself as a pre-cision farming specialist, using a platform designed to help optimise the management of farms to improve their productivity and sustainability.

Lastly, **Dootix** (Canton of Fribourg) helps producers affi-liated to the cheese producers' association Interprofession du Vacherin fribourgeois to adopt digital and computer technology. The quality control sampling process used for Vacherin cheese has been digitalised, saving farmers hours of tiresome paperwork.

A high-tech farm at Grangeneuve (Fribourg)

The Grangeneuve agricultural institute near Fribourg promotes the adoption of new technology in agriculture by training and supporting farmers in using it. For its teaching programmes, **Grangeneuve** boasts a working farm packed with new tech: 2,000 m2 of solar panels, four hay-drying systems with automatic data monitoring, and the cutting-edge herd monitoring system Herd Navigator developed by DeLaval. Alongside this, the site's agricultural consultancy centre provides advice and data management services to dairy farmers who adopt new technology to reduce their greenhouse gas emissions (see page 78).

MARTIN RUFER
Director of the Swiss Farmers' Union

Digitalisation and the new technologies are an opportunity for agriculture. We can use them to ensure more sustainable production and improve traceability, from producer to consumer.

REDUCING THE USE OF ANTIBIOTICS AND PESTICIDES

The use of pesticides in agriculture is a subject of frequent public debate. In the vast majority of cases, farmers are aware of their impact on the environment and are trying to reduce their reliance on these substances. In this context, the adoption of precision agriculture is gaining ground. Instead of spraying crops with large quantities of chemicals, it is more sensible – from an economic point of view too – to distribute these products in a targeted way only where they are needed, in the right quantity and with the right frequency.

Drones and multicopters have a crucial role to play here, and increasing numbers of companies are offering product application services that make use of these airborne devices. This treatment method is more precise and less harmful than spraying by helicopter or from tractor-mounted blowers, methods that also have an impact on air and noise pollution and soil compaction (see pages 26 and 32).

Switzerland is at the forefront internationally of developing drone applications in viticulture, especially on steeply sloping ground. In 2019, it was the first country in Europe to authorise spraying drones. For this to happen, it is important to have a clear legal framework and effective coordination between different public bodies to facilitate the authorisation process. This technology is set to gain ground in other areas such as market gardening, but also in carefully targeted preventive operations in large-scale crop growing. Drones can be used to locate newborn deer calves in fields, for example.

Recently established companies such as **Aero41** (Canton of Vaud, see page 90). **Remote Vision** (Canton of Appenzell Ausserrhoden), **Agrostar** (Canton of Aargau), and **Agri.Aero**, **Altidrone** and **AgroFly** (all based in the Canton of Valais) are already in business and growing fast. As we have already mentioned (see page 21), **ecoRobotix** offers a tractor-towed or self-propelled solution for precise spraying that drastically reduces the use of pesticides. Although drones are not widely used in Swiss agriculture at present, this technology has tremendous potential for the future of the industry. Start-ups like **SenseFly**, **Gamaya** (see page 21) and **Wingtra** continue to develop new applications based on this technology.

Overall, Switzerland is doing well in its use of sensors, control and tracking systems (Involi) and data processing. The SmartFarming project developed by the **Grangeneuve Agricultural Institute** near Fribourg, in partnership with Agroscope and industrial partners including Swisscom, Icube and ecoRobotix, is working on a new approach to farming that makes use of multimodal data. The data is collected from various sensors with a view to controlling and automating the use of resources such as water and pesticides. The results of this project are due in 2023.

Switzerland is also not lagging behind when it comes to livestock farming. Since 1999, it has banned the use of antibiotics administered preventively or to boost performance in the food industry. As a result of various awareness programmes and campaigns, the total quantity of antibiotics used on farms has been falling steadily since 2008. In the Canton of Fribourg, in 2016 **the Cantonal Office for Agriculture** launched a pilot project called ReLait. This project proactively provides farmers with strategies for reducing their use of antibiotics, creating a forum for the exchange of experience between producers. And it is working: the resulting fall in antibiotics use is impressive. The farms using the most antibiotics have made the most significant reductions in treatments, without sacrificing quality or production volume. The Fribourg programme began as a cantonal initiative but is now receiving financial support from the Confederation. The second phase, involving 150 additional farms, is set to run until 2024, in collaboration with the Faculty of Veterinary Medicine at the University of Bern.

The company **TwentyGreen** (Canton of Lucerne) has formulated a probiotic feed supplement that promotes animal growth while limiting the use of antibiotics. Lastly, **Greenas-tic** (Canton of Vaud) has developed GreenApp, which draws on botanical and scientific information and interactions ob-served in permaculture. This application helps users design a pesticide-free garden by recreating natural associations between plants and vegetables.

REDUCING THE IMPACT ON WATER

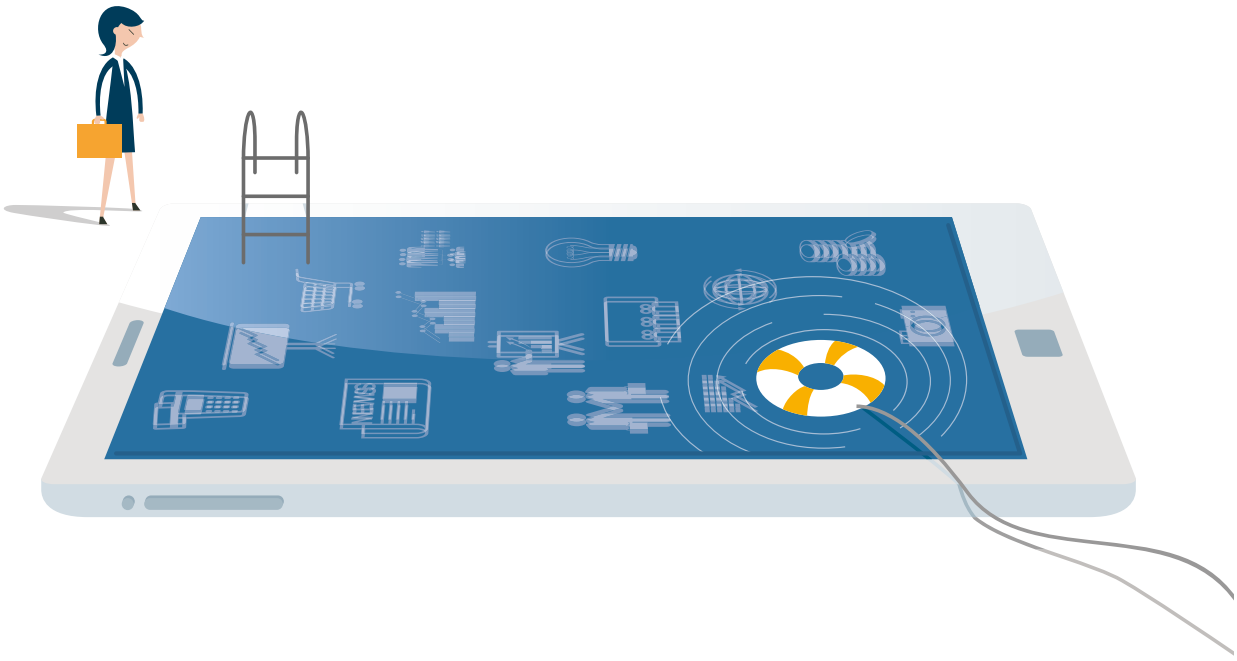
Water is an essential resource. In some parts of the world, including Switzerland, water resources are beset by conflicting demands from sectors such as household consumption, agricultural irrigation and artificial snow production in ski resorts.

Several Swiss companies have already come up with ways to ensure that water is used sustainably. One of these is **AQUA4D**, based at the Daval Ecopark in Sierre (Canton of Valais), which is developing a water treatment unit for use on large farms. This device uses no chemicals and provides savings of up to 30% in irrigation water. It also ensures better assimilation of minerals by the plants and reduces the number of nematodes, the tiny parasitic worms that affect the plant roots (see page 82). AQUA4D's solution is a comprehensive one that can for example be used to measure crop growth by drawing on a whole battery of indicators collected from separate sensors measuring variables such as humidity, salinity and temperature.

Hydrosolutions (Canton of Zurich) specialises in water management for agricultural irrigation, focusing on its use in arid regions. The company creates tailor-made solutions by working with local stakeholders and making use of mobile and web-based communications technology, which provides farmers in these regions with all the essentials they need to manage their water resources.

Agroscope, Switzerland's flagship agricultural research institution, has developed the Agrometeo website[7] for use by farmers. In just a few clicks, users can, for example, access a full hydrological assessment of their agricultural land (see page 75).

The KLS filter developed by **RWB Groupe** (Canton of Jura) is used to treat water in areas that are not connected to a drinking water system. This device, which contains bauxite, makes use of slow-sand-filtration and gravel-filtration technology. Easy to maintain and particularly suitable for remote farms, this filter can treat up to 30,000 litres of water a day. The technology is manufactured in partnership with the water company **Etertub** (Canton of Glarus).



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REDUCING THE IMPACT ON SOIL AND SOIL COMPACTION

Healthy soil contains a high proportion of organic matter. Examples of agricultural practices that improve the soil's organic content are crop rotation, planting cover crops, reducing the extent to which the soil is worked, and recycling crop residues through techniques such as composting and biodigestion. Different types of agriculture such as agroecology, pasture rotation, agroforestry, conservation farming and permaculture are practices designed to extend the life of organic matter by returning agricultural waste to the soil and to minimise the use of resources. Alongside these methods, regenerative agriculture is increasingly gaining currency. Designed to improve soil quality through natural means, this method also helps restore fertility to diseased or depleted soils. These practices are mostly based on traditional subsistence farming methods used all over the world, complemented by modern research and innovations in sustainable agriculture.

The food production industry has cottoned on to these different issues and is slowly becoming interested in circular agricultural production systems. **Nespresso**, for example, has turned to agroforestry to preserve and increase the resilience of coffee cultivation ecosystems. This practice is also starting to be adopted at cantonal level. AGRIDEA, the Swiss Association for the Development of Agriculture and Rural Areas, is helping no fewer than 140 farms to develop agroforestry in the cantons of Geneva, Jura, Neuchâtel and Vaud.

The start-up **Alver** (Canton of Fribourg) markets innovative foodstuffs such as the powdered algae product Golden Chlorella, a neutral-tasting powder containing 63% protein, making it the most protein-rich product in its category. Producing this superfood takes just 2.5% of the arable land and 2.3% of the water required to produce traditional animal proteins. It is one to watch.

In a similar vein, the start-up **Planted Foods** (Canton of Zurich) produces plant-based products as an alternative to animal proteins. In March 2021, barely 18 months after it was founded, this spin-off of the Swiss Federal Institute of Technology Zurich (ETHZ) raised CHF 17 million to expand its #TastyRevolution abroad. The company's aim is to replace animal proteins with plant proteins without having to make any real compromises in terms of flavour or nutritional value (see page 86). An important milestone in the evolution of nutrition!

To minimise the impact of agriculture on soil and land, an increasing number of aquaponics farms are springing up in Switzerland. One of these is the farm established in Zurich by the start-up Umami. In indoor premises in the middle of the city, **Umami** grows cabbages, lettuces, radishes and other root vegetables on hemp mats. Grown under LED light, these crops are connected to tanks in which fish and shrimp are farmed. The water in these tanks is filtered by plants before being used to irrigate the crops, and the fish droppings are used to fertilise the seedlings. This is how aquaponics works, by copying what happens in nature. No pesticides or herbicides here!

Aeroponics, which is also gaining ground in Switzerland, is a soilless way of growing plants, a technique championed by the scale-up CombaGroup (Canton of Vaud), which has now commercialised the technology under the name **CleanGreens Solutions** (see page 96). CombaGroup grows lettuces and other plants in a completely airtight, regulated environment, without the use of chemicals or one drop of water more than is necessary. Another aeroponics company, **Swissponic** (Canton of Ticino), is at the cutting edge of personalised (semi-automatic or fully automated) hydroponics systems design, for both large-scale crop growers and private individuals.

Automated vertical farms are also now in vogue. **Ecogrow** has established a vertical farm near Lausanne that is designed to recreate an ecosystem in a closed environment without the use of fertiliser and with minimal energy consumption (through the use of LED lighting). Another vertical farm near Basel run by the start-up **Growcer** began operating at the beginning of 2020. Machines manage the sowing, watering and harvesting of the crops, which are delivered to a nearby supermarket. This farm can grow crops throughout the year, without earth or pesticides and using 90% less water than conventional farming. It saves space too: a floor area of 400 m2 provides a total growing area of around 1,000 m2.
Yasai (Canton of Zurich) has come up with a vertical farm that adopts the circular economy philosophy. It re-uses the waste from smart cities such as waste water and green waste as resources to help its plants to grow (see page 88).

Caulys (Canton of Vaud) is developing an indoor vertical farm for individuals and commerce which is designed to produce just enough for daily consumption. Watering, light, temperature, humidity: everything is adjusted in real time to guarantee optimum growing conditions for the plants.

The final halt on our whistle-stop tour of urban farms is the start-up **Légumes Perchés** in Prilly (Canton of Vaud), which is creating microfarms on apartment block roofs and in schools. Winner of the 2020 Prix SUD, this com-munity-based start-up offers added value to real estate companies too, like Patrimonium Residential Opportunity, which is now able to provide residents of the OASSIS deve-lopment in Crissier (Canton of Vaud) with urban gardens. This concept includes a social dimension through com-munity involvement, which is also extremely important in creating short circuits and a commercial outlet for local and regional produce (see page 72).

There are two main aspects to the growing mechanisation of farming. On the one hand, it facilitates many of the tasks a farmer has to complete, but on the other, more productivity and better performance also mean bigger and heavier farm machinery. Experts at Agroscope and partner institutions in Switzerland, Germany and Sweden have analysed the impact of the weight of farm machinery on the properties and functions of the soil. Their research has shown that these increasingly heavy machines are compacting the soil ever more and restricting root growth, which is having a negative impact of harvests. This has also made it harder for rain to soak into the soil, increasing the risk of flooding.

One possible answer is to use robots that are lighter than tractors, like **ecoRobotix**'s machine. The increasingly wides-pread use of drones (see page 23) is also a future solution to this problem, of which the general public is so far only dimly aware.

THIERRY DUVANEL
Director of Collaborative Innovation, Bühler Group

Feeding 10 billion people sustainably by 2050 – that is the challenge we all face. The growing number of agritech and food tech start-ups underlines just how huge it is.

IMPROVING ENERGY EFFICIENCY

According to the Swiss Farmers' Union (SFU), each year, the average Swiss farm consumes 20,000 kWh of electricity and 4,000 litres of diesel, along with various other fossil fuels, depending on the sector in which it operates. Improving energy efficiency is therefore a must, and an avenue with considerable potential. The SFU has thrown its hat into the ring, using the AgroCleanTech platform to encourage farmers to be more energy efficient, use renewable energy and help minimise climate change.

On the subject of energy efficiency, with the support of SwissEnergy, the cantons of western Switzerland and the Swiss Federal Office for Agriculture, the energy consultant AgroCleanTech has launched the AgriPEIK programme. It has also set up – and continues to run – several programmes supported by ProKilowatt (an initiative of the Swiss Federal Office of Energy) designed to reduce the electricity consumption of Swiss farms. These include a programme to improve the energy efficiency of piglet nests and another designed to recover the heat produced when cooling milk. The latter project involved installing around 240 frequency converters on milking machinery, resulting in a cumulative electricity saving of more than 11 GWh.

Agricultural land can also provide space suitable for generating renewable energy, so in the long term, farmers may end up farming energy too! A large number of farms have already erected vast ranks of photovoltaic panels on their land. «The farming industry has understood it has a part to play. Energy generation will provide a huge boost for agriculture,» says Professor Daniel Favrat of the Swiss Federal Institute of Technology in Lausanne (EPFL)[8].

Insolight (Canton of Vaud) is a company operating in what is known as the agrivoltaic sector. Insolight is using concentrator technology to develop high-yield solar panels that are transparent. This technology, which allows for varying the density of the shade generated, makes it possible to grow plants directly underneath the panels, increasing the surface area available for exploiting solar energy. The idea is to construct solar power plants without making the farmland unusable for crops, leaving sufficient room for tractors to drive underneath the panels.

BEM in Monthey (Canton of Valais) is marketing what it calls solar power containers: modular, mobile 15kW energy generation units housed in containers fitted with batteries that make the user energy self-sufficient. The unit's electronics make it possible to plug in other renewable energy sources such as wind and hydroelectric power too, and because it features a simple set-up with photovoltaic modules, the unit can be up and running, or packed away, in just half an hour. This solution is ideal for farmers, who can use it to ventilate a stable or dry hay for example, and it is also very useful in mountain summer pastures, where it can replace conventional generators. In addition to its use in mountainous areas, this system's flexibility makes it a particularly attractive option for farms remote from any electricity grid, such as on an island or in parts of North Africa.

Swiss Intech, a company based in La Tour-de-Peilz (Canton of Vaud) has developed Pumpilo, a solar-powered water pump that can draw water more than 100 metres vertically using a power output of just tens of watts. This solution is ideal for use in irrigation and domestic water supply in developing countries. It is also suitable for continuous water pumping, in mountain summer pastures for example. **Ennos** (Canton of Bern) is likewise developing a solar pump for use in irrigation and domestic water supply. These low-tech – and, more importantly, portable – solutions are eminently suitable for farmers in developing countries.

In this area, Swiss expertise is making its mark abroad. The Fribourg-based company **Allani Sunlife Holding** has specia-lised in developing solar-powered dryers that are used on organic farms in North Africa, for example.

BIOGAS: SOURCING ENERGY FROM WASTE

Swiss farmers also have a significant role to play in energy generation through methanisation and biogas production. Numerous biogas plants are already up and running in Switzerland: **Biogaz Mandement**, **Martin Biogaz**, **Duchli Ranch** and **Biogas Ticino** to name but a few. The Swiss Federal Office of Energy (SFOE) has published a map showing the GPS locations of the biogas plants that qualify for the feed-in tariff (FIT) scheme[9]. The full list of all of the country's biogas plants is also available on a map published on the Opendata website[10].

The biogas plant in Henniez (Canton of Vaud) is a good illustration of a collaborative project between farmers and other economic partners. The genesis of this project was the potential risk of the source of Henniez mineral water, operated by **Nestlé Waters**, being contaminated by the ammonia produced by excess agricultural waste. The company **Groupe E Greenwatt** was brought in to help build a renewable-energy biogas infrastructure next door to the Nestlé bottling plant. According to Nestlé, this plant now converts 25,000 tonnes of farm manure into green energy and fertilisers every year. A network of 27 Swiss dairy farms supplies the manure, which is mixed with coffee waste generated from the local Nespresso and Nescafé factories. When these materials break down, they produce natural gas, which is then combusted to generate electricity. The resulting power provides all the heat required by the bottling plant, and the excess electricity generated by the project is sold to the Swiss electricity grid. Since the biogas plant opened, the Henniez installation has seen its CO_2 emissions halved.

In another project, **Fireforce Technology** (Canton of Vaud) is developing a combustion process that provides a very clean, efficient way of converting biomass into heat energy. The quality or water content of the wood fed into the boiler does not have a significant effect on the amounts of fine particulates produced by combustion. In the longer term, this technology could become extremely useful for heating houses, and farms in particular.

Other businesses are generating energy from wood waste in pellet form. **Proxipel** (Canton of Vaud), which markets a mobile pelleting unit for use in the forestry industry, is one example. Many companies also sell the finished product, such as **Valpellets** (Canton of Valais), **Pellets du Jura** (Canton of Jura), **BestPellet** (Canton of Fribourg), **Bürli Trocknungsanlage** (Canton of Lucerne), **Braunschweiler Pellets** (Canton of Aargau) and **Lehmann Holzwerk** (Canton of St Gallen).

ERIC PLAN
General Secretary of CleantechAlps

Switzerland has a great tradition in agriculture and its capacity for innovation gives it a leading role in the development of agritech.

AGRICULTURAL WASTE AND BIOMASS: UNDERPINNING THE BIOECONOMY

The start-up **Bloom Biorenewables** (Canton of Fribourg) has developed an efficient chemical process that converts non-edible plant matter into products capable of replacing petroleum products. Its patented process makes use of lignocellulosic biomass, also known as LC biomass (wood and agricultural waste such as nutshells). The compounds synthesised through this process can be used to manufacture a wide variety of products such as plastics, resins, flavourings, herbicides, cosmetics and even pharmaceutical products (see page 95).

Also in the Canton of Fribourg, the Kera project coordinated by the **Plastics Innovation Competence Center** (PICC), in collaboration with **Micarna** and other industrial partners, is working on an alternative to plastic packaging made from chicken feathers. The region produces large quantities of this commodity, which is made up mostly of keratin (a protein) that the project intends to convert into a water-resistant polymer. Possible applications are injection moulding, for the manufacture of moulded parts, and compostable plastic films. By washing, grinding up and then chemically modifying the chicken feathers, the project scientists are able to recycle a waste product that would otherwise mostly have been burned or composted. The technology is still at the experimental stage, but could soon be exported all over the world.

Embion Technologies (Canton of Vaud) is also working on a biotechnological process which in this case uses hydrolysis to process agricultural LC waste. The resulting industrial enzymes can be used in an eco-friendly process that depolymerises cellulose and other carbohydrates. This technology accelerates the efficient extraction of bioactive ingredients to make commercial use of agricultural by-products and industrial residues that are currently just thrown away.

Based in Biel/Bienne (Canton of Bern), **Cormo** is developing a peat substitute from the rind of maize stems and cobs. Other Swiss businesses are putting more unusual agricultural residues to good use. One example of this is **NaturLoop** (Canton of Bern), which is turning coconut waste into construction panels. The panels are being developed in Switzerland and manufactured in the Philippines.

These examples are merely the first of a significant trend that is on the horizon with the development of the bioeconomy (the optimum exploitation of biomass), in which energy, molecules and raw materials, for example, can be 'harvested' from agricultural waste, replacing the conventional synthetic materials produced by the chemicals industry.

STÉPHANE FANKHAUSER
Founder of the Molondin Agropôle

A vision gives rise to a concept, but it is expertise and ambition that get the job done. At the Agropôle, we are developing a sustainable way to feed the world in the future.

IMPROVING ANIMAL HEALTH AND WELFARE

In 2019, the Food and Agriculture Organization of the United Nations (FAO) and Global Dairy Platform published the report 'Climate Change and the Global Dairy Cattle Sector'. This worldwide study identified improving bovine health as key to reducing the greenhouse gas emissions resulting from livestock farming.

Healthier animals are more productive and generate fewer emissions per unit weight of finished product. Improving animal health reduces the intensity of emissions and improves the effectiveness of the resources used by reducing mortality and boosting productivity and fertility. As a result, fewer animals are needed to meet demand. The positive association between improved animal health and both increased production and reduced emissions has been demonstrated for various diseases. Good animal health facilitates commerce and trading and makes it easier to adopt systems with low carbon emissions.

The FAO is helping to improve animal health around the world to step up the productivity and sustainability of livestock production. It is one of the worldwide partners of the One Health initiative[11], which is interested in the link between animals, humans and the environment.

Farmers and animal breeders are aware of the issues surrounding their livestock's welfare and quality of life. Technology, including agritech, can play a useful part here. One example of this is milking robots. In their most advanced form, these devices allow the cow to decide when it should be milked, entering and leaving the milking parlour when it wants to. In this way, the robot takes the optimum quantity of milk. This new technology makes a general improvement to animal health and welfare: the herds are less stressed, and this is reflected in an improvement in milk quality.

According to the trade publication UFA Revue, by early 2020, nearly 1,000 milking robots were in use on Swiss farms. These robots are manufactured by companies in the Netherlands (Lely), Sweden (DeLaval) and Germany (GEA).

In Switzerland, **Agolin** (see page 91) markets a product that not only reduces methane emissions from ruminants but also improves their digestion and welfare.

REDUCING CO_2 AND NOISE EMISSIONS

Air quality is something that affects everyone, but the farming industry also has to deal with the issues of greenhouses gases and noise pollution. A variety of technological solutions are on hand to help farmers in these two respects.

When it comes to reducing CO_2 emissions, turning to electrical machinery is one solution, and replacing helicopters and tractors with drones for some applications is in fact an improvement on both counts, resulting in a reduction in both emissions and noise pollution (see page 23). In Valais, the ValNature cooperative has launched a huge vineyard machinery electrification project, initially developing prototype sprayers and later electric tracked tractors. One sprayer is now being commercially produced by the Swiss company **Birchmeier**.

Agolin (Canton of Vaud) has developed a feed additive that reduces methane emissions from livestock. This product could be a game changer when it comes to the Confederation's 2030 Agenda and Net Zero Emission goals, given that livestock is the biggest single source of greenhouse gas emissions in the farming industry. This natural product aids the animals' digestion, which also improves their welfare (see page 91).

In Neuchâtel, the start-up **Infrascreen** is working on a new generation of thermal screens that reduce the amount of heating required in greenhouses. These screens result in lower CO_2 emissions from greenhouses, which are often heated using gas. With this system, emission reductions can be as high as 40%, while crop yields have been shown to increase by 15% (see page 89).

The **Beelong** indicator developed by EHL Hospitality Business & Hotel Management School in Lausanne is a way of evaluating the environmental impact of foods on a scale from A to E. The idea behind the scheme is to provide the restaurant industry and food buyers with environmental information about food products, enabling them to make better-informed choices. It is also a good way for farmers to promote the benefits of locally produced food, which is likely to achieve a better Beelong score than foods produced on the other side of world – particularly from the point of view of carbon emissions.

Staying on the subject of promoting the value of different foods, the Zurich-based company **Eaternity** has developed a nutri-score system that enables foodstuff producers to evaluate the environmental footprint of their products.

Companies like **Magic Tomato** in Geneva are working to make an impact locally by providing a home delivery service for orders placed with partners in their local network. This approach provides small-scale food growers with an additional short-circuit outlet for their produce, which has a positive impact on CO_2 emissions. Magic Tomato has plans to expand the concept to a wider area, possibly in the form of franchises to ensure that the concept remains local and carbon efficient.

COMBATING FOOD WASTE

Some elements of agritech provide ways to combat the scourge of food waste. **Agrosustain** (Canton of Vaud) is de-veloping a completely new kind of product that inhibits the growth of several kinds of pathogenic fungi and in some cases kills them – organically. This natural method, which is set to enter commercial production this year, is a way of limiting food waste. Supermarket retailers are interested in Agrosustain's claims that its product can extend the shelf life of fruit and vegetables by around a week (see page 81). Similarly, **Ozone.ch**, based in Le Locle (Canton of Neuchâ-tel), has developed a process that extends the sell-by date of fruit stock, thereby reducing spoilage rates.

Digital apps are another way to tackle the problem. In Switzerland, **Too Good To Go** connects retailers with consumers, offering unsold stock at reduced prices before it spoils. By the end of 2020, more than a million Swiss consumers had downloaded the app, with nearly 3,500 businesses (including supermarkets, hotels and bakeries) signing up.

The Bern-based company **Äss-Bar** has come up with the same idea, offering bakery products that haven't sold by closing time at knockdown prices, generally the day after baking. There are now Äss-Bars in St Gallen, Winterthur, Zurich, Lucerne, Basel, Bern, Biel/Bienne, Lausanne and Fribourg, selling their wares under the slogan «Freshly made yesterday».

The **UglyFruits** initiative markets unsold fruit and vege-tables in optimised, plastic-free packaging. It also promotes the idea of the short supply circuit, being the only interme-diary between producers and consumers, with customers managing their one-off or regular weekly orders online. More and more initiatives of this kind are springing up, creating a commercial outlet for the fruit that the super-markets don't want to sell.

Big data can also be a very useful tool in combating food waste. Making more and better use of statistical data is a way of raising awareness of this problem among retailers, farmers and consumers and also of improving food produc-tion planning.

Recently, other more original global initiatives have been launched. One of these is the **Falling Fruit** app, which iden-tifies fruit trees in towns and cities, enabling residents to go and pick them for free when the time is ripe, preventing the fruit from ending up rotting on the pavement.

Facts and figures

According to a recent study by WWF, out of 100 potatoes harvested in Switzerland, only 34 are actually consumed. Despite being perfectly edible, the other 66 are removed because they do not meet aesthetic or quality criteria. This waste is not specific to agriculture. It exists at every level of the production and consumption chain: cultivation, processing, sale and end consumption. According to figures produced in 2019 by the Federal Office for the Environment, no fewer than 2.8 million tonnes of food are wasted every year in Switzerland.

This equates to 330 kilos per person per year, or 37% of agricultural production, accounting for roughly a quarter of the greenhouse gases produced by Switzerland's food production industry.

ENCOURAGING FOOD TRACEABILITY

Ensuring the traceability of food from field to fork has a great many benefits – particularly for consumers, who get to know where their food comes from, but also for farmers, who can use it to create a closer connection with their end customers. Now possible through the use of digital applications, traceability enables farmers to manage their farms more efficiently.

The AGRO-TECH software provided by the Swiss Federal Office for Agriculture since 2000 is used by farmers to fulfil their legal agricultural traceability obligations. The app, available for smartphone and tablet, is a comprehensive management tool that is used to enter all sorts of useful data. Each module interacts with the other relevant mo-dules, preventing farmers from having to enter the same data more than once and saving them time.

Barto (Canton of Bern) has developed a digital farm solution that simplifies management, scheduling and reporting tasks for farmers. In addition, **Agridea** offers a broad range of software packages tailored to the requirements of all the different farming systems and sectors in Swiss agriculture (see page 83).

Xfarm (Canton of Ticino) is a platform developed by farmers for farmers to help them join the digital farming trend. This app simplifies farm data collection and analysis, reduces paperwork and ensures that agricultural products are traceable. It uses a combination of management software and sensors deployed on the farmer's land. The platform also features modules for financial management, crop and fertilisation planning, production line traceability, disease alerts, irrigation advice and farming weather forecasts (see page 93).

On an international level, two companies have joined forces to launch a large-scale pilot project. Swiss biotech multinational Lonza and start-up Authena (Canton of Zug) are working together to combat the use of counterfeit agrochemicals, which is very widespread in South America (20% of products sold) and Europe (10%). These counterfeit products are dangerous to human health, the environment and the crops themselves. The two companies have developed what is set to be one of the first blockchain-based digital technologies in the industry. This will provide not only proof of the authenticity of the chemical products being sold, but also full traceability and transparency throughout the value chain.

APPLYING THE PRECEPTS OF THE CIRCULAR ECONOMY

The connection between agriculture and the circular economy is a fundamental one: if a piece of fruit or a vegetable (organic matter) 'falls' from a tree or plant and is not collected, it remains on the ground, where it is broken down into nutrients by microorganisms. These nutrients enrich the soil. This natural process closes the biological cycle by providing the tree, plant or soil with the nutrients it needs to begin a new production cycle.

When put to use in agriculture and the food production industry, the circular economy is a way of applying this biological cycle more effectively. This can, for example, take the form of not incinerating food waste because this doesn't return the nutrients they contain to the soil. It also makes the most of the potential offered by organic matter through the bioeconomy (cascading use of resources).

What is the bioeconomy?

The bioeconomy is the name given to all economic activities based directly on the moderate use of biological resources. One principle of the bioeconomy is to maximise the use of renewable bioresources while taking into account the limits of agroecosystems. What this means in practice is applying circular organisation to agricultural production (re-using co-products, recycling waste and optimising energy flows).

The bioeconomy is thus about the economical use of the resources produced by the living world, such as farm waste, which can replace the conventional synthetic materials produced by the chemicals industry.

Organic matter can be returned to the soil at every stage of the food production value chain. The journey from field to fork results in losses of organic matter, some of which are more commonly referred to as agricultural by-products. In the production phase, this means the produce that remains in the fields. In the transformation phase, it means the different materials that result from the industrial preparation of a product, such as pulp, peelings and bones. In the use phase, the by-products are the food left uneaten on the plate or which goes off in the refrigerator. Re-using these by-products tends to extend the lifespan of this organic matter and lessen the environmental impact of the different processes.

There are many examples of this 're-purposing' in Switzerland. **Schweizer Zucker** (Canton of Thurgau) sells the pulp generated by its sugar beet processing method as animal feed. L'Union Maraîchère de Genève creates high-end food products from unsold local agricultural produce. Some Swiss farmers have adopted biomethanisation technology that enables them to generate energy and produce fertiliser from agricultural waste (see page 28).

This kind of 'recycling' constitutes a circular strategy that can be appended to a company's business model. It can, however, also be a business model in itself, as in the case of **Centravo** (Canton of Bern), which collects and recycles abattoir and butchery by-products (see page 28). The same is true of companies that process soil and compost products, such as **Ricoter** (Canton of Aargau).

AgriCo: a 100-hectare site in Saint-Aubin developing innovation in agriculture

AgriCo, the Swiss Campus for Agri and Food Innovation, is dedicated to creating value in agriculture, nutrition and the bioeconomy. This site is part of a complete ecosystem designed to foster innovation through synergies between private, institutional and academic stakeholders.
With 100 ha of agricultural land at its disposal for full-scale field trials, it also boasts a number of industrial sites, offices and laboratories which between them cover every development stage, from research to production and including precision fermentation and agriculture 4.0.
www.agrico.swiss

ENCOURAGING BIODIVERSITY

Biodiversity is essential for high-quality agriculture. In this context, the fate of bees, which are very important for pollination and a great many other things, is a matter of concern. Several Swiss companies are working on ways of halting the decline in bee numbers.

Vatorex (Canton of Zurich) has developed a system that varies the amount of heat in the hive as a natural method of controlling numbers of the varroa parasite, which threatens the survival of bees. This company is also developing a mobile app designed to facilitate the logistical and administrative work of beekeeping (see page 84).

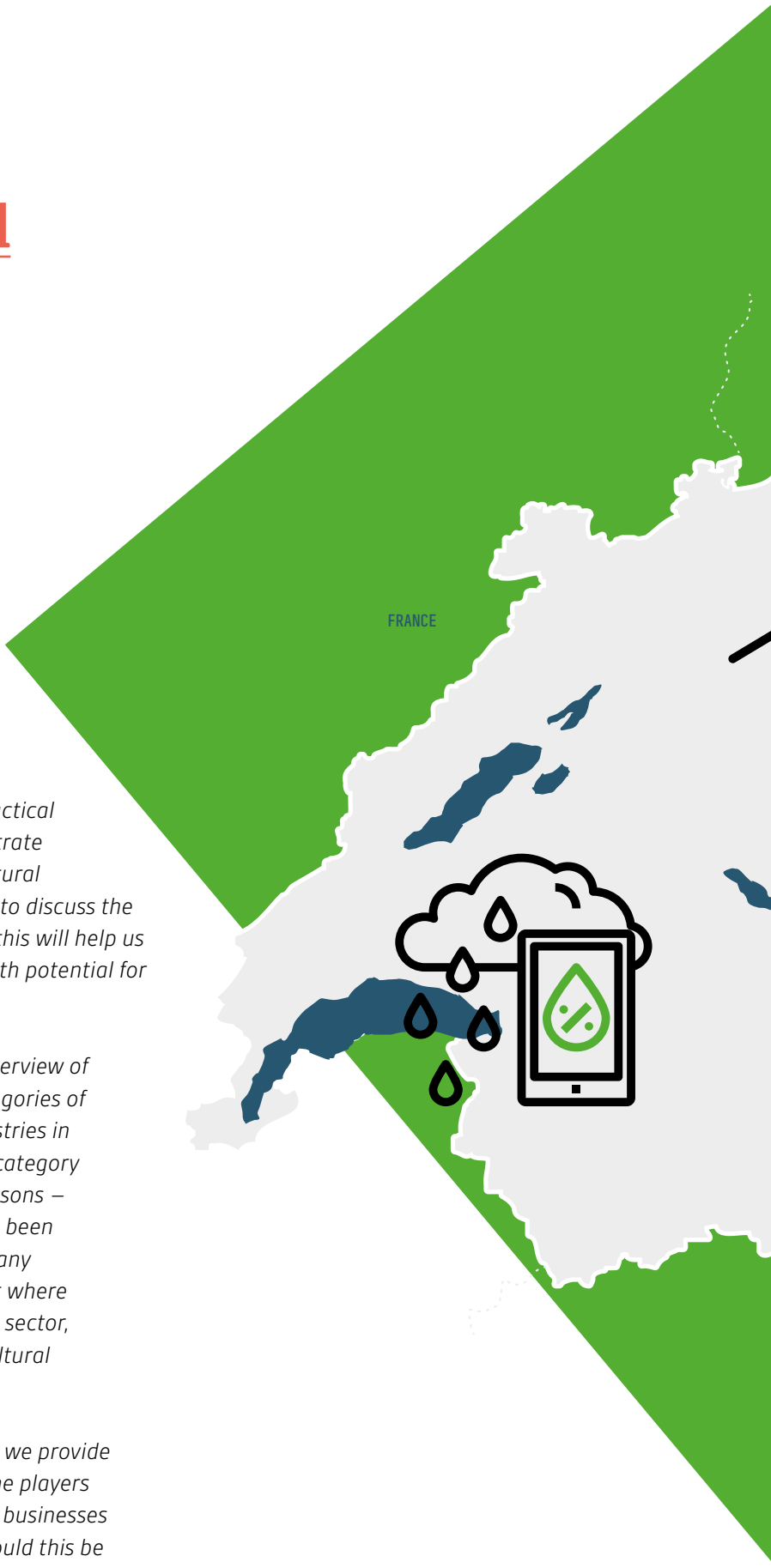
Apizoom (Canton of Fribourg) has produced another mobile app that detects and counts the number of varroas in beehives. Companies such as **CitizenBees** (Canton of Neu-châtel) are coming up with ways of enticing precious bee colonies back to urban areas too. CitizenBees is promoting apiculture on the roofs of business premises, with real-time monitoring of the bees' activity.

In the Canton of Valais, **DransEnergie** has also developed an app that connects beehives to the Web. Small solar panels on the beehive roof power a battery which operates an electronic weighing device, a mini-camera, and a server that transmits the images and information recorded inside the hive directly to the beekeeper's smartphone. There is even a sensor which counts the number of bees entering and leaving the hive.

The PrimalBee system developed by **BeeHelpful** (Canton of Ticino) reduces the need for physical involvement in the inspection, feeding and chemical treatment of bee colonies by up to 70%. This system not only cuts labour costs, it also reduces transport expenditure, because it is no longer necessary to travel repeatedly to different sites to inspect the bee colonies.

Bee Vectoring Technology, a Canadian company that has premises at AgriCo in Saint-Aubin (Canton of Fribourg), has found an effective and sustainable way to manage crops using bees. It has developed a system for controlling parasites and diseases by making use of these industrious little workers provided by Mother Nature. When the bees go out pollinating, they leave behind substances used for the targeted control of pests and diseases, which last all season (see page 80).

The agritech ecosystem and value chain in Switzerland



Although not exhaustive, the detailed list of practical examples provided in the previous chapter illustrate Switzerland's capacity for innovation in agricultural technology. In this chapter, we think it is useful to discuss the agricultural value chain in its entirety because this will help us identify its strengths, along with those areas with potential for improvement.

But first, we would like to present a systemic overview of the Swiss agritech ecosystem, showing the categories of players making up this ecosystem and the industries in which they operate. The major players in each category are explicitly mentioned, but – for practical reasons – individual businesses are not. It would not have been relevant to publish here an endless list of company names, and this is also problematic in a context where companies potentially belong to more than one sector, such as the preparation or processing of agricultural produce.

Instead, for each of the links in the value chain, we provide a summarising description of the activities of the players in that sector. This makes it easy to identify the businesses concerned and map their location by region should this be required.

The Agritech Ecosystem in Switzerland ▸
Source: CleantechAlps

CONFEDERATION

- OFAG
- OFEV
- OFSP
- OSAV
- SECO
- Innosuisse

EDUCATIONAL AND TRAINING INSTITUTIONS

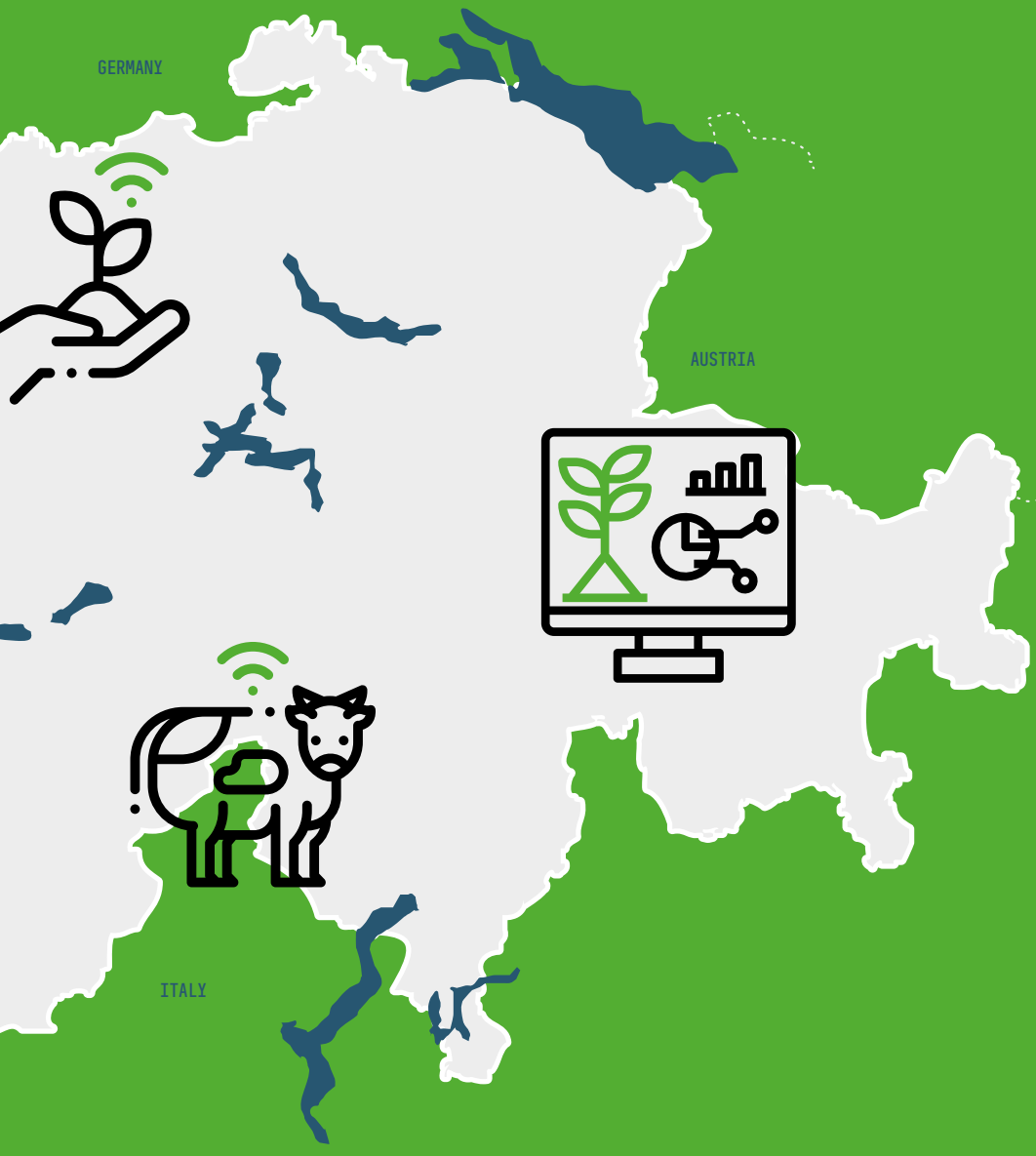
- EPFL/ETHZ
- Universities
- UAS, HEG, HEPIA
- Adolphe Merkle Institute
- Cantonal schools of agriculture (Vaud, Jura, etc.)
- Grangeneuve Agricultural Institute
- Cantonal Centre Bern
- Strickhof
- EIC - Changins School of Engineering
- cfpne Lullier vocational training school

COLLABORATIVE PLATFORMS AND NETWORKS

- Swiss Food Research
- NTN Innovation Booster - Swiss Food Ecosystems
- CleantechAlps

TRADE ASSOCIATIONS, FEDERATIONS AND UNIONS

- Federation of Swiss Food Industries
- swissgranum
- Swisspatat
- Chocosuisse
- Swiss Federation of Cereal Producers
- Fruit-Union Suisse
- Swiss Farmers' Union
- Swiss Vegetable Growers Association
- Interprofession de la vigne et du vin (Swiss winegrowers' and winemakers' association)
- Interprofession du Vacherin fribourgeois (cheese producers' association)
- etc.



INDUSTRY

- Start-ups
- SMEs
- Large companies
- Consultants

RESEARCH INSTITUTIONS AND TEST LABORATORIES

- Agroscope
- Swiss Future Farm
- FiBL - Research Institute of Organic Agriculture
- AgriCo
- Agropôle Molondin
- PhytoArk
- Swiss Center of Applied Underground Technologies
- Mediplant
- BlueArk Entremont
- Nestlé Research Center
- Wädenswil viticulture centre
- Cubic
- etc.

SUPPORT PROGRAMMES

- AgriPEIK
- Swiss Landscape Fund
- Fund for the Promotion of Forestry and Wood Research
- National sustainability action plan (PAN-RPGAA)
- Coordination platform for innovative projects
- Wood Action Plan
- Regional development projects
- NRP 73 Sustainable Economy

ASSOCIATIONS AND FOUNDATIONS

- AGRIDEA
- Food & Nutrition Cluster
- Swiss Food & Nutrition Valley
- Swiss Society for Food Chemistry
- IP-Suisse
- Swiss Society for Nutrition
- Swiss Society for Food Hygiene
- Swiss Society of Food Science and Technology
- Swiss association of agricultural and food engineers (svial)
- Agro-Marketing Suisse
- SwissGAP
- AgroCleanTech
- etc.

PUBLIC/PARAPUBLIC PLAYERS

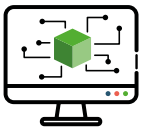
- Municipalities
- Cantons
- Switzerland Global Enterprise

SWITZERLAND GLOBAL ENTERPRISE (S-GE), SUPPORTING SWISS SMES INTERNATIONALISE AND FOREIGN COMPANIES TO BECOME ESTABLISHED

Switzerland global enterprise (S-GE) the official export and investment promotion agency of Switzerland, present in all of Switzerland and in more than 27 countries, supporting Swiss SMEs, especially cleantech companies with international business development and helping innovative internationally active companies become established in Switzerland. Providing value to customers and creating prosperity for Switzerland through a unique national and global network of partners.

EXPORT PROMOTION

Working on behalf of the Swiss Confederation, represented by the State Secretariat for Economic Affairs (SECO), S-GE uses its expertise in internationalisation to help Swiss companies, especially SMEs, identify and develop new business potential on a worldwide basis. It provides regular information about relevant trends in the global markets, as well as professional advice and support in finding contacts and partners, and identifying new business opportunities.



SWISS CLEANTECH COMPANY DATABASE CUBE

This database of Swiss cleantech companies, known as the Cleantech CUBE, is a basis for communicating services and for promoting companies both in Switzerland and abroad. Registration is free. www.s-ge.com/cube

INVESTMENT PROMOTION

As part of its remit from the Swiss Confederation and the cantons, S-GE provides potential foreign investors with information about Switzerland as a business location. Its services for foreign companies include assessing the potential of their projects before they are presented to the cantons. S-GE assists the cantons with the relocation of foreign companies, providing market and trend analyses and coordinating the activities of all the bodies involved.

SWITZERLAND GLOBAL ENTERPRISE

enabling new business

www.s-ge.com/cleantech

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ONE Sustainable Fund – Global Environment

ONE CREATION Coopérative

BCV - Certificat Tracker AMC EcoCircularity

CONINCO
Explorers in finance

Certified B Corporation

Supervisé par la FINMA depuis 2012

Vevey | Genève www.coninco.ch

ONE Sustainable Fund - Global Environment et Europe Dividend sont des fonds communs de placement de droit luxembourgeois. La société de gestion est FundPartner Solutions (Europe) S.A. Le gérant du fonds est CONINCO Explorers in finance SA - Quai Perdonnet 5, CH-1800 Vevey – qui est soumise à une surveillance prudentielle de l'Autorité Fédérale de Surveillance des Marchés Financiers (FINMA). Les documents du fonds tels que prospectus et contrat, rapports annuels et semestriels sont disponibles et peuvent être obtenus gratuitement sur simple demande auprès du gérant. ONE CREATION Coopérative est une personne morale de droit suisse ouverte à tous les investisseurs. Le BCV - Certificat Tracker AMC EcoCircularity est un produit structuré qui n'est pas un placement collectif au sens de la LPCC et n'est donc soumis ni à autorisation, ni à la surveillance de la FINMA. L'investisseur supporte de surcroît un risque d'émetteur. Ce certificat est activement géré de manière discrétionnaire et dynamique. Cette publicité ne constitue pas un conseil en investissement. Les performances du passé ne sont pas une garantie pour les résultats futurs.

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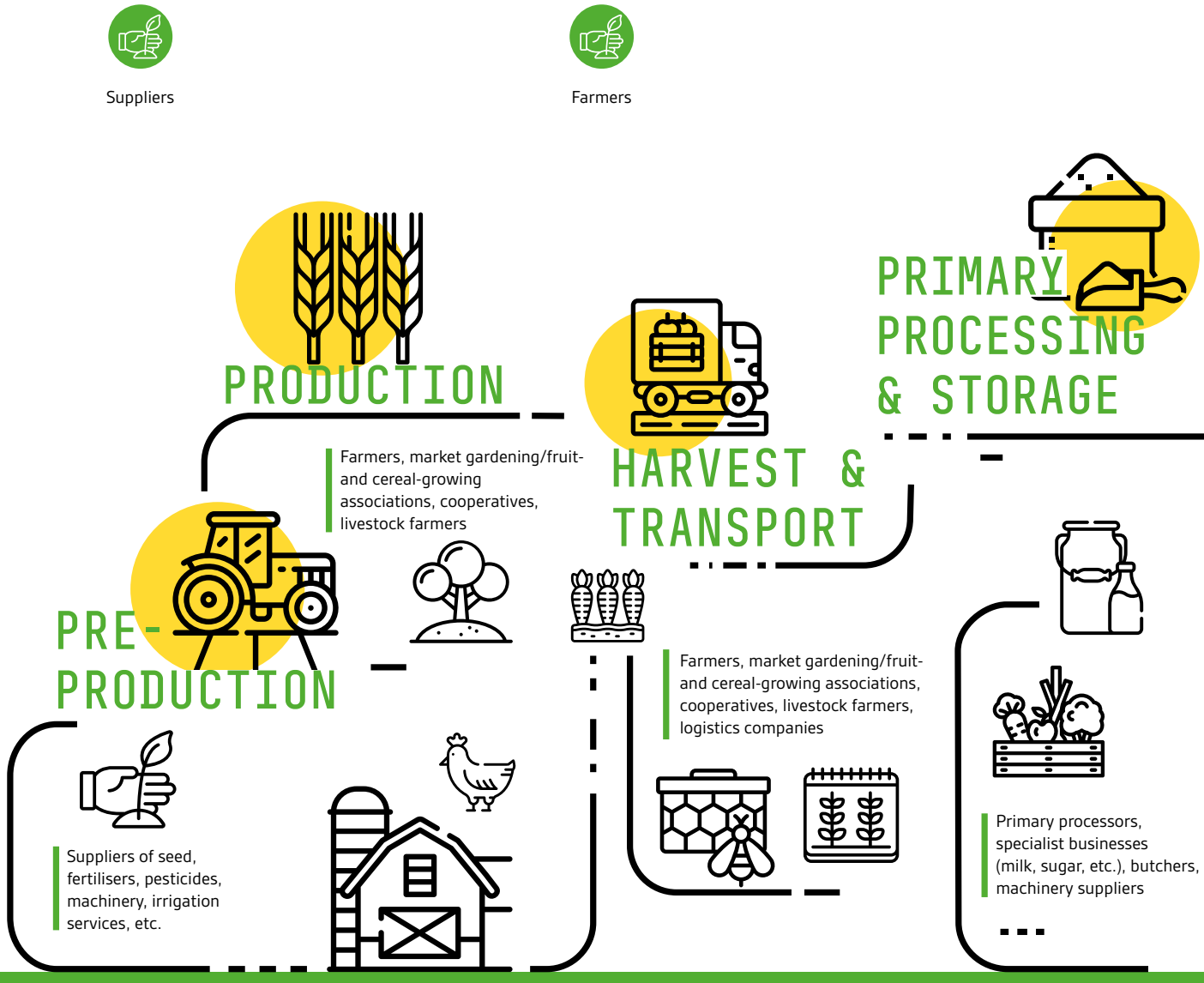
THE AGRICULTURAL VALUE CHAIN

The global agricultural value chain has changed little in recent decades. It comprises four major steps:

- production (the core activity of farmers)
- processing (preparation of products)
- commercialisation (including packaging and logistics)
- the end user or consumer

To take into account the impact of digital technology and measure the contribution made by agritech, we have updated this schematic representation of the agricultural value chain by drawing on practical experience in the field and a number of complementary viewpoints garnered from a review of the literature.

Some commentators divide this value chain into two parts, with agritech upstream and food tech downstream. Others, like AGFunder, talk of an 'Agri-FoodTech' value chain, which equates to the global agricultural value chain, only couched in more up-to-date language!



The Figure 2 below shows different stages of this agri-cultural value chain, with the categories of main players described according to the conventional viewpoint.

Figure 2
The agricultural value chain showing the types of players and businesses involved
Source : CleantechAlps inspired by: A.T. Keaney analysis, Sofies, Researchgate.net, AGFunder

Legend:

Value chain in **green** *and yellow*

Positioning *of stakeholder categories for each stage* | Households, restaurants

Agricultural *actors in this value chain*

As we have seen, this sector is undergoing a significant evolution, driven in part by digitalisation. New players operating in activities in the pre-production category are coming onto the market, developing equipment and solutions that enter the chain upstream of their use by the farming industry. The activities of these players no longer fit into the current categorisation, however. AGFunder classifies agritech into 15 categories (see Figure 3 below).

1

AG BIOTECHNOLOGY
On-farm for crop & animal ag including genetics, microbiome, breeding, animal health.

2

AGRIBUSINESS MARKETPLACES
Commodities trading platforms, online input procurement, equipment leasing.

3

BIOENERGY & BIOMATERIALS
Non-food extraction & processing, feedstock technology, cannabis pharmaceuticals.

4

FARM MANAGEMENT SOFTWARE, SENSING & IOT
Ag data capturing devices, decision support software, big data analytics.

5

FARM ROBOTICS, MECHANIZATION & EQUIPMENT
On-farm machinery, automation, drone manufacturers, cultivation equipment.

6

MIDSTREAM TECHNOLOGIES
Food safety & traceability tech, legistics & transport, processing tech.

7

NOVEL FARMING SYSTEMS
Indoor farms, aquaculture, insect & algae production.

15

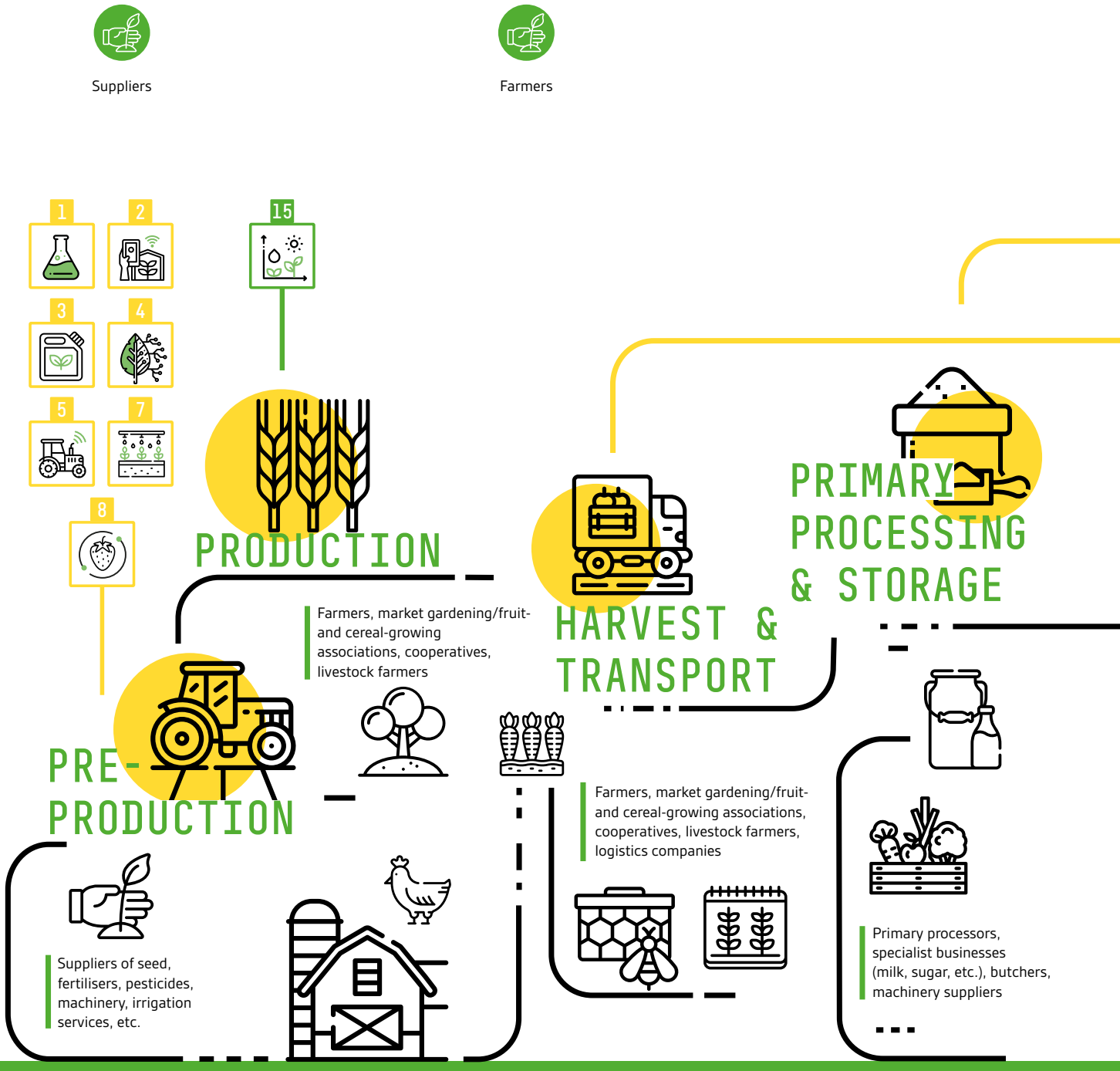
MISCELLANEOUS e.g. fintech for farmers

Figure 3
The different categories of agritech
Source : AGFunder

When these categories are placed in their positions on the agricultural value chain, it becomes apparent that the new activities that belong to these categories mostly occur at the two ends of the chain, with the exception of the two activities that belong to the agri-food processing industry. The only new activity located in the chain link that relates to the core business of farmers is in new finance solutions to help fund the acquisition of the new equipment developed for farming. Interestingly, no activity concerns the core activity of farmers directly.

In other words, the farming sector is isolated, stuck in the middle between the new production solutions and the new commercial exploitation and sales solutions for agricultural products.

Despite the core position that the activities of farmers occupy in the agricultural value chain (in the production and harvest chain links), farmers are in danger of having even less room for manoeuvre in the future if they do not become involved in the developments already under way.



Up to now, they have been under constant pressure from the supermarkets, which has led to an almost systematic fall in margins, accompanied by a gradual loss of independence. With the advent of agritech, this situation is in danger of occurring once again, hence the necessity for farmers to remain abreast of the developments taking place at both ends of the value chain and to seize the many and varied opportunities that this new technology has to offer.

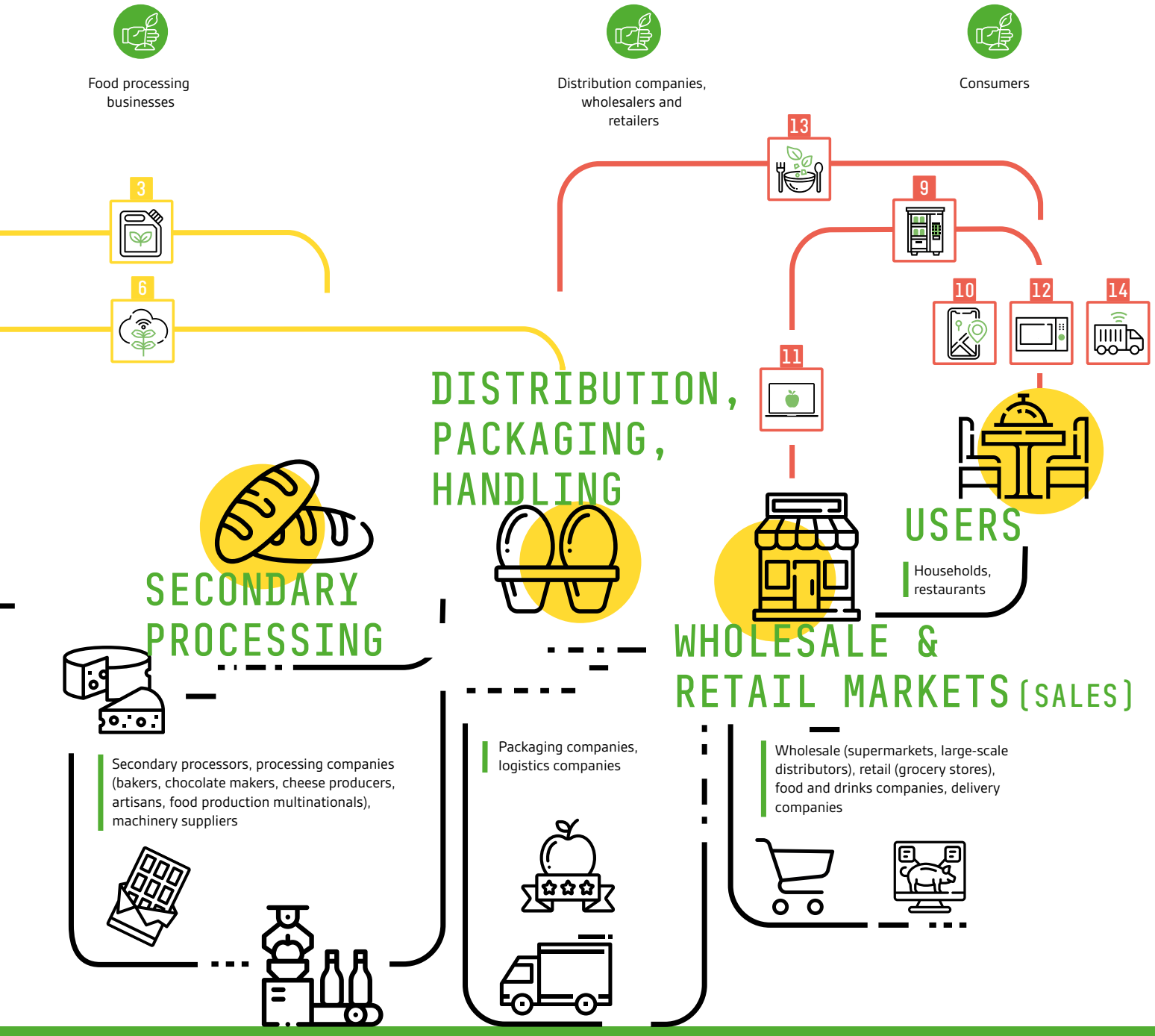
Figure 4
The position of the agritech categories on the agricultural value chain

Legend:

Value chain in **green** *and yellow*

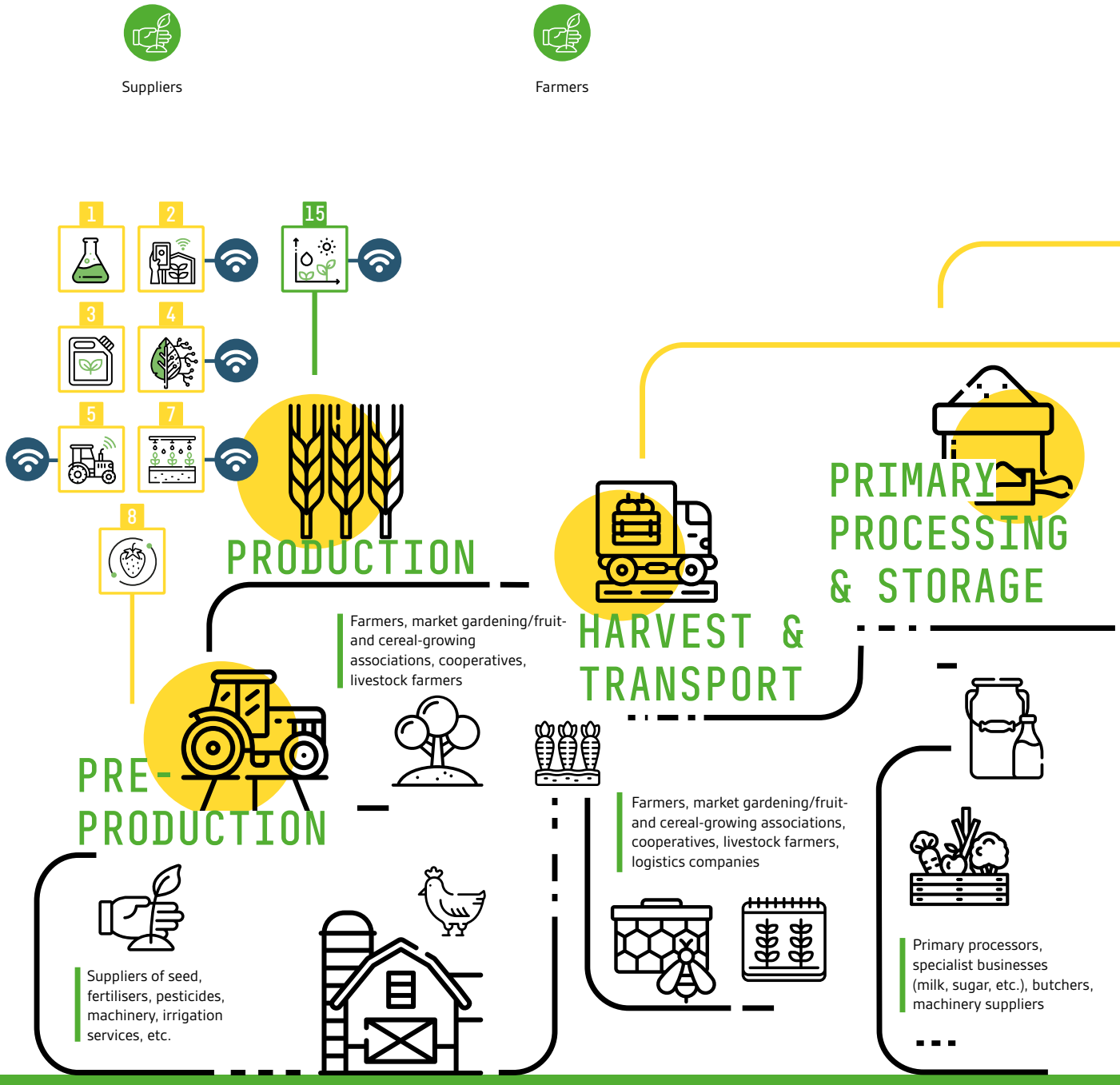
Positioning *of stakeholder categories for each stage*

Agricultural *actors in this value chain*



Some farmers are already doing this very successfully, through farm markets and by producing traditional local produce. This helps them expand their activities to the right of the value chain to reach the end customer and keep in touch with the evolution of consumers' day-to-day requirements. This enables them to anticipate new requirements, satisfy those requirements and potentially increase their margins. One example of this is the development of the «Terroir Fribourg» concept, a practical response by the Canton of Fribourg to this issue, rolled out across the region to ensure it has the desired impact and reaches critical mass. It seems likely that other regions will follow suit in the future.

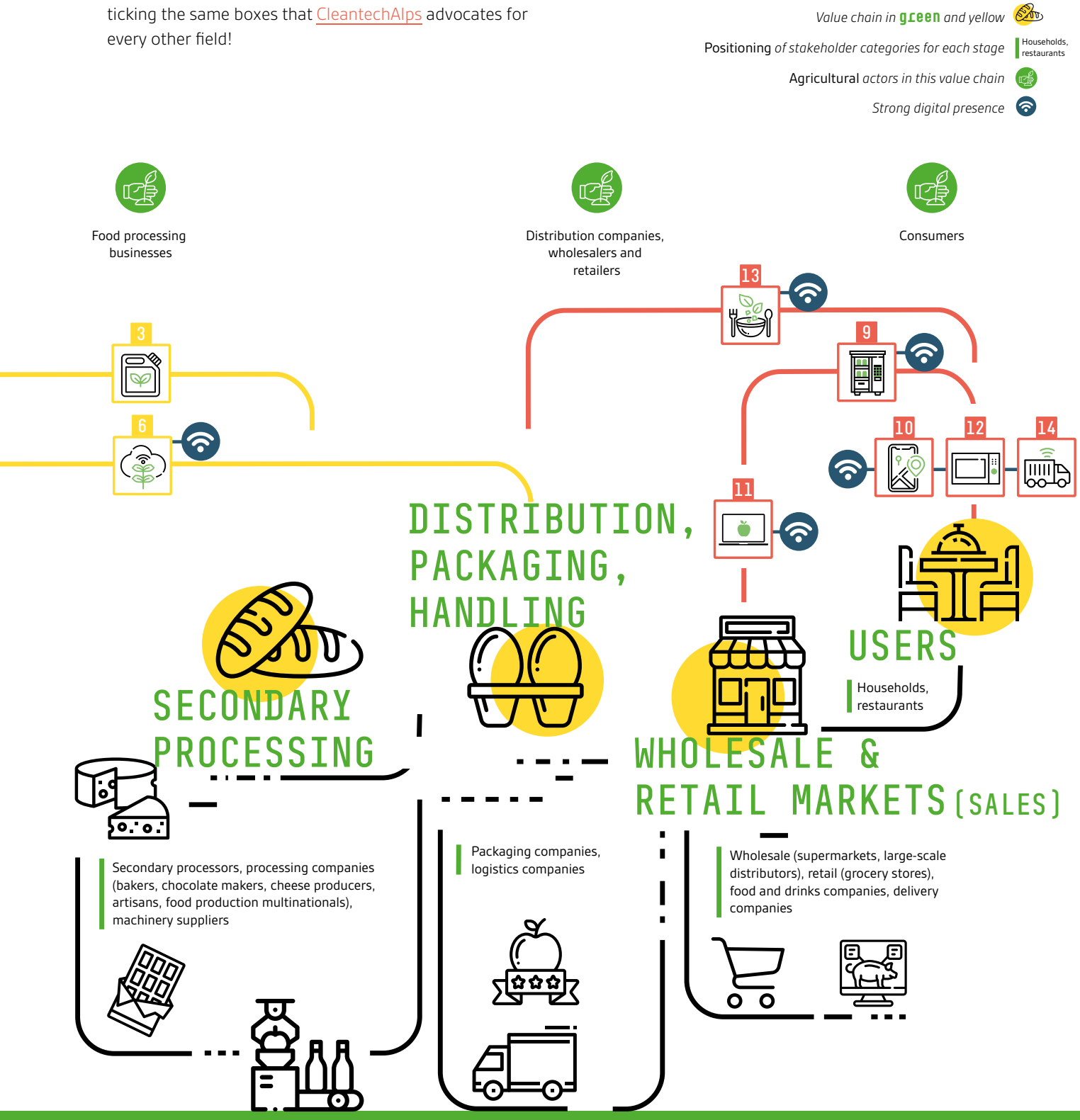
Centres of innovation, where pilot programmes and new applications are developed and then trialled, form an essential part of this ecosystem. These places provide a forum for exchange and discussion that create a kind of partnership with farmers, allowing them to stay abreast of developments in products and equipment and have a say in their development. In this context, it is essential that the players in the farming industry get into the habit of regularly mixing with their colleagues in these centres. The Canton of Fribourg is exemplary in this respect, boasting sites such as Grangeneuve Agricultural Institute in Posieux and AgriCo in Saint-Aubin.



It is essential that farmers come together with the developers of future solutions to ensure that the equipment and applications they develop fulfil an actual requirement, providing the functionality they actually need out in the field and not a host of unnecessary options that will inevitably make the end product more expensive than it could be. In agritech, as in cleantech in general, the maxim needs to be: cheap and robust, but with a Swiss finish. In short, future products must be the Swatches of the agritech world, ticking the same boxes that CleantechAlps advocates for every other field!

Let us return now to our analysis of the value chain, with a view to identifying new agritech-related activities.The following Figure 5 shows the categories with a strong digital component.

Figure 5
The presence of digital technology throughout the agricultural value chain



It is immediately apparent that all of the new activities at the end of the chain are based on or at least incorporate a significant digital element. This is not true to the same extent on the left of the value chain, in terms of the development of new equipment and management and analysis systems. This observation does, however, require qualification, since all of the new production, management and planning systems do include a significant digital technology element. The activities less dependent on digital tech are related to biotechnology and the exploitation of biomass, regardless of their ultimate destination, which can be in the healthcare/pharma, food production or energy sectors. This leads directly to the issue of biosourced components from the bioeconomy.

The Figure 5 above unequivocally highlights the importance that the concept of smart farming is acquiring for the farming industry, and above all its impact on the entire value chain. This again points to the necessity of providing training and exchange platforms such as the **Swiss Future Farm** in the Canton of Thurgau, which describes itself as the only experimentation hub in agricultural digitalisation of its kind in Europe.

The idea behind the **Grangeneuve** training centre in the Canton of Fribourg is to anticipate the evolution of the agricultural sector by providing a dedicated infrastructure capable of teaching, testing and developing different technologies that meet the requirements of the users in a particular sector. The national centre of excellence for raw milk, due to open on the Grangeneuve site at the end of 2021 (see page 78), is a prime illustration of this.

The players in agricultural innovation and research in Switzerland

Various associations, institutions and foundations are making agricultural innovation a priority. Together with the country's research and development institutes, these players are doing an excellent job of helping farmers who are keen to innovate or make use of agritech.
In this chapter, we describe the main initiatives in the field.

INSTITUTIONS CONDUCTING RESEARCH AND SUPPORTING INNOVATION

ADOLPHE MERKLE INSTITUTE

This institute, attached to the University of Fribourg, is an independent research centre for nanoscience and materials science. Some of its work relates to agriculture, such as the development of nano-fertilisers, which are designed to do away with pesticides.
www.ami.swiss

AGRICO (SAINT-AUBIN)

This campus, owned by the Canton of Fribourg, is dedicated to creating value in the fields of agriculture, nutrition and biomass. The site's unique remit covers every stage of the development process from research to food production. AgriCo has use of around 100 hectares of farmland, plus space to expand to accommodate future innovative projects.
www.agrico.swiss

AGROSCOPE

The activities of Agroscope, Switzerland's national centre of excellence for agricultural and food production research, are applicable to the food production industry's entire value creation chain. Its role is to develop a competitive, multifunctional farming industry that produces high-quality foods and ensures healthy eating without harming the environment. The work carried out at Agroscope is a combination of research, advising political bodies and implementation tasks, along with knowledge exchange and technology transfer. The institute also conducts fundamental research focused on practical applications while working directly with industry players. It has 12 research sites in Switzerland (including the Swiss Future Farm). Through its research programmes, Agroscope focuses on identifying future challenges in Swiss agriculture and food production and coming up with appropriate smart farming solutions that have the potential to improve Swiss competitiveness without compromising the role of people in agriculture.
www.agroscope.ch

AGROPÔLE (MOLONDIN)

With farmland for field trials and 35,000 m2 of industrial development land, the Agropôle campus is home to industry players, service providers and innovators working to bring forward tomorrow's sustainable solutions.
www.agropole.ch

BLUEARK ENTREMONT

An innovation hub developed jointly by The Ark Foundation, ALTIS and the municipalities of Bagnes, Bovernier, Sembrancher and Vollèges, BlueArk Entremont specialises in the sustainable and smart management of water, and more broadly the environment. BlueArk is also the originator of the BlueArk Challenge, a call for open-innovation projects aimed at solving the challenges facing water management, such as irrigation, flooding, drought and the management of the bisse irrigation channels. It is also behind the Smart Water event, a forum for discussion and innovative smart water management solutions.
www.blueark.ch

CUBIC INNOVATION CAMPUS (ST GALLEN)

The research carried out on the Bühler group's innovation campus focuses on the more efficient and sustainable use of technology in the food production industry.
www.buhlergroup.com

EPFL GEODETIC ENGINEERING LABORATORY (LAUSANNE)

This laboratory's main activity is in the field of geomatic engineering. Based on the science of geodesy, geomatic engineering – one of the key information technologies of the 21st century – includes the acquisition, modelling, analysis and management of spatial reference data. This data is used in a wide range of applications such as land surveying, positioning and navigation, and also digital imaging, surface scanning and other remote sensing techniques, and more generally for database input in geographic information systems (GISs).
www.epfl.ch/labs/topo

ETHZ – INSTITUTE OF AGRICULTURAL SCIENCES (IAS) (ZURICH)

The mission of the Institute of Agricultural Sciences is to promote the creation and dissemination of knowledge about agricultural ecosystems and their complex interactions between the environment and human society. This equips us to meet current and future challenges and ensures the long-term sustainability of the agricultural production and associated food systems required to feed the world.
www.ias.ethz.ch

FIBL (FRICK)

The Research Institute of Organic Agriculture (FiBL) was established in 1973, moving to its current base in Frick (Canton of Aargau) in 1997. FiBL is one of the most respected organic agriculture research institutes in the world, employing some 200 specialists. The institute's strengths lie in the way it closely overlaps its different research fields and rapidly transfers the knowledge gained from its research to extension activities and practical applications. FiBL's expertise in a variety of fields is also in demand outside Switzerland, and the institute participates in numerous international projects in not only research but also extension programmes, continuing vocational training and development cooperation.
On its Swiss site in Frick, FiBL has a winery with its own wine cellars, along with orchards, a farm and a restaurant, all operating under organic farming rules. In 2016, it opened a division for French-speaking Switzerland in Lausanne.
www.fibl.org

FOOD & NUTRITION CLUSTER (FRIBOURG)

This cluster's mission is to support innovation initiatives by combining expertise in food production and processing with know-how in nutrition, health and emerging technologies while embracing sustainable development and respect for the local environment.
www.clusterfoodnutrition.ch

FOOD ECOSYSTEM INSTITUTE (FRIBOURG)

The mission of the Food Ecosystem Institute at Fribourg School of Management is to help the entire food ecosystem to join the Industry 4.0 era and establish sustainable development strategies.
www.heg-fr.ch

GRANGENEUVE AGRICULTURAL INSTITUTE (POSIEUX)

Grangeneuve provides basic and degree-level education and professional development training. It also focuses on extension activities, consulting, applied research and agricultural and para-agricultural testing. By the end of 2021, Grangeneuve will be the home of the national centre of excellence for raw milk.
www.fr.ch/grangeneuve

HES-SO VALAIS-WALLIS (SION)

The Life Technologies Institute is part of the HES-SO Valais-Wallis School of Engineering. The institute's missions include applied research and development (aR&D), service provision and continuing vocational training. It works with SMEs operating in the food production and cosmetics industries, conducting a large number of research projects in these fields. The institute also has a research group that specialises in food microbiology and food safety, bioactive compounds and the processing of natural food products.
www.hevs.ch

INSTITUTE LAND-NATURE-ENVIRONMENT (GENEVA)

The research carried out at the Institute Land-Nature-Environment (part of the Geneva School of Engineering, Architecture and Landscape) relates to the fields of agronomy and environmental management. Its cross-sectional and multi-disciplinary research in these areas focuses on the management, conservation and sustainable economic exploitation of ecosystems and their resources and on optimising agricultural systems to protect water and soil resources and life.
www.hesge.ch/hepia/en/rad/intne

MEDIPLANT (CONTHEY)

Established in 1988, Mediplant is a research and development centre that focuses on the commercial uses of aromatic, medicinal and cosmetic plants. It works closely with farmers and farming cooperatives, offering a tailored service, from domestication and cultivation to the development and production of extracts.
www.mediplant.ch

NESTLÉ RESEARCH CENTER (NRC)

NRC contributes to progress in science and technology, from fundamental research in health and nutrition to applied research in product development.
www.nestle.com/randd/news/allnews/nestle-strengthens-its-research-capabilities-in-switzerland

PHYTOARK (CONTHEY)

PhytoArk is a technology park for companies whose core business is the commercial exploitation of natural ingredients. It provides a home for start-ups, service companies and manufacturing SMEs that produce high-added-value products for the ingredients, cosmetics, food, health-and-nutrition and plant-based pharmaceuticals industries. PhytoArk's facilities include a managed technology platform for the development and pre-industrial production of natural ingredients. It also manages a collection of alpine plant extracts used for R&D purposes. The site has close links with mountain agriculture, specifically all aspects of the use of aromatic and medicinal plants, including new applications and processing to make herbal sweets and teas.
www.phytoark.ch

SCAUT - SWISS CENTER OF APPLIED UNDERGROUND TECHNOLOGIES (ST GALLEN)

SCAUT uses its Underground Farming concept study as the basis for research into the use of underground spaces to produce food, working with interested parties in the food and agricultural sectors. The ecological aspects – such as short supply routes, the recycling economy and optimising production conditions – play an important role here.
www.scaut-association.com

SCHOOL OF AGRICULTURAL, FOREST AND FOOD SCIENCES HAFL (BERN)

HAFL conducts teaching and research in the agricultural, forest and food sciences, connecting people, nature and technology to promote sustainable development. Its applied research deals with the issues facing these fields now and in the future.
www.bfh.ch/hafl

SCHOOL OF VITICULTURE AND OENOLOGY (CHANGINS)

This school is unique in Switzerland in that it is a national centre of excellence in higher education in the viticulture, wine and arboriculture professions. It includes a Viticulture and Oenology degree programme delivered by a university of applied sciences, a school of viticulture (Ecole supérieure de technicien-ne vitivinicole) and a wine school, which provides adult education courses. The school conducts applied research and development projects in close collaboration with the wine-growing and oenology sectors.
www.changins.ch

SIB SWISS INSTITUTE OF BIOINFORMATICS (LAUSANNE)

SIB is a not-for-profit academic organisation whose mission is to direct and coordinate bioinformatics in Switzerland. The institute's data science experts work towards the common goal of advancing biological and medical research and improving healthcare.
www.sib.swiss

STRICKHOF (LINDAU)

Strickhof is a department of the Canton of Zurich's Office of Landscape, Agriculture and Environment. It is a centre of excellence in the fields of agriculture, food, and home economics, running classes and training courses and making its expertise available to a wide range of professionals, mainly in the fields of agricultural technology and digitalisation.
www.agrovet-strickhof.ch

SWISS FOOD & NUTRITION VALLEY (LAUSANNE)

This association, founded by the Federal Institute of Technology in Lausanne (EPFL), EHL Hospitality Business & Hotel Management School in Lausanne and the Canton of Vaud, uses cutting-edge science and technology to investigate the major sustainability challenges of the future in the food and nutrition sectors. It is working to develop and strengthen the existing innovation ecosystem in precision agriculture, packaging science, waste reduction, food processing, and nutrition, organising events in Switzerland and abroad and attracting talent, start-ups and investment to the region.
www.swissfoodnutritionvalley.ch

SWISS FUTURE FARM (TÄNIKON)

Coordinated by Agroscope, the Swiss centre of excellence for agricultural research, Swiss Future Farm occupies an 81-hectare site that provides the only experimental platform of its kind in Europe to focus on IT in agriculture.
www.swissfuturefarm.ch

SWISS VITAMIN INSTITUTE – ISV (EPALINGES)

ISV boasts unique expertise in vitamin analysis, focusing on two research and development strands: analysis of vitamins and other compounds of physiological importance and establishing vitamin reference values to reflect the vitamin status of populations in modern societies. In this context, the institute is particularly interested in new vitamin formulations in veterinary care.
www.swissvitamin.ch

VETSUISSE FACULTY (BERN)

The research carried out by the Vetsuisse Faculty at the University of Bern aims to further our knowledge of animal diseases and processes that spread or prevent diseases, develop approaches designed to improve animal health and welfare management, study animal welfare, explore public health and societal issues and exploit the potential of animal disease models in biomedical research.
www.vetsuisse.unibe.ch

WBZW WÄDENSWIL VITICULTURE CENTRE

The Weinbauzentrum is the centre of excellence in viticulture for German-speaking Switzerland. WBZW, which has been operating as a public-private start-up since 1 January 2018, focuses on applied research and finding practical solutions to current problems in the winegrowing-winemaking sector.
www.weinbauzentrum.ch

WORLD FOOD SYSTEM CENTER (ZURICH)

Created on the initiative of the Swiss Federal Institute of Technology in Zurich, the World Food System Center supports multi-sectional and cross-disciplinary approaches to meeting the food industry's future challenges. The centre's remit includes research, education and public awareness initiatives aimed at helping to ensure sustainable food and nutrition security.
https://worldfoodsystem.ethz.ch

ZURICH UNIVERSITY OF APPLIED SCIENCES ZHAW (WÄDENSWIL)

The University of Applied Sciences in Zurich (ZHAW) includes an institute that specialises in environmental and food production systems, focusing on sustainability in food systems, regional development and tourism. The institute works with the different agricultural sectors in modelling new approaches and innovations aimed at sustainably transforming environmental and food production systems.
www.zhaw.ch

PROGRAMMES AND NETWORKS SUPPORTING INNOVATION IN AGRICULTURE

AGRIQNET

The purpose of this national platform is to provide financial support for sustainable, innovative agricultural projects in Switzerland to increase their added value for the farms concerned. To qualify for support, projects must be of a strongly innovative nature and must focus on the priority areas of quality and sustainability.
www.agriqnet.ch

AGROCLEANTECH

Comprising an association and a public limited company, AgroCleanTech manages the AgriPEIK programme, which supports energy efficiency in agriculture. The association is a platform designed to act as an intermediary and a source of information on energy efficiency, renewable energy and combating climate change in agriculture. The public limited company develops incentive programmes in energy efficiency and climate protection.
www.agrocleantech.ch

COORDINATION PLATFORM FOR INNOVATIVE PROJECTS

Set up by the Federal Office for Agriculture (FOAG), this platform provides funding for preliminary studies for innovative projects to help organisations interested in initiating quality projects that meet the objectives and instruments of Switzerland's agricultural policy.
www.blw.admin.ch

FUND FOR THE PROMOTION OF FORESTRY AND WOOD RESEARCH

This fund, financed by the Confederation (Federal Office for the Environment) and Cantons, supports research and development projects that help improve the competitiveness of Switzerland's forestry and timber economy.
www.bafu.admin.ch/whff

NATIONAL ACTION PLAN FOR THE CONSERVATION AND SUSTAINABLE USE OF PHYTOGENETIC RESOURCES IN FOOD AND AGRICULTURE (PAN-RPGAA)

This tool, managed by the Federal Office for Agriculture (FOAG), is designed to promote the preservation and sustainable use of diversity in plant varieties important to agriculture. PAN-RPGAA takes the form of projects conducted in collaboration with different organisations operating at regional or national level.
www.blw.admin.ch

NTN INNOVATION BOOSTER - SWISS FOOD ECOSYSTEMS

The Fribourg-based association Suisse Agro Food Leadinghouse, which includes the Food & Nutrition Cluster and Swiss Food Research, was recently awarded a four-year funding package by Innosuisse to run a national thematic network (NTN Innobooster) in food production. The main topic covers various fields:

- Commercial exploitation of biomass
- Smart nutrition
- Efficient use of resources
- Circular economy
- Sustainable packaging

www.swissfoodresearch.ch

NATIONAL RESEARCH PROGRAMME 73 (NRP 73)

This programme covers all the natural resources, includes every stage of the value chain and incorporates an exhaustive study of the environment, economy and society. NRP 73's current agriculture-related projects include those relevant to the following topics:

- **the nutritional and environmental impact of food consumption in Switzerland**: Working with databases on global nutrition composition, food consumption, trade and life cycle analysis, these projects are designed to develop specific, fact-based processing ideas.
- **digital innovations for sustainable agriculture**: an interdisciplinary team at the Federal Institute of Technology (ETH) in Zurich is studying the technological, agronomic and socioeconomic factors that enable the use of innovative information and communication technology to foster sustainable agriculture in Switzerland.
- **the interaction between economics and ecology in Swiss agricultural businesses**. This project looks at the internal processes in agricultural businesses, conducting an ecological and economic analysis of each business's different branches, in other words the areas of the business that have specialised in various products. The information obtained from this study will help make Swiss agriculture more sustainable.

www.nfp73.ch

OQUADU - PROMOTING QUALITY AND SUSTAINABILITY IN THE FOOD SECTOR

The ordinance on the promotion of quality and sustainability in the agro-food sector (OQuaDu) provides financial support for innovative projects that have a positive influence on the sustainability or quality of farm produce and increase its agricultural added value.
www.blw.admin.ch

REGIONAL DEVELOPMENT PROJECTS (RDPS)

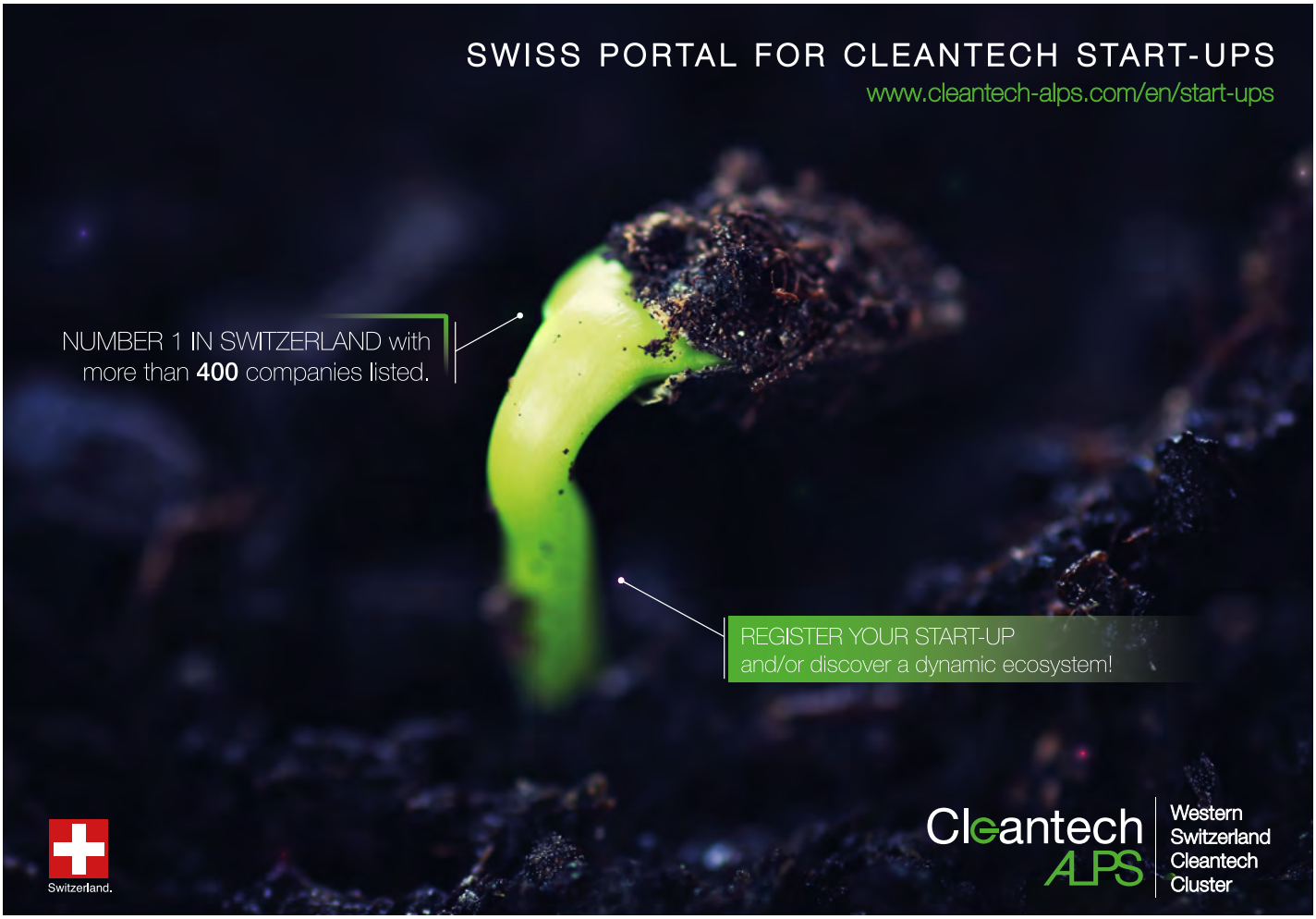
Coordinated by the Federal Office for Agriculture (FOAG), these projects bring together ideas from regional interest groups that contribute to the promotion of rural development. The main objective of each RDP is to create added value in agriculture through regional collaboration and improving farm incomes.
www.blw.admin.ch

SWISS FOOD RESEARCH (ZURICH)

The Swiss Agro-Food Innovation Network contributes to innovative projects from concept through to market launch. Its main role is to provide finance to plug funding gaps, thereby preventing ideas and projects from failing prematurely.
www.swissfoodresearch.ch

WOOD ACTION PLAN

This plan is designed to implement the Confederation's wood resource policy. Launched in 2009, it supports projects relating to wood as a commodity and wood processing.
www.bafu.admin.ch



WESTERN SWITZERLAND'S

INNOVATION CLUSTERS

+

4 DYNAMIC & VIBRANT ECOSYSTEMS

- alp.ict — info & digital technologies
- BioAlps — life sciences
- Cleantech ALPS — clean technologies
- MICRONARC — micro & nano technologies

SUPPORTED BY

Taking things further: the main future trends

In this chapter, we propose to take things one step further, analysing the main trends that will shape farming and agricultural technology in the near and more distant future. Our aim here it not to venture into the realms of science fiction but to look at some of the experimental pilot programmes currently taking place in Switzerland and further afield which are trialling technology that could catch on in the future.

WILL AI BECOME UBIQUITOUS?

Artificial intelligence (AI) is currently still little-used in farming. The first robots developed by **ecoRobotix** are already using AI to pick out and kill weeds automatically. But the potential of technology driven by big data is vast. AI can increase yields by drawing on parameters such as the climate, the condition of the seed and soil, the irrigation level and the risk of disease. It can tell farmers what to plant and when and where to plant it, which plants to monitor and when to harvest them.

In the Netherlands, **Connecterra** has developed AI that helps dairy farmers monitor the health and welfare of their herds. The company fits cow collars with a sensor, which records data that is then processed using complex algorithms. After analysis, the results are sent to the farmer in the form of information that is easy to understand and act upon.

The Israeli start-up **Tastewise** specialises in forecasting food trends. The company uses AI to process billions of pieces of information taken from restaurant menus, online recipes and food posts on social media to provide real-time data, analyses and food trend forecasts. Using this information, producers can make informed decisions about which food to produce.

ARE ROBOTS READY TO TAKE ON MORE COMPLEX TASKS?

At the Consumer Technology Association trade fair CES in Las Vegas in 2020, a tractor sporting sensors at the front and rear was presented to the world for the first time. Using GPS positioning and images transmitted in real time by a drone, this tractor is able to harvest only those parcels of land that require it. In the future, machines will plough, plant and pick in our fields – in short, they will work the fields autonomously while their urbanite human counterparts sit at computer screens designing them.

Also at CES in 2020, Switzerland presented the world's first robotic raclette scraper – the Roboclette, which serves up the traditional Swiss melted-cheese dish. It was developed by a research group led by the Idiap Research Institute in Martigny (Canton of Valais). Showcasing of this kind is a good way of getting the farming industry and agricultural products talked about, particularly by the younger age groups. It also raises awareness about the place that robots may well have in our society in the future.

Robots are thus a development that will prove significant in agriculture too. According to the US-based market intelligence and consulting firm **Tractica**, the worldwide market for agricultural robots is set to grow exponentially, from three billion dollars in 2015 to 73 billion dollars by 2024.

Driverless tractors and farm machinery are becoming an increasingly common sight all over the world. In the United States, **Harvest CROO Robotics** has developed a robot that helps strawberry growers pick and package their product. The Florida-based company even claims that one robot can do the work of 30 people. Using AI technology, robots may soon be able to free farmers from repetitive and/or difficult tasks, in particular in parts of the world where labour costs are high.

In Israel, **Tevel** has developed autonomous drones that use AI to pick fruit. These 'flying pickers' have a mecha-nical grabber that will not only harvest fruit but also thin and prune fruit trees. This robot uses special algorithms to detect and categorise not only different kinds of fruit, but leaves and other harvestables too. It also collects data about the quality and quantity of the fruit growing on each tree in the orchard.

In a similar vein, the San Franciscan company **ImpactVision** uses hyperspectral imaging to help food producers quickly evaluate the quality of their products to prevent waste in the supply chain. Using ultra-high-definition images, it is able to acquire information undetectable by the human eye, such as the quality of the interior and chemical composition (indicators of the maturity, firmness, shelf life of food products, etc.). By analysing this data, scientists are working on ways of improving the processing of foods throughout the supply chain.

With an annual turnover of more than CHF 3 billion, the **Bühler** group in Uzwil (Canton of St Gallen), which originally built a reputation on its food processing machines, is at the cutting edge of research in image processing and big data. For example, Bühler's scientists can recognise each individual grain of rice in an installation processing 15 tonnes of it every hour. This technology is used to identify, in real time, any toxins in the rice grains during the sorting process. AI is becoming increasingly common in all kinds of technologies used in packaging both food raw materials and processed products.

In Monthey (Canton of Valais), **REM Analytics** has developed a unique technology called Advanced Testing for Genetic Composition (ATGC), which uses electrophoresis combined with bioinformatics and statistical modelling to determine the genetic make-up of foods. This paves the way for new approaches to certifying the origin of foodstuffs and detecting commercial fraud, including passing off genetically modified organisms. This technology goes one step further by making it possible to analyse the soil microbiome to optimise the yield and quality of crops. ATGC technology can also be used to detect the presence of pathogens in foods, guaranteeing food safety at each stage of product processing.

In the Netherlands, **AgroCares** has developed a range of tools that can monitor and instantly analyse nutrients in soil, foods and leaves, and also in insects. The company manufactures digital devices that farmers can use to collect data in the field and receive personalised recommendations for the best way to manage their farmland.

Robotisation and automation (which are closely linked to AI) are also being adopted by the food production sector. The major industrial groups are already developing the new trends in this field. One example is the **Nespresso** production facility in Romont (Canton of Fribourg), which incorporates an impressive amount of automation and robotisation. This is a vast subject which would justifiy a special report of its own. The digitalisation of the processing and packaging of agricultural and food products will step up conventional ways of automating production lines, heralding the advent of the food production industry 4.0.

ARE FARMS SET TO START USING HYDROGEN?

New propulsion technology is also starting to be adopted in the agricultural industry. In 2020, China's first electric tractor powered by (hydrogen) fuel cells was launched by the National Institute of Agro-machinery Innovation and Creation in Luoyang. With the development of clean energy, we can speculate that Swiss farms may soon be equipped with tractors of this type… providing they can hold their own against the robots and drones that they will be competing with.

WILL WE SEE OPTIMISED FARMS IN CITY CENTRES?

Urban agriculture, which sometimes makes use of aquaponics and vertical farms, is set to continue to grow (see page 26), and we are likely to see increasing numbers of these resource-maximising, futuristic farms in the coming years.

At the same time, the major industrial groups are also becoming interested in farming. In October 2019, the US giant **Microsoft** announced it was making a 1.5-million-dollar investment in the 'Grand Farm' project, a development in North Dakota designed to become a hub for innovation. New technology, including AI, will be used in arable and livestock farming there, with an evaluation of its success due by 2023.

In the Netherlands, **Kipster** is building revolutionary bird- and environment-friendly poultry farms designed around the instinctive behaviour and needs of the chickens. Kipster's farms are energy-positive and produce the world's first carbon-neutral eggs.

Lastly, the Pittsburgh-based start-up **Fifth Season** has pledged to create a «magical greens experience» through a combination of robotics and vertical farming, saying goodbye to conventional seasonal farming. Its controlled-environment farming method eliminates the uncertainties inherent in conventional agriculture, growing fresh, local vegetables throughout the year.

WILL PRODUCTION LIVESTOCK BE REPLACED BY INSECTS?

With the growing global population, demand for proteins is set to continue to grow. As a result, insect farming is becoming an increasingly common trend, with the practice of entomotechnology emerging in several countries. This is the science of farming insects fed on food residues to produce a protein-rich food source for both humans and animals. In Switzerland too, this trend is starting to catch on, thanks to businesses like **Lowimpact food** (Canton of Fribourg) – which recovers co-products from local beer breweries and fruit juice manufacturers to feed the edible insects it farms –, **Essento Food** (Canton of Zurich) and **TicInsect** (Canton of Ticino).

There are many examples beyond Switzerland's borders, too. The French start-up **Ÿnsect** has been operating a pilot vertical insect farm in France since 2016. The venture has proved a success, and with global demand growing, the company plans to build the world's biggest vertical farm, producing 100,000 tonnes of insects a year. The protein-rich mealworm beetles farmed by Ÿnsect are used to make animal feed, and their droppings are recycled into organic fertiliser used on farms – an eco-friendly alternative to chemical fertilisers.

Also in France, way back in 2014, **NextAlim** set up a pilot industrial plant near Poitiers to farm black soldier fly larvae, which are fed on waste before being turned into agricultural feeds and fertilisers. This method could also help meet the growing demand for protein to feed the planet, based on the circular economy model.

Alternative proteins are one of the fastest-growing segments of the food industry. A study by Meticulous Research found that laboratory-grown vegetable protein and other non-conventional proteins are set to become a 17.9-billion-dollar industry by 2025. This growth in the market is largely down to demand for healthier and more sustainable alternatives to foods of animal origin. The challenge now is to develop foods that meat eaters will find acceptable. The Boston-based start-up **Motif FoodWorks** uses fermentation to make plant-based foods that are not only a good source of essential proteins and nutrients but have also met with consumer approval in terms of flavour and eating expe-rience.

WILL LOCALLY SOURCED PRODUCE AND SHORT-CIRCUIT SUPPLY GAIN THE UPPER HAND?

With the current move towards a more sustainable and resilient society and economy, short circuits that commercialise locally grown produce are set to take over from the conventional marketing approach. It is difficult to say where the balance will be struck, but what is certain is that, in this new competitive environment, the Fribourg area is already several steps ahead.

WILL BLOCKCHAIN TECH BE USED IN FARMING TOO?

Blockchain technology, used – among other things – to make transactions in financial and other commodities secure, may also prove to be a very good fit with the farming industry. The first trials are already under way. The French start-up **Connecting Food** uses new technology including blockchain to ensure that the transactions carried out by the players operating in the food sector are bona fide and to provide consumers with reliable, transparent information.

The fledgling company has developed **LiveAudit**, a digitalised auditing module that guarantees the reliability of information about not just a random sample but the entire production, 24 hours a day and seven days a week. This solution also enables Connecting Food to assist farmers with the process of certifying their food products.

WILL FOOD PRODUCTION AND BIOTECHNOLOGY COME TOGETHER?

The core business of **BluAct** (Canton of Zurich) is using new materials for the commercial exploitation of agricultural by-products. The Swiss Federal Institute of Technology Zurich spin-off has taken a milk by-product and turned it into a membrane that purifies water. Whey (the residue from cheese making) is rich in proteins. BluAct extracts the fibrils (tiny fibres) from these proteins to build the membrane. When combined with active charcoal, this membrane can filter heavy metals such as mercury and arsenic out of water.
The company is working on other applications too, such as precision fermentation and alternative proteins.

DR. CHRISTOPH CARLEN
Head of the 'Plant Production Systems' Strategic Research Division at Agroscope

Digitalisation improves research performance and makes it possible to develop and optimise decision-making tools and robotics for agriculture.


741.74
119.63
762.7
667.43

Expert views

As we have seen in the previous pages, agricultural technology is a vast subject. To open up the debate and the range of possibilities even wider, we talked to two professionals working in different industries and fields. They are both active in areas directly related to agritech, and here they give us their views on the subject.

3 questions for...

JEAN-MARC CHAPPUIS

Assistant Director of the Swiss Federal Office for Agriculture (FOAG), holds a PhD in agronomy and since 2018 has headed the Knowledge Systems, Technology and International Affairs Directorate. Before joining FOAG's senior management team, he was agricultural policy advisor to Federal Councillor Johann N. Schneider-Ammann.

Mr Chappuis, because of its long tradition, people tend to think that the agricultural industry is set in stone. How much room is there for innovation in farming, and what role do you see it playing?

Agriculture has a reputation for being conservative. But that doesn't mean it's set in stone; far from it. In recent decades, agriculture has repeatedly shown that it can be flexible. It has undergone considerable change, particularly in the development of agricultural policy. Innovation has always been part of agriculture, in areas such as the use of new machinery, the introduction of new varieties and the development of new marketing channels. The introduction of new technology, such as autonomous machinery, also provides us with ways of reducing the impact of farming on the environment while fulfilling its primary function, which is to produce food.

What are the main challenges facing the agricultural sector for 2025?

Climate change is the major challenge; well, it's two challenges really. On the one hand, agriculture must adapt to the changes that are taking place, such as recurrent droughts, and on the other it must play its part in reducing greenhouse gases. Farming has taken over much of this country's land and has a big influence on our ecosystems. We need to reduce the negative effects of exploiting our resources, such as loss of biodiversity and the excessive use of pesticides. Producing more, but in a more targeted way, while reducing our input – that's the objective.

Which cleantech technologies are the most promising for Swiss farming?

Smaller machinery is certainly set to play an important role in the future. This includes things like drones, which can distribute fungicides more easily and accurately. These days, robots can carry out spot spraying, which uses a fraction of the herbicides normally used in market gardening, and some can pull weeds out mechanically. Small smart devices reduce the energy consumption of farms. The tremendous advances in digitalisation have enabled us to make progress in production, processing and distribution, mainly by generating, exchanging and facilitating the application of new knowledge.

3 questions for...

MATTHEW ROBIN
CEO of the ELSA-MIFROMA group

What are the key elements or instruments, for example in terms of innovation, that will enable Switzerland's farming and food production sector to start adopting high-added-value integration?

Every business faces the necessity of accessing complementary technologies that will help them adjust their concepts to reality. This is the same for any industry whose purpose is to generate added value. The farming and food production sectors benefit from access to the research and development infrastructure provided by our universities, R&D centres and analytical and evaluation methods, for example. We have also seen how our established home-grown industry is open to new partnerships and experimenting with new concepts. The federal and cantonal authorities can support this by providing networking opportunities, financial stimuli and a base infrastructure, encouraging dialogue and establishing forums for exchange.

The Covid-19 crisis has demonstrated the importance of controlling the value chain and of short circuits. What drivers do you have at your disposal to promote a more integrated approach?

Controlling the value chain and having direct contact with suppliers and consumers are an integral part of the Migros model. The Migros-Industrie companies are keen to maintain healthy, long-term relationships with their agricultural raw materials suppliers for products such as milk, cheese, meat and flour and with the manufacturers that make our packaging in Switzerland and abroad. During the Covid-19 crisis, a small number of production and logistics chains struggled with the sudden explosion in demand for staples all over Europe. In our case, our established processes, good communication and mutually trusting relationship with our partners saw us through. We work hard not only to strengthen these relationships, but we are also actively committed to working towards a circular economy. When it comes to sustainability, we have a clear roadmap of where we want to be by 2040.

Agritech has a bright future. How do you explain the high concentration of agritech in your region?

Western Switzerland has a long-standing food production tradition. While other parts of the country focus more on pharmaceuticals, chemistry or watchmaking, for us it's agritech. It's simply a case of 'birds of a feather flock together'. We already have the know-how and infrastructure to support new businesses that can complement what we do here. An experienced labour force, career development opportunities, industry-specific services in the region, and an industry-friendly political environment: all these things sway the choices a business makes when setting up in a particular region.

Summary and conclusion

In agriculture, technology – and digitalisation in particular – must not be an end in itself. It is only worth pushing for the integration of agritech if farmers, along with their counterparts in related sectors, are able to reap the benefits.

Nevertheless, as we have seen in the pages of this special report, technology clearly has a part to play in agriculture. Moves towards adopting this technology are already under way, and the new approaches being developed are all promising avenues and opportunities for the agricultural industry and farmers of the future.

The sector faces some big challenges, and we are already seeing a major shift in consumer behaviour – in consumption patterns, for example. It is vital that we engage with the issues arising from these advances in technology and society so that we can better position the sector and those who operate within it.

Technology does cost money, however, and making the investment pay off in the medium term is not always easy. But Switzerland must remain at the leading edge of innovation in this field and not wait for all the solutions to filter through from abroad. Development by locally grown businesses that share Switzerland's agricultural culture and mentality is important in ensuring continuity of growth in the farming industry. This must look to the use of technology, not just wherever this can lighten the load for farmers, but also where it will give them a clear competitive edge in terms of protecting our environment and natural resources.

Using pesticides more smartly and sparingly, deploying non-polluting machinery and lighter equipment to reduce soil compaction wherever possible, aligning production to future-proof products that generate lower CO_2 emissions… these are just some examples of the task that lies ahead. These laudable intentions can become the new reality without discarding the Swiss agricultural know-how and culture that has fed the nation thus far.

Profiles of agritech businesses and institutes

This is where we get down to the nitty gritty! A number of Swiss businesses and institutes are working hard from day to day, coming up with clever innovations in the field of agriculture. We thought it important to include details of some of these remarkable initiatives, even if, regrettably, we do not have the space here to provide an exhaustive list. You can read about them in the following pages.

LÉGUMES PERCHÉS

Urban farms are the future

The company Légumes Perchés (which could be translated as Vertical Vegetables) designs and creates food-growing spaces on rooftops, between apartment blocks and in school playgrounds – projects that don't just feed the local population but also raise awareness about growing our own food.

The disconnect between urban life and farming, along with the vast amount of food wasted – food that is often produced outside our towns and cities – were the two things that made Thomas Verduyn, co-founder and director of Légumes Perchés, take the plunge with his new venture at the end of 2017. Just over three years later, the association has become a start-up. Légumes Perchés is not only bringing greenery to buildings and biodiversity to urban areas, it is also responding to increasing demand for 'edible spaces', places to grow food, from residents, developers and local councils. As a result, urban orchards and kitchen gardens – most of them above ground and there to generate edible produce – have sprung up across whole districts and even towns. «Each space can produce several kilos or perhaps tonnes of fruit and vegetables every year,» says Verduyn.

In 2020, 17 projects were started up in French-speaking Switzerland, including three rooftop gardens on buildings in the new 650-dwelling OASSIS development in Crissier (Vaud). The young team running Légumes Perchés (average age 26) includes an agricultural engineer, a nutritional psychologist, a permaculturist and a geoscientist. Thomas Verduyn himself has a degree in political science and a Master's in information systems.

SUPPORTING PROJECTS FROM PLANT TO PLATE

Winner of the 2020 Prix SUD, this Lausanne-based start-up provides technical and educational support for food-growing projects and the people running them throughout the project process. Légumes Perchés is there to help not just when a project is getting off the ground (literally), but also by organising planting, harvesting and produce preparation workshops. «We hold cooking sessions on rooftops, in school playgrounds and at community centres.» These projects are therefore all about getting local communities involved and providing fertile ground for future ventures.

Since growing plants in urban environments means off-ground cultivation, one focus of Légumes Perchés' work is creating local soils by building up layers of the materials required to obtain a well aerated, light substrate capable of holding back running water – to limit the amount of drinking water used for watering. The start-up is also taking part in a European project involving private individuals and businesses, led by the Geneva School of Engineering, Architecture and Landscape. «The idea is to attach sensors to the plants that will give us real-time information about their requirements and weaknesses. This will enable us to act before there's a need for preventive methods, which usually involve the use of fertilisers. In the longer term, we want to try out this approach in the urban environment.»

LÉGUMES PERCHÉS
www.legumesperches.ch info@legumesperches.ch

JNJ AUTOMATION

High-tech help for cheesemakers

JNJ automation designs and manufactures machines for processing and packaging cheese. The company is based in Romont in the canton of Fribourg, where it was founded, and is among the few companies in the world to offer this type of equipment.

Industry 4.0 in the bioeconomy: the robots developed by JNJ automation can handle around 120 cheese wheels an hour (15,000 a week) during the cheese maturation process. They lift the rounds off the slow-cured spruce shelves, turn them over and brush them before putting them back. What's more, the company produces the most compact model on the market, small enough to squeeze into the old and often cramped cellars used for cheese production. The product catalogue also contains scissor-lift platforms, shelf-handling carts, slicing machines, pot washers and wrappers.

The Managing Director of JNJ automation, Sébastien Jaquier, hopes to pass on his passion for manufacturing machines that «cosset the cheeses». In 2017, he abandoned the pyramidal management hierarchy and moved to an empowering company culture, in order to give each of the 80 employees a greater voice in the business. «We want to instil a spirit of commitment and collaboration in this family business,» he says. And there is no shortage of either ideas or work. In February 2021, JNJ moved to larger premises to house the extra production machinery needed to meet increasing market demand.

BIG EXPORTS AND LITTLE COMPETITION

JNJ automation is the undisputed world leader in its field because it is practically the only one to offer this type of high-added-value machinery. There are two other companies in Switzerland that offer similar equipment, but only one is particularly active. «Wherever you are in the world, if you are looking for a robot of this kind on the internet, you'll come across us or one of these two competitors,» says Jaquier. From Romont, the company exports just over 60% of its production to France, England, the United States and Canada. However, the emerging market is Russia, with investors ready to finance complete processes (farms, cows, dairies, cellars and marketing). In Switzerland, JNJ mainly equips small dairies, local cheese cooperatives and independent maturers.

A TURNKEY SOLUTION

Customers can also avail themselves of the skills of alisys SA (an architectural practice specialising in constructing dairies and cheese factories) and Sugnaux SA (builders and installers of dairy and cheese-making equipment – tanks, presses, pipes, etc.), also members of the JNJ Group SA holding company.

JNJ AUTOMATION
www.jnj.swiss info@jnj.swiss

ECPF

Finding innovative ways to step up land development

By establishing the Cantonal Land Development Agency (ECPF), the Canton of Fribourg now has an organ dedicated to acquiring, managing, developing and making available sites and buildings for economic activity, particularly in the field of agritech.

Under the cantonal legislation on active land policy (LPFA) passed in 2019, the Canton of Fribourg now has an instrument for developing sites with economic potential that it previously lacked. «Fribourg has developed very quickly, with a number of clusters springing up,» explains Corinne Rebetez, ECPF's Coordination and Communication Manager. «But this has not been followed by the provision of infrastructures, particularly for the many SMEs present in the canton, and we currently have a shortage of land and buildings in suitable locations becoming available within the required time frames.» This is where the six staff members working at ECPF come in. Their job is to apply the active land policy adopted by the Canton, obtain an overview of the situation, identify the strengths and advantages of the different zones available and develop and manage the strategic sites.

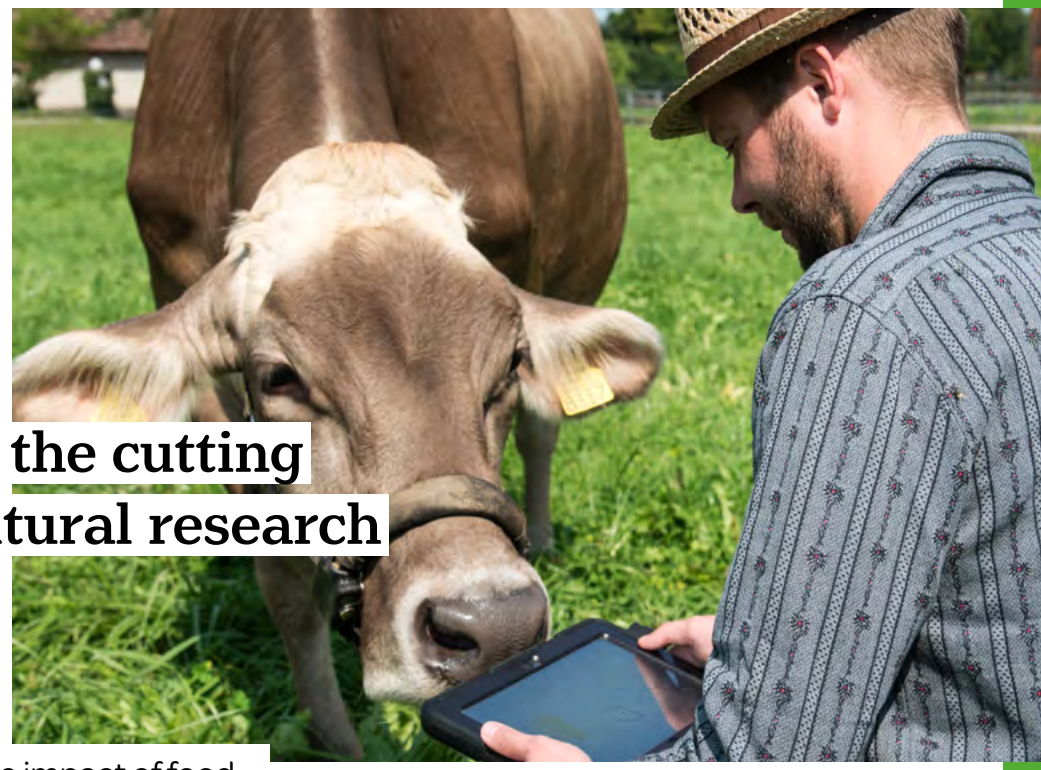
FOCUS ON AGRITECH COMPANIES

One of ECPF's responsibilities is to manage the land and buildings recently acquired by the Canton on the Romont, Marly and Saint-Aubin sites. The last of these is home to the AgriCo campus and focuses on agritech. «It is the most advanced of the three sites, working to create value in the fields of agriculture, nutrition and biomass by providing a unique space.» The site is designed to cover every stage of the development process, from research to food production. The industrial building plots, administrative buildings and laboratories there are close by a million square metres of agricultural land stretching across on the Broye Plain that is suitable for large-scale trials.

ECPF's role is also to promote synergies between private, institutional and university partners, chiefly the Grangeneuve and Agroscope agricultural institutes. A number of projects are already up and running on the Saint-Aubin site: the start-up Alver – one of the first to begin operating on the site – develops vegan food products containing a protein-rich microalga; Amarella is developing high-quality macaroons made from Swiss-grown natural ingredients; and Lowimpact Food recovers co-products from local beer breweries and fruit juice manufacturers to feed the edible insects it farms. By 2034, the site is expected to provide 1,600 jobs. Administratively, ECPF is attached to the Ministry of Economic Affairs of the Canton of Fribourg.

ECPF
www.agrico.swiss info@ecpf.ch

AGROSCOPE



Switzerland at the cutting edge of agricultural research

Food safety, hygiene and the impact of food on nature and human health: these are all areas of research carried out at Agroscope. Working with farmers and food producers, the centre is also inventing the food of the future.

Food is a key industry that lies at the heart of many sustainability issues, both in ecological and health terms. Because we should consider not just the food we eat, but also how this food is produced. This is precisely where the research at Agroscope comes in, covering a broad spectrum that takes in both the environmental aspects of food production and how food consumption affects our health. Working closely with agricultural players, in particular the whole of the dairy and cheese industry, the centre's main mission is knowledge transfer. Its aims? To preserve our resources and help create a better quality of life. One area of expertise developed by Agroscope is in raw milk products and their various health benefits and risks.

«Food – and therefore farming too – has a direct impact on our environmental footprint,» says Fabian Wahl, Head of Food Microbial Systems Research at Agroscope. «The research we carry out is also relevant to the pandemic, because changes in the food we eat can have a direct effect on our immune system.»

WHAT PROTEIN FOR THE FUTURE?

Another challenge for farmers is providing high-quality protein without harming the environment. The meat-based products we currently produce obviously have a considerable impact, both in terms of sustainability – water consumption, soil depletion and pollution of the water table – and on our health if we eat too much of them. Agroscope is carrying out research in this area to gain a better insight into the biological value of the protein obtained from plants and animals. «In the long term, this agritech research project should also tell us if we can optimise our sources of plant protein, for example through microbial transformation or fermentation, or in combination with other foods.»
By 2030, the Grangeneuve-Posieux Campus will also be the home of Agroscope's future main research centre, creating around 450 jobs in the canton of Fribourg.

AGROSCOPE
www.agroscope.ch fabian.wahl@agroscope.admin.ch

FARMX

Farmers and the sharing economy

With FarmX, for a farmer to hire the machinery they need, all it takes is a few clicks on a smartphone. The brainchild of the AgriJura Chamber of Agriculture, the FarmX app marketed by the company of the same name makes it easy for farmers to share their use of agricultural machinery.

«FarmX's objective is to reduce machinery costs for farmers,» says François Monin, the Director of AgriJura, which is based in Courtételle in northwest Switzerland. The idea, which adopts the sharing economy model, was launched by his predecessor Michel Darbellay. Investing in agricultural equipment is an expensive business for farmers, particularly in Switzerland where plots are often on the small side. This makes it difficult for farmers to make their money back on all the machinery they might need, especially since some of it may be used for just a few hours a year. «And also, with the development of smart farming, which means that fewer agrochemicals are required, the technology quickly becomes obsolete. You have to be able to keep up!»

Hence the idea of this pioneering platform that enables farmers to rent machinery from each other. This is nothing new in farming communities, but previously the internet was used only to complement existing practice via a classified-ad-style website. «FarmX goes one step further, connecting farmers through an app that shows real-time availability of each piece of machinery, with one-click booking.»

AN INITIATIVE SURE TO CATCH ON ABROAD

To hire something, all you have to do is enter the kind of machinery you need, the geographical radius and the date you want it. The app operates on a subscription model, with FarmX acting as the invoicing intermediary. It went live in January 2019 and had 3,650 active users and 920 items of machinery on its books at the beginning of 2021. AgriJura may be the brains behind FarmX, but right from the start it has been keen to get other chambers of agriculture in the canton and other machinery-sharing communities involved. Prométerre, the Vaud chamber of agriculture, and Maschinenring Schweiz, a company representing several sharing communities, have been on board since the beginning.

Today, FarmX is a national project, supported by the Federal Office for Agriculture. «Our short-term ambition is to bring together other communities and to get other farmers to sign up quickly so that we have a sufficiently broad membership and machinery network for the whole of Switzerland.» And then? François Monin says that the model can be quickly duplicated, enabling the scheme to be rolled out and adopted internationally. AgriJura is already working on ideas for this with Seccom, its software development partner in the FarmX venture.

FARMX
www.farmx.ch direction@agrijura.ch

A network for the agri-food ecosystem

The Cluster Food & Nutrition is a platform that connects the key players in the agri-food industry. It draws on a large network of partners to offer workshops, training and conferences. Supporting innovation is also a central pillar of its activities.

The Cluster Food & Nutrition is located in the blueFACTORY technology park in Fribourg and uses networking to support innovation in the agri-food sector. The association's mission is to strengthen collaboration between the various players in the regional and national digital ecosystem and to support them in their innovation efforts. It is ready to explore all the possible synergies, even the most unlikely. «It is important for professionals in the sector to meet and inspire each other,» says Nadine Lacroix, who has managed the association since 2015. «And related sectors also need to exchange ideas, because the cheese sector could very well have something interesting to offer the chocolate sector.»

A MULTIDISCIPLINARY NETWORK

The Cluster draws its strength from the richness and diversity of its network. The small, three-person-strong operational team moderates the exchanges of a hundred or so members and partners from the food, agricultural, packaging and distribution sectors, as well as from research and training institutions and professional associations. In just one example of its achievements, The Cluster Food & Nutrition was involved in the development of Champidor, a variety of mushrooms rich in vitamin D that is sold in Coop supermarkets. For this project, it brought together the Swiss union of mushroom producers, the Swiss Vitamin Institute and the School of Agricultural, Forest and Food Sciences HAFL in Zollikofen. «We have an interdisciplinary approach. While agri-food remains the main sector, the health, nutrition, sustainability, digitisation and agritech sectors are also integrated, and we aim to promote them holistically,» says Lacroix.

SUPPORT AND PARTNERSHIPS

The Cluster Food & Nutrition, in partnership with Swiss Food Research, has obtained funding from Innosuisse, the Swiss innovation agency, for the next four years (2021 to end 2024). The two associations will jointly run a new thematic network and support innovative projects in the fields of intelligent nutrition, biomass conversion, resource efficiency, the circular economy and sustainable packaging. This funding will enable them to provide financial support to companies and assist in the development of numerous projects.
The Cluster is a project of the Région Capitale Suisse association, which is composed of five cantons (Bern, Fribourg, Neuchâtel, Solothurn and Valais) and several cities, municipalities and regional organisations. It is financially supported by the Swiss State Secretariat for Economic Affairs (SECO) and the New Regional Policy (NRP) developed by the Confederation and the cantons.

CLUSTER FOOD & NUTRITION
www.clusterfoodnutrition.ch nadine.lacroix@clusterfoodnutrition.ch

GRANGENEUVE

Where tradition meets innovation

The Canton of Fribourg's agricultural institute, known as Grangeneuve, offers academic courses in the land-based and nature professions. The Institute also provides technical consultancy services to agriculture professionals and has forged a reputation as a centre of applied research, also integrating technology in its development projects.

The Grangeneuve Institute has been providing basic and degree-level education and professional development training in French and German for 125 years. Annually, around 1,100 young students attend the Institute, studying for careers in the various agriculture, forestry, horticulture, dairy industry and food production professions, along with home economics and stewarding. The Institute, located near Hauterive Abbey south of Fribourg, has its own farms and sells the produce prepared on site. «Our main priority is striking a balance between tradition and innovation,» says Pascal Toffel, who took over as Head of the Institute five years ago. «We are keen to innovate in the different professions and teach the youngsters that they are allowed to do things differently than their predecessors.» Continuing professional development is thus of particular importance to Toffel, who was previously Director of the Union of Swiss Vegetable Producers. What's more, he has seen an increasing number of career-change students in their forties from urban areas who are very aware of the sustainability issues in the food industry – an illustration of the change that the agricultural sector is undergoing, with innovations like urban farms and the general trend towards short, local supply chains.

SUPPORTING DIGITAL TECH PROJECTS

In January 2021, the Canton of Fribourg began offering grants to local milk producers investing in a 'next-generation' system. The innovations it is supporting include solutions for monitoring the health, nutrient intake or physical condition of the cows, feeding systems such as feeding robots, and pasture management tools for measuring the height of grass. In addition to financial support, Grangeneuve offers a variety of data analysis services (particularly in milk yield recording) and provides advice throughout the project. The Institute also provides dairy farms with a carbon footprint evaluation audit before the new system is introduced and at the end of the project.

The Grangeneuve site boasts a variety of infrastructures, including a new dairy farm, a cheese school and a technology hall, and the Institute is there to support projects run by artisan and industrial SMEs and individuals. From this autumn, Grangeneuve will be working with Agroscope* to develop a national centre of excellence for raw milk in Switzerland. With these different instruments, the Canton will have the full range of facilities to achieve its ambition of playing a leading role in the food production industry nationwide.

**Switzerland's national centre of excellence for agricultural and food production research (see page 75).*

CANTON OF FRIBOURG'S AGRICULTURAL INSTITUTE
www.fr.ch/grangeneuve pascal.toffel@fr.ch

PROMFR

Developing the bioeconomy

The State of Fribourg Development Agency (FDA) supports companies in the canton. Created in 1972, it was the first economic promotion agency in Switzerland. Today, its focus is on developing the bioeconomy.

The FDA supports companies that are already established in the canton of Fribourg, or wishing to set up in the canton, in their creation and development. In 2020, the FDA enabled 54 businesses to set up or expand. In addition, the agency's team represents the canton of Fribourg's interests in more than 40 public and private organisations. The FDA works closely with regional clusters to promote exchanges between economic players in the same sector. «Given the great diversity of the Fribourg economy and the variety of its centres of excellence, there are academic and business partners in our canton for virtually every business idea,» says Jerry Krattiger, FDA's Managing Director.

FOCUS AREAS AND AGRI-FOOD STRATEGY

Many sectors are included in the FDA portfolio, but the strategic guidelines, in line with the economic development strategy (2020–2026), focus on two areas. These are the bioeconomy – in other words all activities involved in biomass production and processing for food production, animal feed, bio-based materials and energy – and Industry 4.0 – the name given to the industrial shift brought about by the digitisation of trade and products. «These two sectors alone account for 42% of the canton's GDP and 44% of jobs,» says Krattiger. The FDA has five innovation sites: AgriCo (Saint-Aubin) focuses on biomass and food processing, blueFACTORY (Fribourg) on future housing and mobility, La Maillarde (Romont) on biopharmacy and environmental technologies, Marly Innovation Center on fine chemicals and digital printing, and Le Vivier (Villaz) on automation and robotisation.

The economic development strategy for the agri-food sector, adopted in January 2021 by the Fribourg State Council, aims to make the canton of Fribourg the leader in this field. In concrete terms, the proposed flagship programmes focus on the roll-out of digitisation and automation (robotics, mechanics, big data) in agriculture and the agri-food industry, the development of biomass, the development of nutrition- and health-related aspects (such as molecules with high added value obtained through biotechnological processes) and consumer behaviour, particularly in terms of nutrition.

PROMFR
www.promfr.ch promfr@fr.ch

BEE VECTORING TECHNOLOGY

Putting honeybees and bumblebees to work

Instead of spraying crops with pesticides, why not get bees to do the work? This is the solution on offer from Bee Vectoring Technology (BVT), a company based on the AgriCo site at Saint-Aubin (Canton of Fribourg). This system is already operating commercially in the US and is currently in the licensing phase in Switzerland.

Agrochemicals are used to protect plants from diseases and pests, helping to ensure good yields of high-quality crops. But in 2012, academics at the University of Guelph in Ontario, Canada, highlighted the wasteful practice of crop spraying, with only a tiny proportion of the chemicals sprayed (estimated to be just 2%) actually ending up on the flowers. They went on to develop the system now being marketed by BVT. «Trays of microorganisms are placed at the hive exit,» explains Christoph Lehnen, BVT's Senior Technical Manager for Europe, Africa and the Middle East. «When the honeybees and bumblebees leave their hives, they pick up the product on their hairs and carry them to the flowers.» This approach also has the advantage of reducing labour, fuel and water costs.

BVT sources the bees from bumblebee breeders and beekeepers. It is also working with international research institutions, universities (in Sweden and Denmark) and Agroscope, the Swiss national centre of excellence in agricultural research.

LICENCE PENDING

BVT successfully licensed the commercial application of its system in the US in 2019 and the company is all set to go full steam ahead with licensing in Switzerland too, putting in its application at the beginning of 2018. «We already have lots of producers and partners interested in our system. All we're waiting for now is the green light from the authorities, which we're hoping to get by the end of 2021 at the latest,» adds Lehnen. In the meantime, BVT has been conducting trials with strawberry and raspberry growers (in collaboration with Agroscope) and is in discussions with the Grangeneuve agricultural institute about trials with colza, another crop that requires pollination. The market is very promising for BVT, which has only one competitor for applications involving bumblebees and none for honeybees. It has also begun the licensing process in Canada and Mexico.

BEE VECTORING TECHNOLOGY
www.beevt.com Christoph Lehnen, clehnen@beevt.com

AGROSUSTAIN

A product that fights food waste

Food waste is a real ecological, ethical and economic disaster, but it could be greatly reduced. A Swiss innovation based on biological processes can extend the freshness and shelf life of fruit and vegetables by a month.

Between harvesting, transport and distribution, fruit and vegetables are subjected to considerable and sometimes prolonged stress, affecting their freshness. This logistics problem is responsible for a significant share of food waste. According to figures from the Federal Office for the Environment, 2.8 million tonnes of food products are thrown away every year in Switzerland alone – equal to 330 kilos per person per annum.

However, a young company in the Lake Geneva region may well hold the solution to a part of the problem. The company, AgroSustain, has succeeded in developing a highly innovative product: a spray that, when applied to fruit and vegetables, keeps them fresh and extends their shelf life by up to a month. The solution is 100% organic and acts by forming a thin protective coating on the food that prevents it from drying out. The food retains its water content and is better able to withstand transport and the other steps that precede its sale.

BENEFITS FOR THE ENTIRE CHAIN, FROM PRODUCTION TO DISTRIBUTION

The commercial potential of this innovation is considerable because spraying can take place at different times and involve different players – producers, transporters and distributors. The spray, which is entirely produced in Switzerland, can be applied immediately after harvesting or before transport or even before the produce goes on sale. «In addition to prolonging the food's freshness and shelf life, it also reduces the amount of plastic used for packaging, as it forms a protective layer,» says CEO Olga Dubey, who holds a PhD in molecular biology. «With a longer shelf life, fruit and vegetables can also be transported by slower but less polluting modes of transport than aeroplanes, helping to reduce the carbon footprint of the food industry.»

The spray is expected to go on sale at the end of 2021, and a large deal has already been closed with Giovanelli, a leading Swiss importer of fruit and vegetables. AgroSustain is also aiming to launch a second innovation, a biological fungicide, in a few years' time.

AGROSUSTAIN
www.agrosustain.ch olga.dubey@agrosustain.ch

AQUA4D

Less water + fewer chemicals + less energy = higher yields

Reducing water consumption and the use of chemicals while addressing the problem of salt saturation of agricultural land – these are the main benefits of the physical treatment technology developed for irrigation water by AQUA4D.

Faced with the global challenge of population increase and resource degradation, farming needs to reinvent itself to become increasingly productive while saving water and preserving the soil. It is in this context that AQUA4D is propagating its groundbreaking optimised irrigation technology, an eco-friendly, low-cost solution it began developing in 2004 for the building industry to tackle pipework blockages. Today, 80% of the company's business is in agriculture.

«We install our units at pumping station outlets to treat the water just before it's used for irrigation,» says CEO Eric Valette. «This treatment makes the water penetrate the ground more effectively and, crucially, means that it will be retained better, encouraging the plants to develop a denser and more resistant root network.» The result? A higher yield with 30% less water, 30% fewer chemicals and without minerals and organic matter blocking the irrigation network. In addition, the treated water naturally cleanses the soil and provides minerals useful to the plants. These benefits have been demonstrated in dozens of scientific studies and hundreds of practical applications in some 40 countries.

BUSINESS SET TO BOOM

AQUA4D has already secured partnerships with a large number of major players operating throughout the agricultural value chain. «We sell our equipment and offer an agricultural engineering consultancy service that enables customers to optimise the benefits of their installations.» The company's main customers are in California and Chile, in micro-irrigation of fruit and vegetable crops.

Thanks to a grant from the European Commission and support from the Swiss Climate Foundation, the Valais-based company has recently developed its seventh-generation system. This will treat much higher flow rates, which will be of interest to large-scale cultivators, accounting for 83% of the irrigation market. AQUA4D is currently testing several prototypes, with industrial production due to start at the beginning of 2022. Other discussions with major industry players are under way. At a time when the development of sustainable agriculture is more in demand than ever, business will soon be booming for AQUA4D.

AQUA4D
aqua4d.com info@aqua4d.com

BARTO

A digital management platform for farmers

Farmers have a lot of paperwork to deal with. Providing parcel and crop data for agricultural surveys, keeping quality control records and documenting best practice to comply with label requirements can be a real headache. But barto has the (digital) solution.

When we walk across a farmer's field or tuck into some fresh farm produce, we seldom realise that a farmer's work is tied up in lots of red tape. Farmers are subject to regular inspections and strictly enforced regulations by the authorities and as a result spend a great deal of their day filling in and sending off forms and documenting what they do. This takes up a lot of time, adding to their already considerable workload. The company barto AG has come up with a digital solution.

Based in Ostermundigen just outside Bern, barto has adapted the digital platform 365FarmNet used in some other European countries to tie in with the specific requirements and regulations that apply in Switzerland. The result? Farmers can now enter and centralise all the different data relating to their farm on a PC or smartphone. This practical solution also saves them a lot of time since they don't have to enter the same information repeatedly on the multiple forms that they are usually required to complete.

HYPERCONNECTED FARMERS

One might think that the agricultural sector would not be amenable to digital solutions, but the reverse is actually the case. Farmers are, in fact, among the most connected professionals in Switzerland, ahead of many other industries. In any case, that is what barto's CEO Jürg Guggisberg has found. «We have even discovered that small mountain farms are just as connected as the large farms on the Swiss Plateau and in the lowlands. Another aspect in our favour is the telecommunications network we have in Switzerland – farmers can use their mobile pretty much anywhere.»

With its Swiss clientele made up mainly of large arable farms, barto is working on tailoring its offer more to their colleagues who farm dairy and meat herds, in a bid to broaden its customer base. Another future project is connecting the platform directly to the websites of the cantonal authorities to facilitate the transfer of data and documents between farmers and their local authorities.

BARTO
www.barto.ch admin@barto.ch

VATOREX

Turning up the heat to save bees from the varroa mite

Beekeeping plays a key role in safeguarding biodiversity and food security. However, the varroa mite is a serious ongoing threat to bee colonies, which have no defence against this parasite. A company in Winterthur has come up with a clever solution.

Bees are industrious and beneficial workers that play a crucial role in biodiversity and food production. Worldwide, the pollination carried out by bees can be valued at more than 150 billion euros annually, roughly the equivalent of Hungary's GDP. Without their valuable help, the supply of fruit, vegetables, coffee and cocoa would struggle to meet current demand. One of the main threats to apiculture is the varroa mite, a parasite that decimates defenceless bee colonies. Chemicals such as acaricides are often used to control this pest, but in the long term these can be harmful to the treated colonies, the environment and public health.

There is a simple solution, however: heat. Above a certain temperature, the varroa mite dies. So the Winterthur-based company Vatorex has turned up the heat on this dangerous pest. «Although it has long been known that heat kills this parasite, up to now, no-one had come up with a practical solution compatible with the existing infrastructures used by beekeepers. This is precisely what we have developed,» says Grant Morgan, Senior Marketing Manager at Vatorex. The company's solution consists of fitting the hive frames with a heating system a bit like domestic underfloor heating, which generates precise heat cycles that kill the parasite.

THE SWEET SMELL OF SUCCESS

From its base in German-speaking Switzerland, Vatorex now exports its system to more than 15 countries throughout Europe and beyond. Its customers include industrial-scale apiculturists along with amateurs and small-scale local beekeepers. In addition to its varroa mite control system, the company also sells kits which collect valuable data about bee colonies, such as hive weight and temperature. This information enables beekeepers to learn more about honey and wax production and conditions in their colonies.

By the end of 2021, the results of a study involving Vatorex's technology carried out by the Research Institute of Organic Agriculture (FiBL) are due to be published. For the company, this research is an important step, since it will further confirm and promote the effectiveness of this innovation in apiculture.

VATOREX
www.vatorex.com Grant Morgan, gm@vatorex.ch

DOLPHIN ENGINEERING

AI assistance in the vineyards

A team of researchers in Lugano have developed PreDiVine, a digital monitoring system that can predict very precisely at what times of the year vines should be treated against diseases and pests.

Thanks to the algorithms of Dolphin Engineering, Swiss winegrowers have no need for crystal balls when it comes to predicting if their vines are at risk of an imminent insect or mould infestation – and can enjoy the great savings they can make in both time and phytosanitary products. The company was set up by Mauro Prevostini and Antonio Vincenzo Taddeo in 2012, after they obtained funding for their project from Innosuisse (then the CTI). The pair were working as researchers in the Faculty of Informatics at the Università della Svizzera italiana (USI-Lugano) at the time. «Combining agriculture and the Internet of Things was a new idea back then,» recalls Prevostini.

Together with Mauro Jermini, director of the Agroscope station in Ticino, they worked on algorithms for predicting the development of Scaphoideus titanus, an insect that carries flavescence dorée, a very dangerous disease for vines. Their goal was to accurately predict the larvae's development periods and location so they could provide the cantonal phytosanitary services with reliable information to trigger the appropriate treatments. The researchers have also integrated prediction algorithms for several phytopathogenic fungi at the request of some winegrowers.

25% REDUCTION IN PHYTOSANITARY PRODUCTS

Around twenty forecasting stations for downy mildew and powdery mildew have been installed in vineyards in the canton of Ticino, on plots considered to be gateways to these fungal diseases. Dolphin Engineering has also connected its technology to the observation stations of several phytosanitary services in Switzerland, France and Italy. It collects data and makes forecasts daily from March to September. «Our system has helped to improve forecasting and optimise alerts, which has considerably reduced the proliferation of Scaphoideus titanus larvae,» says Prevostini.

While it is difficult to quantify the savings in phytosanitary products achieved thanks to PreDiVine, some studies estimate them at around 25%. Prevostini also stresses the tremendous savings in work hours made by the ability to precisely plan activities in the vineyards, particularly treatments. The technology could find other applications, too, for example in greenhouses. Research is being carried out in this area at the Faculty of Informatics on the automatic recognition of insect pests, in connection with bioclimatic measurements (temperature and hygrometry).

DOLPHIN ENGINEERING
www.dolphin-engineering.ch mp@dolphin-engineering.ch

ALVER

Super proteins that are good for you and for our planet

With its products based on high-protein microalgae with myriad nutritional virtues, a young company from Fribourg is making its contribution to a sustainable and environmentally friendly diet.

Alver means elf in Old Norse. With a nod to those supernatural beings, this is the name that Mine Uran and Majbritt Byskov-Bridges chose for the company they founded in 2016. Their project is the result of Uran's extensive research into alternative proteins. She and Byskov-Bridges share the belief that the world's population urgently needs protein-rich foods that can be produced with few resources. The two women also want to respond to consumer demand for healthier food.

Their superfood is the microalgae Golden Chlorella, which grows naturally on the beds of freshwater bodies. «It grows very well in a fermenter, in a process comparable to that of making beer,» says Byskov-Bridges. «It requires 36 times less water to grow than animal protein and emits much less CO_2.» This added value makes a difference in terms of both overall nutrition – microalgae are packed with vitamins and minerals – and environmental impact.

SALES DOUBLING EVERY YEAR

For two years, the partners refined their research and development, selecting the ideal Golden Chlorella from thousands of strains. Unlike other species of microalgae, its golden colour is not off-putting, and its taste is neutral. They tested the market in 2018, marketing first a powder then dry finished products such as pasta. Their first Swiss customers were pharmacies and health food shops, followed by supermarkets and restaurants. Alver is also sold in Germany by EDEKA and in France by Leclerc.

While sales are doubling every year, Alver's Golden Chlorella is currently only sold under the brand of the same name. However, Byskov-Bridges says, «We've raised funds to increase our production capacity and supply other food industry players.» From 5 to 7 tonnes of algae a year today, Alver is aiming for 50 tonnes a year by 2023. The company is continuing its research and development to select other types of Chlorella for new applications. A white strain could be used in the composition of vegan cheeses, for instance. The company is also working with a large Swiss group on meat alternatives.

ALVER
www.alver.ch contact@alver.ch

ECOROBOTIX

AI at work in the fields

«Recognise and act» would be a suitable company motto for ecoRobotix. These two actions lie at the heart of the technology developed by this company, a high-precision herbicide spraying system designed for use on farms.

«We take AI and put it to work in the fields,» says Aurélien Demaurex, co-founder and Vice-Chairman of the board of directors. In 2011, Demaurex met Steve Tanner, who told him about his big idea: to lessen the environmental impact of farming by drastically reducing the use of herbicides. Ten years and several prototypes later, the two associates' order books are full for the next few months. Their smart sprayer, ARA, was launched on the market in March 2021, in collaboration with Bucher Landtechnik, one of Switzerland's biggest farm machinery importers and distributors.

The device developed by ecoRobotix addresses one of the main issues faced by all farmers: how to get rid of weeds. «Worldwide, the chemical herbicide market is worth CHF 30 billion a year.» But the company's vision is also to develop systems that address in a specific, targeted way all the requirements of every plant in the field, including watering, adding nutrients and eliminating pests.

REDUCING THE USE OF CHEMICALS BY 95%

The ecoRobotix sprayer is mounted on a kind of trailer towed behind a tractor. Put simply, the device recognises the weeds and sprays them accurately with a small quantity of herbicide. Rather than dousing crops liberally with agrochemicals, this technology uses AI to achieve ultra-targeted spraying (on a surface area of 3 x 6 cm) at a rate of four hectares an hour, reducing the use of chemicals by 95% compared to a conventional sprayer. «This is the first step in enabling farmers to lessen their environmental impact. The advantage of our AI is its precision. In the long term we'll be able to use it to destroy weeds without the use of chemicals.» Also in the pipeline is a self-propelled robotic model. The company has the potential for worldwide growth, but for now its main market is Europe (essentially Switzerland, France and Germany). A victim of its own success, ecoRobotix is currently struggling to keep pace with demand at its workshops in the north of the Vaud canton.

ECOROBOTIX
www.ecorobotix.com info@ecorobotix.com

YASAI

Farming reaches new heights

Ground and ground water pollution, growing urbanisation and space optimisation are all challenges that farmers have to contend with. There are some clever ways of doing this, and one of them is the vertical farming on offer from the fledgling company Yasai.

If they are to preserve the environment while improving yields, farmers need to turn to innovative solutions. And Yasai, a spin-off of ETH Zurich, is one of the companies using the kinds of technologies and methods that are redefining the farming paradigm. How? With vertical farming, a concept that involves growing different types of food plants in a way that optimises the space required and reduces its footprint and water consumption. This method can also be used to bring agricultural production to the urban environment.

What's more, the system developed by the Zurich-based company uses zero pesticides. And growing the crops on a series of vertical levels optimises the use of space and increases productivity by a factor of up to 15 per square metre compared to conventional market gardening. Meanwhile, water consumption is reduced by 95%. And lastly, because these vertical farms can be established near supermarkets in the middle of urban centres, they can reduce – or even eliminate – the transport of goods from production site to sales outlet.

ORGANIC GROWTH

Operating in Switzerland, Yasai has already developed a number of effective commercial synergies with a number of restaurants and the fenaco agricultural cooperative, thereby gaining direct access to the majority of Switzerland's supermarket retailers. «In the long term, our objective is to grow internationally too,» says CEO Mark Essam Zahran. «Once we've completed our full-scale trial on the Swiss market, we'll be ready to look at a global rollout.»

And to stand out from the competition, right from the start, Yasai has made a point of offering the full range of services, from production infrastructure design to packaging and logistics. The company's other ambition is to develop farming centres in which different entities can rent square meterage and infrastructures developed by Yasai, based on the popular model of the data centre, where IT companies rent servers.

YASAI
www.yasai.ch mack@yasai.ch

INFRASCREEN

An innovative screen improves greenhouse emissions

The Neuchâtel start-up is developing a plastic film using thin film deposition technology, integrated into a thermal screen. This technology should help to heat greenhouses more efficiently, while still allowing the light essential for photosynthesis to pass through.

Co-founded by Benoît de Combaud and Henri de Lalande, Infrascreen is working on a solution for more sustainable greenhouse farming. Traditionally, greenhouses are heated with natural gas. This process allows for a fifteen-fold increase in productivity compared to growing crops in the open field, but it also produces three times more CO_2 emissions.

The technology developed by Infrascreen allows the radiation to be selectively filtered to let the light through while retaining the heat. «In practice, it's like wrapping a survival blanket round the greenhouses, but one that's transparent to light,» says de Lalande. This screen is made up of a series of thin layers developed by CSEM, the Swiss centre for electronics and microtechnology, combined with a thermal filter.

LOWER CO_2 EMISSIONS

The first tests were carried out in the Netherlands – one of the regions with the most greenhouses in the world – where this technological advance was enthusiastically received. Independent measurements taken by a laboratory at Wageningen University demonstrated its effectiveness. The infrared retention process not only improves energy efficiency but also increases profitability – up to 200 tonnes less CO_2 emissions per hectare per year and a 20% saving in heating costs.

The solution is therefore very interesting for market gardeners looking to improve sustainability, as 80% of a greenhouse's CO_2 emissions are caused by heating – the system would save around €2 per square metre. «This is enough to offset the extra cost of switching to renewable energy for heating,» says de Lalande.

The next steps for Infrascreen are to produce an industrial prototype and to launch pilot tests in the Netherlands and Switzerland from next autumn. In terms of future commercial development, the company's sights are set on Northern Europe, Russia, Switzerland, Germany and Canada. And the potential is enormous! It is estimated that there are 5 billion square metres of greenhouses in the world.

In July 2020, Henri de Lalande and Benoît de Combaud were awarded the BCN Innovation Prize by the Cantonal Bank in Neuchâtel for their solution. One of their main supporters is the Foundation for Technological Innovation (FIT).

INFRASCREEN
www.infrascreen.com henri@infrascreen.com

AERO41

Using drones to up the eco-ante for organic wines

There are plenty of good reasons for using drones to spray crops: they are ultra-accurate, quiet, fast and effective. Arguments that have already convinced Swiss winegrowers and are set to win over producers outside Switzerland too.

Aero41 specialises in crop spraying by drone, working with a network of partners to develop and manufacture sprays and provide spraying services to farmers and winegrowers. Before founding the company in 2019, Frédéric Hemmeler flew helicopters for 15 years. So when it comes to aerial crop spraying, he knows his onions. He also knows that, sooner or later, Switzerland will have to fall into line with its European neighbours, which banned aerial spraying years ago.

That is what got him thinking about using drones to replace aircraft, an idea that has plenty going for it. «They are quieter and also extremely accurate. There is practically no spray drift, which has always been the main problem with conventional aerial spraying. We are getting results comparable to ground treatments – and our customers confirm that. There is almost zero waste because we're pretty much able to control the direction of every droplet,» claims Frédéric Hemmeler. What's more, Aero41's drones are licensed as a ground treatment because they don't need to fly high to be effective. By minimising its flying altitude, the drone is able to use the downward air currents generated by its propellers to disturb the leaves, ensuring a more even distribution of the sprayed product. This feature is of particular interest to organic producers because plant coverage must be optimised for the product to be effective. Aero41 is currently working on upgrading its drones to meet customers' needs even more effectively in the future. Using artificial intelligence (AI) and geolocation data in particular, the drones are even capable of recognising a particular field, which further increases their accuracy and effectiveness.

A POTENTIAL FOR 100,000 HECTARES IN EUROPE ALONE

Winegrowers using difficult-to-access land quickly realised the advantages of this product and were the first to adopt the technology. And that's fine with Frédéric Hemmeler: in Europe alone, the primary market targeted by his company, he has identified around 100,000 hectares of vines cultivated on gradients of more than 30%. On this type of terrain, it is estimated that spraying one hectare requires four hours of manual labour. A drone can do it in 60 to 90 minutes. Not only that, it prevents the soil erosion caused by a tracked spraying vehicle. And last – but by no means least – drone spraying avoids any human contact with the produce. A way of enabling the drone to refill autonomously is also on the drawing board.
Switzerland and Austria have already licensed the use of drones, and certification is pending in France, Germany and Italy. Wine producers on the West Coast of the USA have shown an interest too.

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AERO41
www.aero41.ch frederic.hemmeler@aero41.com

AGOLIN

Agolin reduces the CO_2 impact of cattle farming

The Jura-based company Agolin markets a plant-based feed additive that helps reduce methane emissions from cattle, providing an effective low-cost solution to limiting the production of greenhouse gases in the farming industry.

According to the United Nations Food and Agriculture Organization, dairy cows and beef cattle produce nearly five billion tonnes CO_2 equivalent every year worldwide, accounting for around 10% of all emissions generated by human activities. Forty percent of these emissions are generated by the animals eructing during the digestion process.

The feed additive developed by Agolin contains plant extracts and is available in both a standard version and in an organic version that complies with organic farming regulations. The additive, called Agolin Ruminant, was originally developed to improve cows' digestive function with a view to increasing milk production – or weight gain in the case of meat herds. This is because more efficient digestion gives the cows a 4% better energy yield from their feed on average. «The reduction in the amount of methane produced is a side effect,» says Kurt Schaller, co-founder and director of the company. A very useful property when it comes to limiting greenhouse gas emissions from ruminants, which are estimated to be 0.5 m3 per animal per day.

SCIENTIFIC RIGOUR

One gram of the additive mixed daily into the feed given to each cow reduces its methane production by 10 to 20%. These figures have been measured and confirmed in a number of trials, many of which were part of research projects in which Agolin has been involved. Because at Agolin, scientific rigour is of vital importance. «We are the first and only company to have carried out long-term academic trials on herds of 150 cows measuring performance, animal wellbeing and gas production,» says Kurt Schaller.

The company exports 99% of its production, mainly to Europe, with the greatest market penetration so far being in Norway, where more than 50% of the cows are fed with Agolin. «The Scandinavians are particularly sensitive to the climate protection argument,» he says. Using this additive could reduce the methane impact of cattle by 200,000 tonnes CO_2 equivalent per year in Europe, based on current cattle numbers. The potential for methane emissions reduction worldwide is huge: 200 million tonnes CO_2 equivalent, four times the total impact of Switzerland's farming industry. And the cost involved is relatively modest, being estimated at 25 euros per tonne of methane saved. The feed additive was awarded Carbon Trust certification in 2018 in recognition of Agolin's efforts in combatting climate change. «Honesty is a value that we hold very dear; we don't make any claims that can't be quantified and proved scientifically,» concludes Kurt Schaller.

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AGOLIN
www.agolin.ch info@agolin.com

CLEANGREENS SOLUTIONS

CleanGreens grows ‘cleaner’ vegetables

Growing high-quality lettuces, herbs and vegetables locally while saving water and preserving resources: this is the boast of CleanGreens, based at the Molondin Agropôle north of Lausanne.

Using conventional farming methods, one kilo of lettuce requires 250 litres of water to grow to maturity. Grown on CleanGreens’ mobile aeroponics platforms, it needs just seven. What’s more, 10 to 12 harvest cycles can be grown per year in the facility, compared to just one or two out in the field. And without leaching the soil, because there is no soil. The plants are grown in a greenhouse of course, but making maximum use of daylight.

This is no miracle, but a feat of technology: the ‘gardening’ is done by robots, which are programmed to spray a very precise quantity of nutrient solution onto the plant roots to ensure they grow at the most efficient rate; the dosage depends on the plants’ maturity. «The quantity of nutrients, the height and strength of the mist, and even the water droplet shape: everything is carefully fine-tuned,» says Serge Gander, CEO of CleanGreens. Even the crops themselves are mechanised, because the plants are automatically shunted along as they grow. On each line, the robots are programmed to treat the plants, dosing the nutrient spray with an incredibly high accuracy.

BETTER CONSERVATION AND LESS WASTE

Closed-circuit fogging also prevents any runoff into the soil. «We can do without it, unlike systems that operate with stagnant water, which is the perfect breeding ground for bacteria like salmonella.» In addition, working in this highly controlled environment means the company can produce foods of consistent quality and quantity all year round. And because it grows locally, close to its consumers, CleanGreens provides a solution with a small ecological footprint. Its customers include restaurants and catering businesses, agrifood and pharmaceutical companies and even cosmetics manufacturers. Avoiding long-distance lorry transport also increases the products’ lifespan and reduces production losses to 10%, compared to more than 60% using conventional methods.

Established in 2013, CleanGreens is a promising scaleup company that employs a workforce of around 15. It now exports to France, where it has won a contract with a distributor of ready-to-eat crudités, and its products will be in the fridge of homes in French-speaking Switzerland from the end of 2020. Discussions with prospective customers are currently under way in the UK, Sweden, Russia and the Middle East, countries which lack the sunlight, warmer temperatures or fresh water for successful market gardening. Highly productive – 80 kg per square metre compared to three under conventional methods – this system may also help meet increasing demands on food supply.

CLEANGREENS SOLUTIONS
www.cleangreens.ch info@cleangreens.ch

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XFARM

Democratising Agriculture 4.0

A farm presents a real challenge in terms of management, optimisation and efficiency, not to mention the administrative requirements that accompany the core activities. xFarm solves this organisational headache with digital technology.

Farmers face constant organisational challenges such as preventing crop diseases, optimising the use of fertilisers and water resources, and planning their teams' working hours. To assist with these farming tasks, while also helping to keep costs down, xFarm has developed its own farm management IT platform.

The company's digital tool, available both as an app for smartphones and in a web version for computers, allows farmers to use a number of free or paid features. Based on a system of sensors that can be used to forecast the weather, plan watering, monitor machinery maintenance and detect the presence of pests or diseases in crops, the platform is designed to be both complete and streamlined in order to be useful to all farmers and all types of farms.

APP, SENSORS AND THE INTERNET OF THINGS

xFarm, which has offices both in Ticino, in Switzerland, and Lombardy, in Italy, has also positioned itself from the start in the field of the Internet of Things (IoT). By developing and selling its own products, it provides its customers with a complete offer, including sensors that can be integrated into their agricultural infrastructures – such as irrigation systems – and easily connected to the digital platform. «We position ourselves as a single point of contact able to help with integration, whether of the digital component or the IoT options that can be grafted onto our system,» says co-founder Martino Poretti.

The company is made up of twenty or so IT developers and agronomic experts working closely with farmers, and its multidisciplinary vision enables it to effectively tie in its digital tools with the realities on the ground. The company has received numerous awards (IMD, CES, MassChallenge and Solar Impulse #1000Solutions, among others) and has also developed a broad international presence, marketing its invention in Switzerland, Spain, Portugal, Italy, Greece and various South American countries. More than 500,000 hectares are currently managed with its solutions.

XFARM
www.xfarm.ag martino@xfarm.ag

WINGTRA

Drones fly to the rescue of agriculture

It is sometimes difficult for farmers to detect certain threats from the ground. To help them better diagnose problems that could affect their crops, Wingtra is offering them a chance to get a bird's eye view.

While agriculture is entirely land based, it seems that challenges will also be tackled from the skies in future. With so many demands on yields, process optimisation and loss control, farmers need to have an overview of their crops. And what better way to get one than with a drone? That is why Zurich-based Wingtra is developing and marketing a new type of drone designed at the Swiss federal institute of technology ETH Zurich.

The device takes off and lands vertically like a helicopter; once airborne, it flies in glider mode, like an aeroplane. This technical feat optimises the drone's efficiency in the air and makes it easier to use. The Wingtra drone can scan areas of more than 400 hectares with centimetre-level accuracy. It collects valuable data on the state of the fields scanned using cameras and sensors designed specifically for agricultural activities. The parameters collected for the farmers include water and fertiliser requirements and the presence of any diseases. Wingtra also operates in other areas, such as construction and mining.

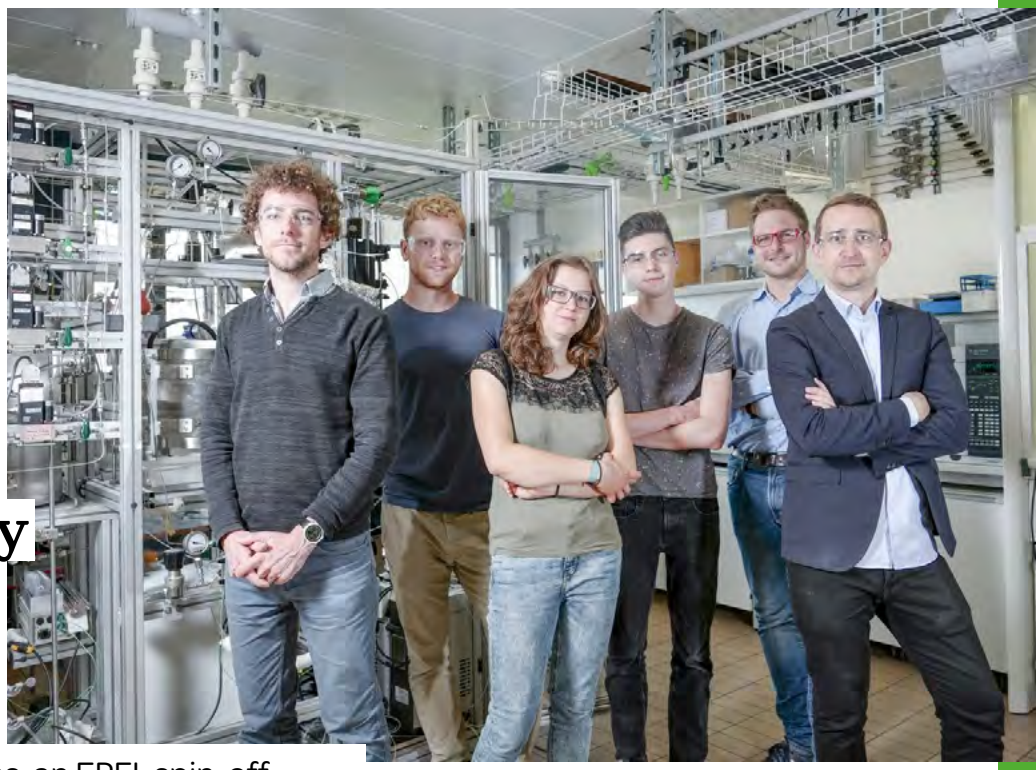
AUTONOMOUS TECHNOLOGY

To make it easier to fly the drone, Wingtra has simplified the controls by largely automating the various flight phases. The user can simply activate these phases from a tablet. «You can learn to fly our drone in less than a quarter of an hour,» says Elias Kleimann, the company's co-founder and CFO. «Our challenge lies more in popularising the data collected for non-experts, so they can interpret it.»

This difficulty explains why many of Wingtra's customers are agronomists called in by farmers to help them improve or even save their crops. The company's plans include making the data provided by its algorithms easier to understand and analyse so that it can be used directly by farmers. Wingtra is not just active in Switzerland but around the world, and is also targeting the agricultural sector in the US and eastern Europe because the areas under cultivation there are very large. Its innovative product has also been used in Kenya, in partnership with the Red Cross, to combat insect invasions that are on the rise, due to climate change, and are devastating plantations.

WINGTRA
wingtra.com justina.kostinaite@wingtra.com

BLOOM BIORENEWABLES



At the heart of the bioeconomy

With the support of Bill Gates, an EPFL spin-off aims to replace crude oil with biomass. One of the possible applications for its process is the extraction of molecules for the manufacture of bio-compounds used in perfumes and food flavourings.

Swiss start-up Bloom Biorenewables intends to use trees and agricultural waste to produce fuels, plastics, perfumes and other molecules for the food and cosmetics industries. These products and compounds are currently produced by the petrochemical industry, contributing to the increase in CO_2 emissions. Using biomass instead means using much shorter carbon cycles of 20 to 50 years, roughly the time it takes for a tree to grow. «We want to offer an alternative that goes some way to tackling the urgent problem of global warming, a consequence of our use of hydrocarbons on a massive scale. We deliver a unique solution that makes use of plants and agriculture,» says CEO Remy Buser.

The process that Bloom has developed is currently in its pilot phase. Within five years, the start-up should be able to produce these compounds in industrial quantities. In February 2021, Bloom received the first financial support from the new Breakthrough Energy Ventures Europe fund, headed by Bill Gates. This helping hand completes a total of CHF 4 million in funding that will go towards scaling up the technology to serial production.

VANILLA FLAVOURING FROM HAZELNUTS

Based at the heart of the Marly Innovation Center in the canton of Fribourg, Bloom has joined forces with the School of Engineering and Architecture Fribourg (HEIA-FR). This collaboration will enable it to carry out tests and produce samples for its first partners. The company's innovative process has already caught the interest of several large companies wishing to put sustainable strategies into practice to help combat the climate emergency.

While Bloom is targeting the highly polluting shipping sector with the development of state-of-the-art biofuels, the company is also working on extracting molecules from lignin – one of the main components of wood – for use in fragrances and flavourings. In early 2021, Barry Callebaut, the Swiss chocolate giant, announced a partnership with the start-up to develop an alternative to vanillin made from hazelnut bark – the artificial vanilla flavouring is used in the manufacture of chocolate and is currently 80% derived from petroleum.

BLOOM BIORENEWABLES
www.bloombiorenewables.com remy@bloombiorenewables.com

PLANTED FOODS

Plant-based meatless chicken

The consumption of meat products causes major sustainability problems. Zurich-based Planted Foods offers a plant-based alternative that still delivers the texture and taste of meat.

Eating meat is a social and dietary habit that is deeply rooted in our culture. It is therefore not easy to introduce new, more responsible ways of eating that satisfy sustainable imperatives. In light of this, Planted, a company based near Winterthur, in the canton of Zurich, is taking an innovative approach. Its solution is to offer products that look and taste like those found in the meat section of supermarkets using plant proteins and fibres. The plants must be neither GMO nor soya, and, if possible, grown in Switzerland.

Using a mechanical process prototyped at the Swiss federal institute of technology ETH Zurich, Planted has optimised its manufacturing process to produce plant-based products that look and taste like marinated chicken, pork and kebabs. This technological feat uses only mechanical and thermal processes to transform plant fibres and proteins into mock meat. Not only have the right fibrous texture and taste been achieved, so has the product's nutritional quality: it has the same protein content, slightly less fat and even more fibre, making it easier to digest.

EATING RESPONSIBLY

The initial impetus for the project was provided by the fact that the technology for creating plant-based meat already existed. «As entrepreneurs, we wanted to create a product compatible with the ecological emergency that faces us all today,» says co-founder Pascal Bieri. «And consumers have almost everything they need to consume responsibly.»

Planted is growing rapidly and currently employs 80 people, including around 20 scientists. The company markets its products to major retailers such as Migros and Coop, but also sells directly via its website and to restaurants and food stalls. After Switzerland, Germany and Austria, the company is now preparing to market its products in France. Its production site in Winterthur has a completely transparent approach, and the general public is always welcome to come and find out how the meat of tomorrow is produced.

PLANTED FOODS
fc.eatplanted.com hello@planted.ch

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