zh aw

Life Sciences and Facility Management

TRANSFER SPECIAL

Strategic programs

Conclusions from our strategic fields

Prof. Dr. Urs Hilber
Dean, School of Life Sciences and Facility Management

“Culture eats strategy for breakfast.”

(Peter Drucker)

When I sit at my desk at home, Peter Drucker looks at me from my bookshelf. He does this from a collection box entitled *The Bible of Management.* It was from Peter Drucker that I learned the theory that a strategy is powerless if corporate culture opposes it. During my time at the University of Applied Sciences, School of Life Sciences and Facility Management, I have gained practical experience of what Drucker’s statement means in reality. With a lot of enthusiasm and intrinsic motivation, whilst still staying true to the Benedictine rules, we launched our School’s strategy in March 2016 together with my colleagues from the School’s management team. “ZHAW Life Sciences and Facility Management: studying and researching in Wädenswil: practical, creative, passionate and reflective; our expertise in life sciences and facility management in the areas of the environment, food and health enables us to make a vital contribution to solving social challenges and improving quality of life.” This is how we defined our strategic foci for the period up to 2025.

Culture of diversity

As a leader, I have tried very hard to bring this strategy to life. However, I’ve failed again and again just because of the culture of great diversity and professional heterogeneity in our school. Almost on the verge of giving up, I ventured one last attempt and opted to use the “Health” strategic field as a pilot. I invited a good two dozen key persons from our School who, in my opinion, should have felt they belonged to the “Health” focus. I will never forget this workshop! I saw the spark in the participants’ eyes as the ideas began to flow. It became apparent that money and trust were the keys to success, the latter more so than the former.

When I got home from my sabbatical, program descriptions were already in place for two strategic fields “Health” and “Food”. The designs for “Environment” and, later, “Society”, followed without much effort on my part. Culture and strategy began to reconcile and stimulate each other. In the end, a large proportion of all the staff and faculty worked in one form or another in one of the strategic programs in dozens of strategic projects.

Success based on trust

The ZHAW is a so-called managed university. This strategic setting was diametrically opposed to the idea of an agile, bottom-up controlled strategic program. “Culture eats strategy for breakfast...”

I am proud that we as the management team have endured, that the success of the strategic foci was based on trust. And I’m proud of what the teams have done with and out of the trust they have been given. In this Transfer 2/2022 special, we summarize the main results of all strategic programs and projects. In addition to this publication, many other print and online products, project results, an MSc program and, most importantly, countless collaborations within the School have emerged.

I hope you enjoy reading the story that shows what Peter Drucker meant with his famous sentence, and I bow to our employees, who have achieved extraordinary things, with a sparkle in their eyes and without looking at their timekeeping ...

Urs Hilber
Dean

Where theory meets practice
Find out more about our research priorities and the collaboration with us in the brochure “Research, development and services”.

www.zhaw.ch/en/lsfm/research

Imprint
Editorial staff: ZHAW Zurich University of Applied Sciences
communication.lsfm@zhaw.ch

Design: obrist-partner.ch
Printing: CO_2-neutral on FSC paper, theilerdruck.ch

Cover photo: Nerve cell, ©gettyimages

October 2022
Number of copys: 3,000

System of the strategic foci – fields – programs

foci	fields	programs
Environment	Environment@LSFM	Sustainable Campus Living Lab / BIOMAT
Food	Food@LSFM	Agro-Food-Business
Health	Health@LSFM	Health Research Hub
Society	Digitization@LSFM	Digital Transformation

Sustainable Campus Living Lab

Prof. Dr. Reto Rupf
Head Research Unit Geoecology,
Institute of Natural Resource Sciences,
rupf@zhaw.ch

Prof. Dr. Carsten Druhmann
Head Competency Group Real Estate Management, Institute of Facility Management,
dhnn@zhaw.ch

Further information on the projects Food Chain Model, Ecological Engineering Living Lab, DeMo, GeoBIM, Klimaduell, Wildlife, Dynamic Knowledge Platform DKP, Pflanzen-App (only available in German)

It is obvious that our society will not be able to cope with the manifold challenges it is facing, such as climate change, species extinction, the increasing scarcity of resources and urban sprawl, without changing its way of living and doing business. Solutions that are "fit for our grandchildren" must be found. We are therefore intensifying the search for new approaches to solutions and for trustworthy role models regarding implementation. The School of Life Sciences and Facility Management (LSFM) is involved in many of these key topics and, as an institution, plays a leading role with regard to sustainability. This objective was also pursued by the strategic program "Sustainable Campus Living Lab@ LSFM" – the sustainable development goals of the United Nations were to be implemented with projects at the LSFM and their realization accelerated.

The focus was on five topics: Circular Economy, Biodiversity, Life Cycle Management, Smart Cities, and Facilities and Services. The results of the eight innovative projects were presented at a Science Festival on June 23, 2022 on the Grüental campus with interactive presentations. In the course of promoting these topics, the ZHAW also became the first university of applied sciences in Switzerland to become active in the International Sustainability Campus Network (ISCN).

We are proud to serve the wider community by ensuring people are well-informed with the latest scientific insights, and to bring about changes in behavior. In this way, we seek to make a valuable contribution to the future. ■

Fig.: The 17 global sustainable development goals of the United Nations (United Nations SDGs, 2015)

Climate duel – the climate wins

Sabine Frei
Research Assistant, Research Group Life Cycle Assessment, Institute of Natural Resource Sciences, lans@zhaw.ch

David Koch
Research Group Sustainability Communication and Environmental Education, Institute of Natural Resource Sciences, kocv@zhaw.ch

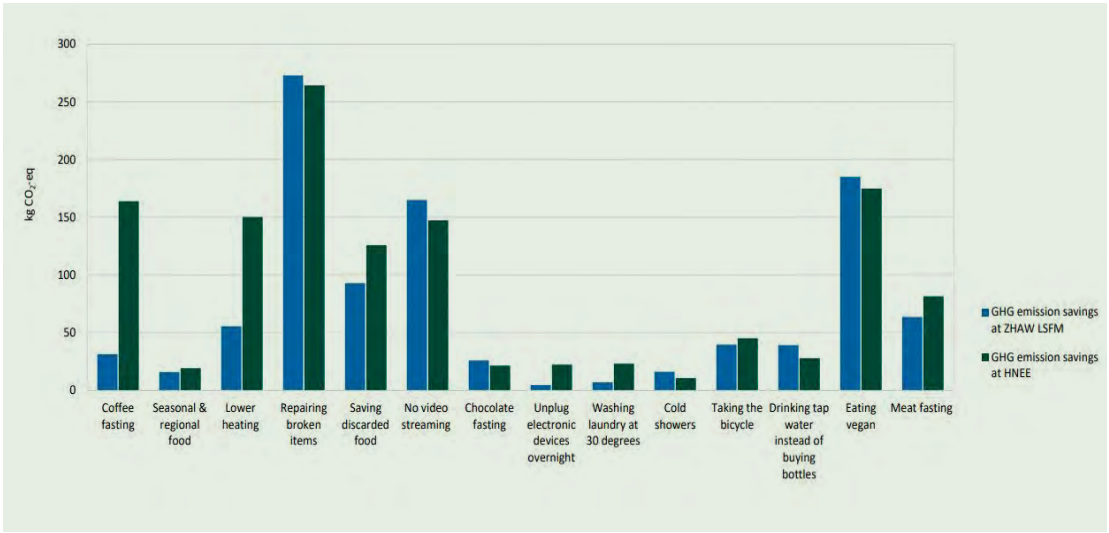
To the project "Campus Challenge Sustainability Exchange"

Using a playful approach to change one's own behavior to consume fewer resources and reduce emissions – this was the aim of the climate duel at the ZHAW. After a successful pilot project last year, planning is now underway for the event in spring 2023, when all ZHAW departments will compete against each other.

Last year, the first climate duel started at the Institute for Natural Resource Sciences, School of Life Sciences and Facility Management. Over the course of six weeks, 375 participants from the ZHAW and the University of Applied Sciences for Sustainable Development Eberswalde (HNEE) in Germany competed in a wide variety of challenges. The goal: to save as much CO_2 as possible in everyday life. In the morning we gave up coffee, in the evening we didn't stream Netflix but read a book – and we also discovered that our socks get clean even when washed at 30 degrees. This enabled us to save a total of 2.3 t CO_2-eq., which corresponds to a car journey of almost 7,000 km: a great achievement. The ZHAW won the most challenges – but the ultimate winner of the duel was the climate.

Next year, the climate duel will return, and we believe an even greater impact is possible. In 2023, the climate duel will take place between all ZHAW schools In addition to a more sustainable university, the project team hopes for more exchange and new friendships within the ZHAW. We all need a sustainable and liveable future!

Anyone who would like to help us spread the word about the ZHAW climate duel is welcome to contact david.koch@zhaw.ch ■



Evaluation

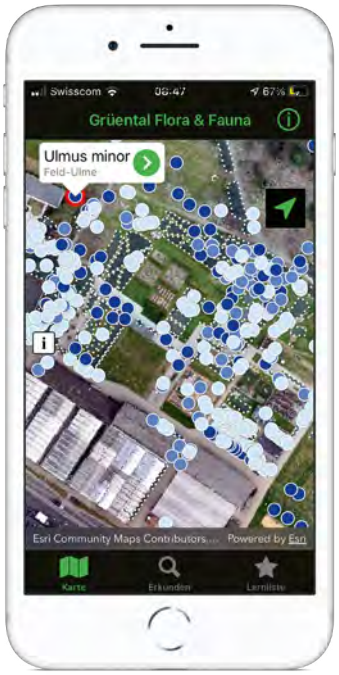
Seven times a trip by car from Wädenswil/Switzerland to Eberswalde/Germany / Google Maps, 2022

“Grüental Flora & Fauna” app

Nils Honetschläger
Research Associate, Institute of Natural Resource Sciences,
hont@zhaw.ch

To the project “Grüental Flora & Fauna app” (app only available in German)

With over 3,000 plant species and varieties, the Grüental campus in Wädenswil is not only a hotspot in terms of biodiversity, but also offers unique framework conditions for plant teaching. The Grüental Flora & Fauna app closes one last gap in this teaching setting. Lecturers can store their individual plant lists in this tool so that students can independently find their course-specific plants on campus. Plants that have been learnt or still need to be learnt can be marked in the personal learning lists. The app also functions as a digital label. Standing in front of an unknown plant, users can read out the name of the plant and other minimal information using the app. A link leads to external pages with detailed information on the individual species. Tours on plant topics, such as medicinal plants or trees with special fall colors, are another offer for the numerous visitors to the campus. Interested persons will also find field botany courses to prepare for botanical examinations of national certificate courses.
The app is a supplement to the physically available plants. It is intended to encourage learners to seek out the plants on site, and learn about them with all their senses. Another part, on the fauna in the Grüental campus, is in development. ■



Overview map

Wildlife@Campus: Small mammals under close attention

Prof. Dr. Roland Graf
Head Research Group Wildlife Management, Institute of Natural Resource Sciences,
graf@zhaw.ch

To the project “Wildlife@Campus: Small mammals under close attention” (only available in German)

Many small mammal species are nocturnal or otherwise cryptic. They are difficult to observe, and survey methods are laborious. Therefore, there is a need to improve these methods to get reliable, systematic and country-wide information on the distribution and population dynamics. In the frame of the project “Wildlife@Campus”, we developed and tested a survey system for small mammals. An optimized setting of a camera trap in a box (photobox) provides high-quality images of small mammals. A machine learning approach allows us to prescreen the huge number of images, thus reducing the effort for manual image interpretation. In the field, we combined the photoboxes with synthetic tubes, in which small mammals deposit their feces. From these environmental DNA samples, the corresponding species can be identified with methods of “Next Generation Sequencing”.
Parallel to the development of survey methods, we were able to reserve an area of about 2 ha for the purpose of actively furthering biodiversity. Staff members and students of the ZHAW campus in Wädenswil built piles of wood, traditional wooden fences, hedgerows and ponds. Visitors can now observe how habitats will change and how biodiversity will evolve over time. They get information on small mammals and the significance of diverse, species-rich habitats. ■

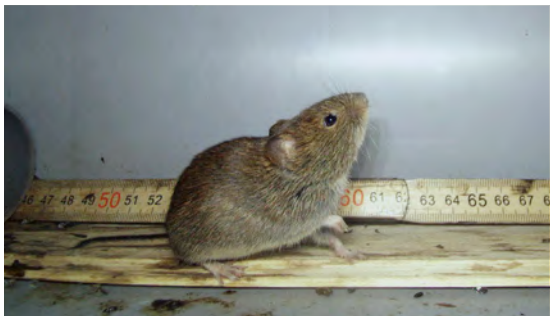


Fig. 1: Bank vole *(Myodes glareolus)* in a camera trap box (photo: WILMA/ZHAW)

Fig. 2: Wood pile from the perspective of a small mammal (photo: Roland Graf)

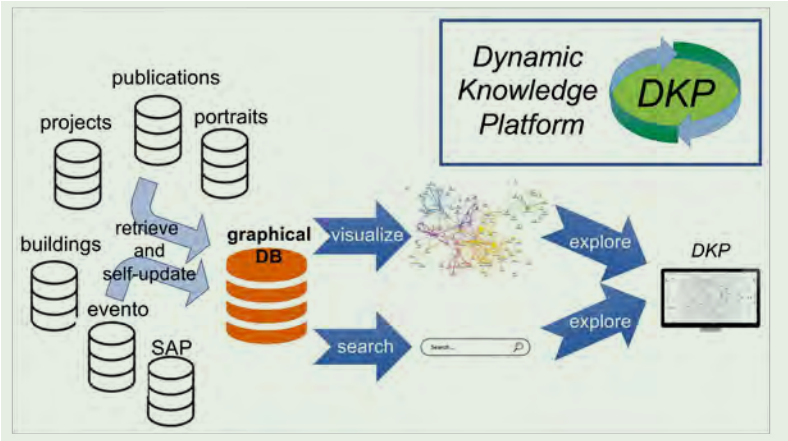
The Dynamic Knowledge Platform

Dr. Victor Garcia
Postdoc, Institute of Computational Life Sciences, gara@zhaw.ch

Adrian Busin
Research Associate, Institute of Computational Life Sciences, busi@zhaw.ch

To the project "Dynamic Knowledge Platform" (only available in German)

ZHAW researchers rely on collaborations with partners from industry and research. To date, these collaborations are mostly based on pre-existing relationships. Identifying new potential partners is hard, since ZHAW's data infrastructure is not geared towards partnership discovery. The Dynamic Knowledge Platform (DKP) addresses this shortcoming. The DKP is a competence visualization tool that allows the navigation of ZHAW's competence landscape to accelerate partnership formation. The DKP gathers competence and skills information distributed across ZHAW databases. The DKP automatically self-updates through data supply from existing databases, substantially reducing maintenance costs: newly added data is continually integrated. This information is then organized into one coherent unit: a graphical database. The graphical database is run on a neo4j framework on a ZHAW-server. A graphical user interface accesses the data and uses a variety of visualization approaches to show distribution of knowledge at ZHAW. All information is made searchable and explorable in an appealing semantic network.
If scaled ZHAW-wide, we hope that the DKP will facilitate closer interconnections between ZHAW researchers across institutes, departments and beyond. ■



Information is first retrieved and updated automatically from a variety of ZHAW-wide data sources and channeled into a centralized graphical database. The database allows for the exploration and visualization of ZHAW's competence landscape in a graphical user interface.

Food Chain Model

Dr. Claudio Beretta
Research Associate, Research Group Food Technology, Institute of Food and Beverage Innovation, beet@zhaw.ch

To the project "Food Chain Model" (only available in German)

There are three important fields of action to make the present food system more sustainable:
– food waste reduction
– the production and availability of sustainable food
– the demand for sustainable food.
The Sustainable Food Chain Model (FCM) offers a basis for decisions for all three fields of action. For the first field of action, the amounts of food waste arising at different stages of the food value chain, differentiated by food category need to be known. For the second field of action, we should understand which processes within the food value chain cause the largest environmental impacts, and compare scenarios of how these impacts can be reduced. The FCM provides answers to these topics by modelling the processes of the food value chain from agricultural production to final consumption with a mass flow analysis linked with a Life Cycle Assessment (LCA). The FCM can also be adopted for the third field of action, where consumers need to be informed about the environmental impacts of different product alternatives.

Consequently, the FCM contributes to sustainable food systems by providing answers that can be integrated into education and sensibilization projects, as well as used for consultancy of economic and political stakeholders. ■

Fig.: Food Chain Model

Development of a GeoBIM-based collaboration framework

Heinz Bernegger
Lecturer, Competency Group Real Estate Management, Institute of Facility Management, bgge@zhaw.ch

Pascal Ochsner
Research Associate, Research Group Geoinformatics, Institute of Natural Resource Sciences, ocpa@zhaw.ch

To the project "GeoBIM Campus N IUNR" (only available in German)

The project investigated the potential for digital support of site development and certification processes that can be achieved through the intelligent use of Geoinformation systems (GIS) and Building Information Modeling (BIM) to accelerate processes, reduce costs and increase the resulting added value. For this purpose, geodata available in Switzerland as systematically examined and an exemplary GIS database on sustainability aspects of buildings and sites was created. Using the ZHAW-building at Seestrasse 55 in Wädenswil (building RA) as an example, a method was developed to visualize sustainability aspects in such a way that they can intelligently and effectively support the optimization of sustainability in planning processes (Figure 1). The topic-specific applicability of the developed methods and concepts was further deepened in various use cases on circular economy, mobility, and climate resilience. As part of the use case on climate resilience, the ZHAW main building on Grüental campus was assessed using the GREENPASS methodology. The results indicate that there is still a need for optimization, especially with regard to thermal comfort (Figure 2). ■

To the project website GREENPASS methodology (only available in German)

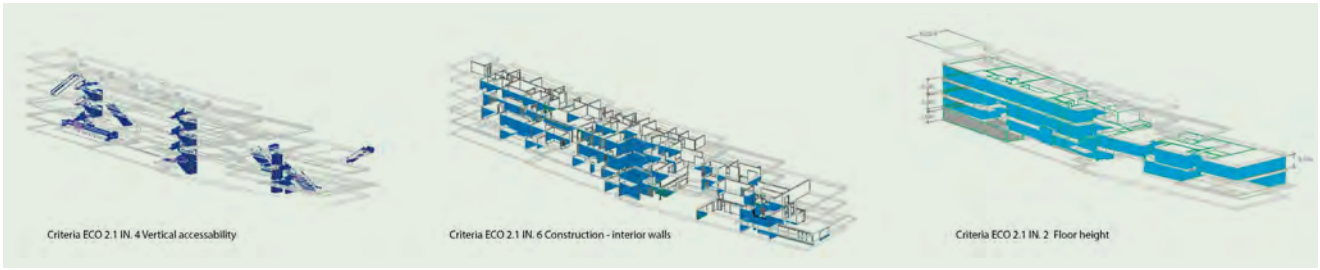


Fig. 1: Visualization model with associated components (e.g. flexibility) at indicator level

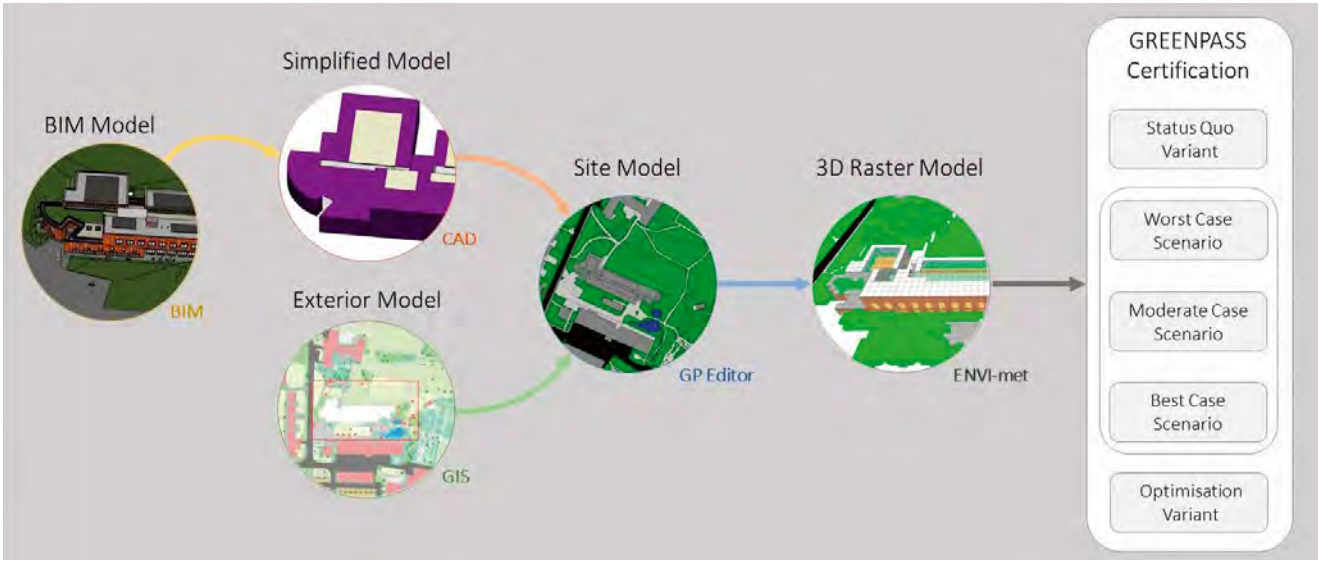


Fig. 2: Greenpass workflow

Urban ecosystems design and modelling

Dr. Chiara Catalano
Research Associate, Research Group Green Space Development, Institute of Natural Resource Sciences
cata@zhaw.ch

Mihaela Meslec
Research Associate, Competency Group Real Estate Management, Institute of Facility Management
mesl@zhaw.ch

DeMo. Urban Ecosystems Design and Modelling: A spatial-based approach to integrating habitats in constructed ecosystems

The project results contribute to easing the climate change crisis by testing and showing which digital workflows can translate the ecologically relevant GIS data and simulations from territorial and urban scale into local net gain biodiversity interventions as part of real estate development projects. The new method for the design and modeling of urban ecosystems was created and tested in a real-case scenario, the ZHAW-campus in Wädenswil (building GA). The project shows the potential of four interconnected digital workflows for a new ecologically informed design approach:

1. Integrate GIS territorial and urban datasets with local scale Building Information Models (BIM) for performing and using the urban ecology simulation results in designing spaces with a biodiversity impact;
2. Enable collaboration and co-creation between ecologists, architects, GIS experts and owners by implementing a BIM Common Data Environment platform to facilitate feedback loops using data from multiple systems;
3. Generate multiple scenarios with parametric design tools based on the ecological data to select the one with a high environmental impact;
4. Visualize, analyze and interact with different design scenarios and datasets with Extended Reality for better decision-making. ■

ZHAW project team: Dr. Chiara Catalano, Green Space Development* (Lead); Mihaela Meslec, Real Estate Management** (CoLead); Nathalie Baumann, Green Space Development*; Prof. Dr. Patrick Laube, Pascal Ochsner, Geoinformatics*; Isabella Aurich, Real Estate Management**

Project partner: ChartierDalix Architekten (www.chartier-dalix.com), TerrOïko (www.terroiko.fr)

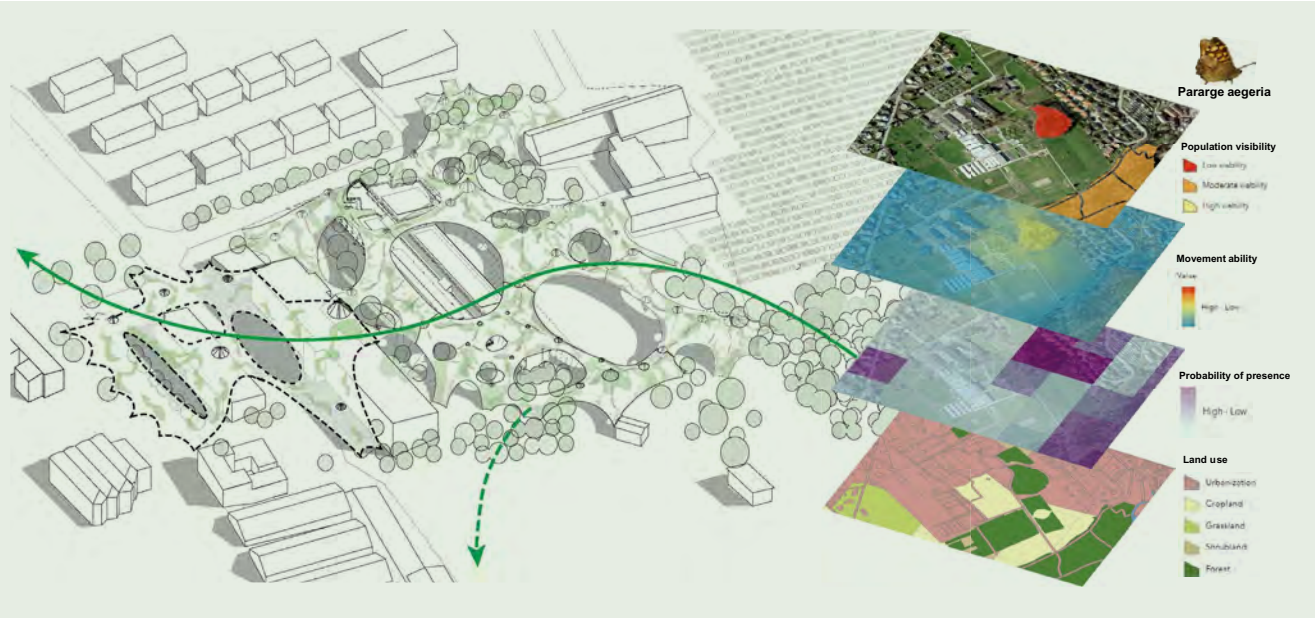


Fig.: Urban transformation for net gain biodiversity (building GA, ZHAW campus, Grüental)

Ecological Engineering Living Lab

Devi Bühler
Research Associate, Research Group Ecotechnology, Institute of Natural Resource Sciences, bued@zhaw.ch

To the project "Ecological Engineering Living Lab"

App «1001 Kreislauf»

Download iOS

Download Andoid

In Ecological Engineering, the processes in nature serve as a model for developing new technologies. As in a natural ecosystem, where nutrients and water circulate, the researchers at ZHAW are developing closed-loop systems that function according to the same principle. The aim is to save resources and minimize the impact on the environment.

With the project "Ecological Engineering Living Lab", visitors can experience the research on circular technologies on Grüental campus. The researchers present six new ways in which resources can be reused sustainably and innovatively in closed-loop systems:

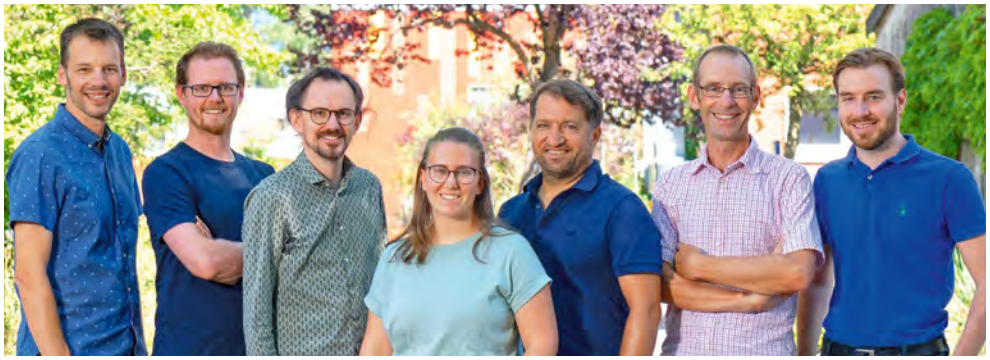
- full cycles instead of empty oceans
- microalgae as do-gooders
- the urban farmer
- food waste
- closed-loop washing machine
- treasure hunt in the toilet

In guided and self-guided tours, visitors can discover the research facilities on campus and, through their visit, become part of the research. The self-guided tour is based on the app "1001 Kreislauf" (only in German) and can be conducted at any time of the day and without pre-registration. Using virtual reality and personal insights into the research activities of the researchers, the app provides a glimpse behind the usually closed greenhouse doors into the interior of the ZHAW's research premises. The same can also be experienced in a guided tour for school classes and interested groups. ■

The principles of closed cycles in the Ecological Engineering Living Lab

Ecotechnology excursions for school classes (excursions only available in German)

Integrated Bio-based Materials Value Chains (BIOMAT)



Team BIOMAT
from left: Dominik Refardt***, Lukas Neutsch*, Gabriel Mäder**, Marina Mariotto***, Selçuk Yildirim**, Christian Adlhart*, Thomas Pielhop*

To the project "BIOMAT (Integrated Bio-based Materials Value Chains)"

The depletion of oil reserves, climate change, significant negative impacts on the environment, and dependency on politically unstable regions are all drivers for seeking alternatives to fossil-based resources. The bioeconomy encompasses the production of renewable biological resources and the conversion of these resources, residues, by-products and side streams into value-added products, such as food, feed, bio-based products, services, and bioenergy. It aims to use 'green' materials instead of fossil-based materials to generate bio-based products.

Within the program, we aim to bring together all relevant expertise at the School of Life Sciences and Facility Management to support a sustainable technological development along the entire value chain of biomaterials. Our objective was to develop sustainable biomass with two different approaches (Figure 1). On one hand, we developed technological processes to produce biomass using microalgae; on the other hand, we used agro-food industry side streams to develop bio-based materials. We also developed innovative processing technologies for the bio-based materials and demonstrated proof of concept for selected applications. ■

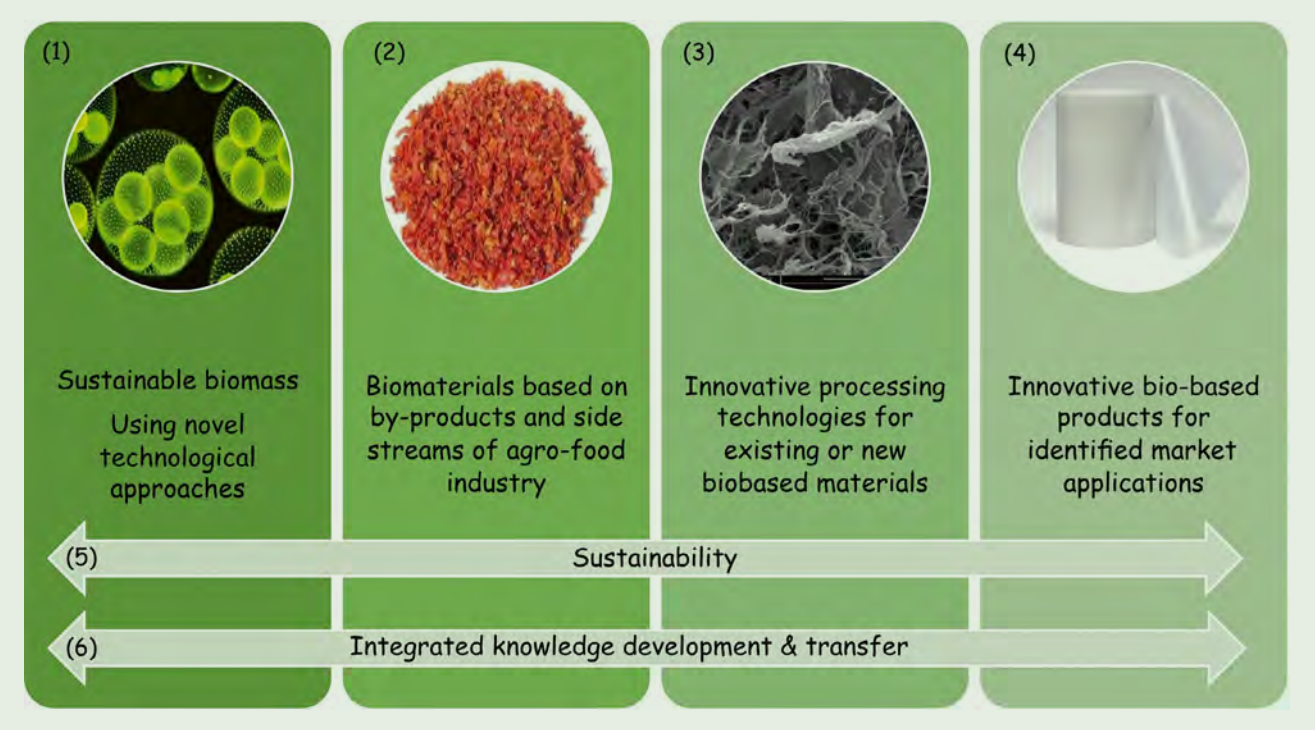


Fig.: Research focus areas of BIOMAT

* Institute of Chemistry and Biotechnology
** Institute of Food and Beverage Innovation
*** Institute of Natural Resource Sciences

Microalgea as a production platform for sustainable raw materials

Dr. Dominik Refardt
Head Research Group Aquaculture Systems,
Institute of Natural Resource Sciences,
refa@zhaw.ch

Dr. Lukas Neutsch
Head Bioprocess Technology Research Group,
Institute of Chemistry and Biotechnology,
neuc@zhaw.ch

Microalgae are a real treasure trove for numerous bio-based substances, such as antioxidants, pigments, lipids or biopolymers. Overall, they are a platform that promises to provide various renewable alternatives to fossil-based products.

Some cyanobacteria are able to synthesize a biopolymer (polyhydroxybutyrate, PHB), which they use as a reserve for carbon and energy. Its accumulation can be triggered by withdrawing certain nutrients, which forces the cyanobacteria to at least save solar energy and CO_2 as PHB. This requires a two-stage cultivation approach, where, initially, biomass growth is promoted under nutrient-sufficient conditions, followed by PHB synthesis under nutrient-depleted conditions. This strategy was verified in the laboratory and then upscaled in an open cultivation system.

At the same time, the opportunity was used to connect PHB production to other existing cycles of matter with the aim of achieving a higher resource efficiency overall. To this end, side streams from other processes, such as biogas production and aquaculture, were used as fertilizer, which, in turn, rendered these processes more environmentally friendly. Using such side streams is challenging, but was possible with appropriate adjustments to the cultivation procedure.

Feasibility demonstrated

The BIOMAT program allowed us to successfully demonstrate the feasibility of phototrophic biopolymer production with the use of side (read: waste) streams from other processes. However, it must also be stated that both productivity and costs are unfavorable when compared to the use of fossil resources, which points to the requirement of reassessing the value of such products.

Fig.: Microalgae, as liquid culture (left) and as paste after dewatering (right). (photo: Tevy, Wädenswil)

This is where more complex procedures for microalgae cultivation, performed in the strictly controlled environment of bioreactors, can play to their strenghts. Protocols and equipment resemble those applied for the biotechnological production of recombinant drugs. The organisms – mostly phototrophic, that is, using light as an energy source – require artificial illumination and automated systems for gas supply, pH regulation, temperature control and mixing.

It is evident that only high-value biomaterials can be considered for such kinds of effort-intense cultivation technologies, but luckily, the domain of microalgae is rich in those. For example, some carbohydrate classes are exclusively formed by the specific biosynthesis pathways found in microalgae. Such "atypical" carbohydrates can serve as biodegradable surfactants, antimicrobial gels or texture-modifying food supplements. They all have in common that viable application scenarios target higher price segments with strict demands in quality and purity.

New production technologies developed

In the context of the BIOMAT program on biotechnological cultivation of microalgae, we developed novel production technologies for such compounds. They are more sustainable and can be combined with equipment already available at many manufacturing sites. Prototypes for customizable illumination systems and new sensor concepts for more accurate monitoring of growing microalgae cultures have been realized. Energy consumption, nutrient uptake, the equilibrium between biomass growth and compound synthesis, as well as mechanical stability and morphology of the microalgae cells, can be controlled more precisely via these methods. All those factors are pivotal to further lower production costs, today one of the main obstacles in taking microalgae-based biomaterials to the market. ■

Use of agro-food industry side streams to develop bio-based materials

Prof. Dr. Selcuk Yildirim
Head of Center for Food Processing and Packaging, Institute of Food and Beverage Innovation, yise@zhaw.ch

Food waste is a topic of concern worldwide as substantial amounts of food end up as waste along the food value chain. This represents not only a resource problem, but also an environmental and economic one, on top of being a moral challenge for modern society.

Among the food waste occurring along the whole supply chain, food waste occurring in the food manufacturing industry (side streams) has huge potential to be valorized since it occurs in very high quantities in more homogeneous forms and contain diverse valuable components and building blocks. A study done at the ZHAW demonstrated that 0.5 million tons (dry weight) of side streams is produced every year in Switzerland. Examples of main side streams include potato peel waste, rapeseed press cake, apple pomace, grape pomace, gelatin, whey protein, spent coffee grounds, cocoa bean husk or coffee bean husks.

Flexible packaging from potato peel

Large quantities of potato peel are produced during the industrial processing of potatoes. These contain valuable biopolymers such as starch, cellulose, pectin and proteins, which are suitable for the production of packaging materials. Within this project, films have been produced from whole potato peels using different processes. Compositions were optimized in a casting process, and the extrusion process was developed to evaluate the upscaling of film production at industrial level.

Fig. 1: Films from potato peels (photo: Tevy, Wädenswil)

Packaging materials from gluten

Another by-product of the food industry that can be used for the production of packaging material is gluten, which occurs in large quantities during starch production. Within this project, we developed gluten-based films using casting methods, which exhibited promising mechanical properties as well as oxygen and water vapor barrier properties. In addition to film production, gluten was processed by compression molding to produce non-flexible products (Figure 2). The mechanical properties of the bio-based materials were further upgraded for different potential applications by optimizing the formulations, such as incorporating coffee grounds as a further side stream.

Fig. 2: Non-flexible products from gluten (photo: Tevy, Wädenswil)

Cellulose and chitin for edible coatings

Cellulose and chitin are widely available bio-based polysaccharides that can be obtained from side streams of the food industry. This project evaluated the potential of these substances as edible protective coatings for fruit. Formulations were developed for different fruits and their influence on the shelf life of the fruits was evaluated.

Fig. 3: Food coated with cellulose and chitin-based coatings (photo: Tevy, Wädenswil)

It was demonstrated that food industry side streams have huge potential for the production of bio-based packaging materials. However, further research is needed to pave the way to industrialization. ■

Processing biopolymers into 3D nanofiber sponges

Prof. Dr. Christian Adlhart
Head of Center for Functional Materials and Nanotechnology, Institute of Chemistry and Biotechnology, adas@zhaw.ch

Nanofibers are 100 to 1,000 times thinner than human hair. They are characterized by a large specific surface area and are used wherever interactions with surfaces are critical. Filters, membranes in protective clothing, coatings of implants or chemical sensors may contain nanofibers. At ZHAW, we have been working for several years on a process to produce ultralight sponges from nanofibers. In this process, the fibers are cut and dispersed. The dispersions are freeze-dried and a highly porous fiber skeleton remains. This is suitable, for example, as a high-performance filter [1] or thermal insulator [2].

Using materials from side streams

In the BIOMAT project, we wanted to replace synthetic polymers such as nylon or the starch-based biopolymer pullulan, with renewable materials from side streams that do not compete with food production. The polysaccharide chitin can be obtained from the cell walls of fungi remains or the exoskeleton of crustaceans. The corn protein zein is a by-product of bioethanol production.

Biopolymers differ from synthetic polymers in that they contain many functional groups, such as OH or NH_2. This often makes them more difficult to process, but offers the possibility of selectively functionalizing the fibers through chemical reactions. In the processing of biopolymers, we want to develop strategies to avoid the use of organic solvents according to the principles of green chemistry, e.g. through the use of aqueous processes. We have succeeded in this with chitosan nanofibers, Figure a, and their conversion into ultralight and highly porous nanofiber sponges [3]. The comparison with a nylon nanofiber sponge [4], Figure b, shows the potential of this by-product from the food industry (Table 1). Although the chitosan nanofibers were slightly thicker and their specific surface area correspondingly lower, the chitosan material was 3 times lighter and consisted almost entirely of air (99.6 % porosity). The 8-fold stiffness with a modulus of 43 kPa was impressive.

Property	Nylon	Chitosan
Fiber diameter / nm	175	309
Specific surface area / $m^2\ g^{-1}$	13	8.4
Bulk density / mg cm^{-3}	16.6	5.8
Porosity / %	98.5	99.6
Effective modulus / kPa	5.3	43

Table 1: Properties of nylon and chitosan nanofiber sponges.

In practice, we used the material as a filter for microplastics. In model tests > 99.4 % of all particles were removed. Since the sponge was flexible, liquids could be pumped through the filter by mechanical movements like an oyster [3]. We are currently working on zein-based nanofiber sponges. Characterized by a hydrophobic surface, they are suitable for separating water-in-oil emulsions, Figure c, or removing oil spills, Figure d, similar to our silane-modified pullulan sponges [5]. This is because these materials can absorb more than 100 times their own weight in oil. Although we assume that the bio-based nanofiber sponges are biodegradable, thus closing the material cycle, we have yet to confirm this in the context of BIOMAT. ■

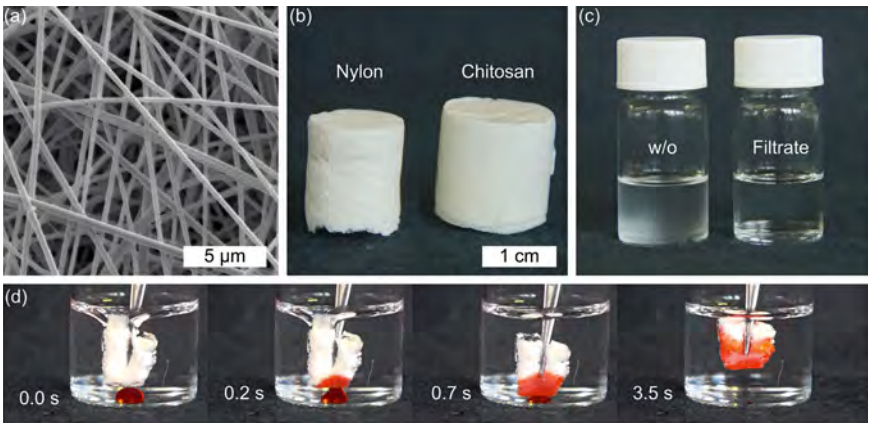


Fig.: (a) Scanning electron microscope (SEM) image of chitosan nanofibers; (b) crude oil based nylon and biomaterial based chitosan nanofiber sponge; (c) water-in-oil emulsion and filtrate after passage through chitosan nanofiber sponge; (d) rapid uptake of sudan red dyed chloroform from water.

[1] Deuber, F.; Mousavi, S.; Federer, L.; Hofer, M.; Adlhart, C. *ACS Appl. Mater. Interfaces* 2018, *10* (10), 9069, 10.1021/acsami.8b00455. **[2]** Zhao, S.; Emery, O.; Wohlhauser, A.; Koebel, M. M.; Adlhart, C.; Malfait, W. J. *Mater. Des.* 2018, *160,* 294, 10.1016/j.matdes.2018.09.010. **[3]** Risch, P.; Adlhart, C. *ACS Appl. Polym. Mater.* 2021, *3* (9), 4685, 10.1021/acsapm.1c00799. **[4]** Mousavi, S.; Filipová, L.; Ebert, J.; Heiligtag, F. J.; Daumke, R.; Loser, W.; Lederger-ber, B.; Frank, B.; Adlhart, C. *Sep. Purif. Technol.* 2022, *284,* 120273, 10.1016/j.seppur.2021.120273. **[5]** Deuber, F.; Mousavi, S.; Federer, L.; Adlhart, C. *Adv. Mater. Interfaces* 2017, *4* (12), 1700065, 10.1002/admi.201700065.

Towards sustainable and regenerative agri-food systems

Prof. Dr. Tilo Hühn
Head Center Food Composition and Process Design, Institute of Food and Beverage Innovation, htil@zhaw.ch

Thomas Bratschi
Head Business Area Development, School of Life Sciences and Facility Management, brat@zhaw.ch

The path through the ongoing crisis seems to be mapped out. Not only the number of people populating this planet is increasing, but, at the same time, the amount of resources they consume is growing. The fact that world overload day is getting closer and closer to the beginning of the year, and that the turning point for the global climate will most likely be reached already in the middle of the decade, is causing concern. Where the individual seeks compensation, the effects on climate, water and biodiversity often remain secondary. Whether through the wars between humans or the war we are waging against the planet, the crisis as a culmination could lose its effect and become permanent. In addition to individual sensory, nutritional and occasion-related suitability, the impact on planetary health as a whole system is becoming increasingly important for the acceptance of food.

The associated challenges concern not only the climate and water consumption, but also biodiversity in particular. Approaches that lead to regenerative production and consumption processes are therefore becoming increasingly important. This starts with the sustainable primary production of raw materials, the creation of value from all flows with a focus on direct human nutrition, the prevention/reduction of food waste at all levels of the value network, the reduction of energy and resource consumption, which should come from regenerative sources, and expresses itself in the form of long-term, and thus grandchild-friendly, circular business models.

Four years ago, we set out on the search for creative and resonant solutions in the field of agri-food business together with many other very different people – an alliance of the willing and capable, a master's degree course and many valuable insights that flowed into it were created. ■

New education systems in the food network – a new master's is being created

Master of Science in Preneurship for Regenerative Food Systems

Maya Ladner
Program director Master of Science in Preneurship for Regenerative Food Systems,
wiey@zhaw.ch

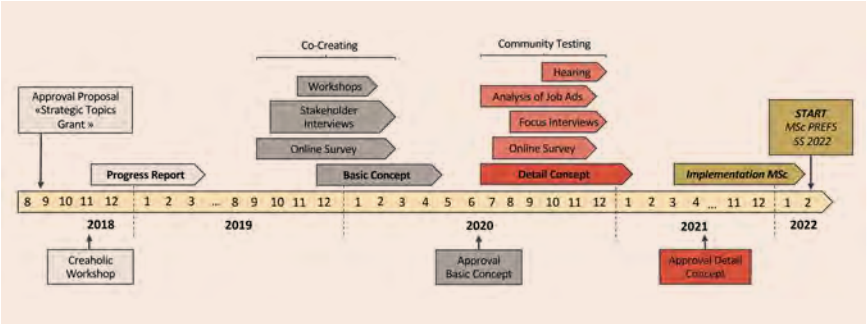


Fig. 1: Development of the new program

"In the next 40 years, we need to produce the same amount of food as in the last 8,000 years" (van den Ende, 2017). Driven by this seemingly insurmountable task, the question of what training people need to bring about the necessary systemic change in food systems was explored from fall 2018. Over the following two-and-a-half years, the MSc in Preneurship for Regenerative Food Systems was developed in a large-scale co-creation process.

Forward-looking product

The co-creation served to involve all relevant demand groups in the development. Based on a comprehensive market analysis, a training program was developed involving all relevant stakeholders. The basic idea of the study program affects many areas and actors, so it was useful to involve as many parties as possible in the development process from the beginning, and to regularly obtain and consider the input of these stakeholders. After all, the new, forward-looking educational product should be of high value for students, universities, employees, employers and founders. In addition to input from the institutes, schools and members of the core team, numerous experts and interested parties were involved in the development of, and continuous reflection on, the concept. It was precisely this interdisciplinary collaboration that repeatedly gave new energy to the development process and led to creative solutions to challenging problems.

Co-creation process

The numerous interviews, online surveys and co-creation workshops provided an excellent basis for sharpening the concept of the master's degree program with other experts inside and outside the ZHAW. The drafts for the educational program were continuously created with a broader, interested mass, prototypes were developed from them and repeatedly reflected on with the community. This iterative process, in which people from outside the field were also repeatedly involved, allowed the development of a master's close to the market. The agile approach allowed ideas and concepts to be tested at an early stage: valuables were retained, inconsistencies were improved or omitted. The exchange with all stakeholders clearly showed that specialists for change processes are needed to meet the challenges in the agri-food sector. The visions of the core team developed more and more into concrete educational systems.

The master's degree that emerged through the co-creation process combines the topics of entrepreneurship, food value creation, digitalization and sustainability. The competence development in this novel combination of topics is driven by an innovative educational concept with Open Curriculum. The students follow their path in a self-organized and intrinsically motivated way. They enable themselves to develop their competences individually, and to apply, test, and further develop them in teams and projects.

Start of the program

The concrete implementation of the study program was started in June 2021, and 25 students have been on their individual yet collaborative paths to think the food systems of today in a more regenerative way since February 23, 2022. The overall goal of the program is to train professionals who, upon completion of their MSc studies, will have the competence to increase the resilience and regenerative capacity of agri-food systems through innovation interdisciplinarity and entrepreneurship. ■

Fig. 2: First students to start

Cocoa in Numbers – from data to knowledge

To the project "Cocoa in Numbers – from data to knowledge"

Prof. Dr. Irene Chetschik
Head Research Group Food Chemistry*, chet@zhaw.ch

Karin Chatelain
Research Associate*, geka@zhaw.ch

Regula Keller
Research Associate**, kelg@zhaw.ch

Prof. Dr. Susanne Miescher Schwenninger
Head Research Group Food Biotechnology*, mies@zhaw.ch

Sonja Trachsel
Research Associate**, trso@zhaw.ch

Tim Walder
Research Assistant***, wadd@zhaw.ch

In an interdisciplinary project funded by the School of of Life Sciences and Facility Management strategic program Agro-Food-Business, a database was developed with the overall aim of generating insights into different dimension of the cocoa value network and achieving greater transparency within it.

For this reason, data from life cycle assessment, social analysis, agronomy, post-harvest processing sensory and chemical constituent analysis was gathered and linked with the existing regulatory requirements within the cocoa value network, providing a new starting point to redefine cocoa quality, safety, and sustainability. Nowadays, consumers of cocoa and chocolate products are not only interested in safe, high-quality products, but also in products which are produced using environmentally friendly methods and under fair social conditions. The demand and, consequently, the necessity, for more transparency in all parts of the value chain is ever growing, ultimately benefitting all stakeholders involved. Among other things, existing databases already cover agronomical aspects, genetic information, or sensory data separately. The idea of combining the diverse data by applying state-of-the-art non-relational graph database techniques offers the potential for modeling the value chain all at once.

Objectives

We intend to generate a database that gives an insight into agronomical, ecological, economic, regulatory, and social aspects, as well as into food quality and safety markers throughout the whole cocoa value chain – from tree to bar – readily accessible for all stakeholders.

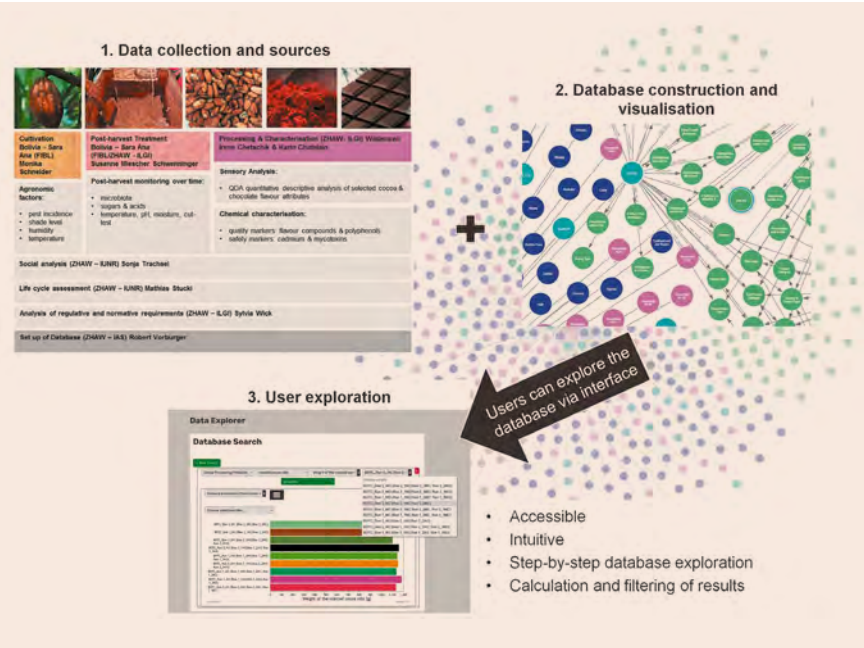


Fig.: Setup of the Cocoa in Numbers database

Methodology

For the setup of the database, model experiments were conducted at the SysCom research station of Research Institute of Organic Agriculture (FiBL) in Sara Ana, Bolivia. For this project cocoa beans deriving from defined cultivation systems were fermented and dried under standardized conditions. Data was collected on agronomic factors, influencing factors of post-harvest processing, chemical constitution, sensory characteristics, environmental impact, social aspects, and regulatory requirements at all stages of the cocoa value chain. The structure of the graph database was set up based on the collected data, the taken samples, their tested attributes and their place in the coca value chain. Furthermore, an intuitive interface allowing all stakeholders to easily explore and query the database was designed.

Results and outlook

The collected data allowed for successful modeling of relationships between certain parameters analysed in the different dimensions of the cocoa value network. Furthermore, the graph database model allowed for the establishment of complex correlations and predictions concerning quality within cocoa value chain networks, thus becoming a promising future tool to achieve greater transparency in the cocoa value chain. It could further help producers to disclose their product qualities for sales promoting activities, and be a useful tool for consumers to choose products with desired quality and safety requirements if the corresponding data can be acquired through new project partners. ■

* Institute of Food and Beverage Innovation
** Institute of Natural Resource Sciences
*** Institute of Applied Computational Life Sciences

Improving traceability in the cocoa value chain

Dr. Martina Bozzola
Research Associate, Institute of Natural Resource Sciences, bozz@zhaw.ch

Prof. Dr. Raushan Bokusheva
Head Research Group Agricultural and Resource Economics, Institute of Natural Resource Sciences, boku@zhaw.ch

The overarching objectives of the project were improving traceability in the cocoa value chain and reducing information asymmetries between primary producers and processors/consumers. The work plan aimed at developing an established program of research activities related to agri-food value chains in cocoa and possibly other agricultural commodities, e.g. coffee.

Better understanding

This project contributed to private and public sector companies and institutions working in agri-food global value chains by fostering information sharing, and a better understanding of the drivers of and barriers to the adoption of productive and sustainable practices along the cocoa and coffee value chains. The key findings from this research were summarized in Chapter 2 "Sustainable Is The New Normal" in the Coffee Guide, published in 2021 by the International Trade Center (International Trade Center (2021). The Coffee Guide. ICT, Geneva*. Although the original objective of this project was to focus on the cocoa value chain, many of the conducted research and outreach activities focused on the coffee value chain. This was done for two reasons: 1. as a contingency plan to cope with some changes in the overall program activities (in particular the unavailability of cocoa farmers' data expected at the time of writing the proposal, and the decision of another team to also focus on coffee as main value chain of interest) but also 2. because new opportunities for collaboration and research emerged related to the coffee value chains. It is important to note, however, that the coffee and cocoa value chains have many similarities, and the overarching goals of the project, in particular to reduce information asymmetries between primary producers and processors/consumers, were achieved and not changed.

Outreach activities

Co-organized and moderated 6 webinars: The team has co-organized a series of 6 webinars called "Alliances Pour le Secteur du café Robusta en Afrique et Madagascar" in partnership with the International Trade Center (ITC), a joint agency of the UN and the WTO, and the Agence des Cafés Robusta d'Afrique et de Madagascar (ACRAM). The ARE team's work covered all aspects of this activity, from the logistic to the co-design of the program, to specific input to some webinars' content. Once the 6 main topics had been identified in partnership with ITC and ACRAM, the ARE team selected and conducted preparatory meetings with the speakers, well-established researchers and practitioners within the chosen topics (generally 3 speakers per webinar). In addition, Dr. Bozzola moderated four out of six webinars. ZHAW collegue Prof. Dr. Chahan Yeretzian, Head of the ZHAW Coffee Excellence Center, was also invited as a speaker to the webinar 1, titled "Démistifier la qualité du café". In line with the overall objective of the AGFB project, the main objective of this initiative was to bring together experts from a variety of disciplines related to the coffee value chain, and launch a knowledge-sharing platform to discuss topics of high relevance and importance to improving the efficiency and sustainability of the coffee value chain, with both an international and regional (Africa Robusta coffee producing countries) perspective. The speakers involved were selected from all stages of the value chain, including organizations of primary producers, processors, researchers, traders, etc.

Webinar titles and covered topic

1. Demystifying coffee quality (98 participants)
2. Promoting sustainability to build resilience (98)
3. Finance and investment in coffee (104)
4. Farmer cooperatives, coffee production and promotion (92)
5. Branding and communication in coffee (92)
6. Coffee market outlook and trends – the potential of finding new markets (83) ■

* International Trade Centre (2021). The Coffee Guide. ITC, Geneva.

The coffee blockchain – from field to cup

Matthias Stucki
Head Research Group Ecotechnologies and Energy Systems*, stck@zhaw.ch

René Itten
Research Associate, Research Group Life Cycle Assessment*, ittn@zhaw.ch

Roland Gassmann
Research Associate, Research Group Knowledge Engineering**, garo@zhaw.ch

Patrick Lütolf
Research Associate, Business Area Development, luel@zhaw.ch

As part of the Agro-Food Business program, an interdisciplinary team investigated concrete applications for blockchain technology in the agri-food business. In cooperation with a coffee trader, a coffee roaster and a retailer, the researchers examined the goal of enabling greater co-determination and inclusion of end consumers. For this purpose, they analyzed the options with a "public blockchain". They also investigated the possibilities of a "private blockchain" for the sustainability assessment of coffee.

The idea behind CoffeeCoin

As a first possible application, the idea of a CoffeeCoin was tested: the objective of CoffeeCoin was to make it possible to include coffee consumers in the coffee value creation network via a blockchain-based, sustainable currency. In concrete terms, a CoffeeCoin in the form of a code is automatically delivered with the purchase of a pack of coffee. Via a platform, coffee consumers are given the opportunity to invest in projects within the value chain. To ensure that the choice of projects and the financial flows are transparently documented, a public blockchain works in the background, transparently recording all transactions. The vision of the CoffeeCoin is to build a socially oriented community that sensitivizes coffee consumers to all actors within the coffee value creation network. The CoffeeCoin gives consumers the opportunity to invest in measures that benefit the value network. Ultimately, this should create a bridge between producers and consumers.

The idea behind using blockchain

Also for the example of coffee, as a second application, it was investigated which possibilities the blockchain application offers for the data management of life cycle assessment models. In a first step, a life cycle assessment was carried out for a coffee value chain system in eight different countries. The aim was to quantify the environmental impact of coffee grown in South and Central America and Africa, roasted in Switzerland and consumed in Europe. The data for the models was collected from coffee traders and coffee processors. The carbon footprint of a cup of black coffee ranged from 64 g CO_2-eq to 96 g CO_2-eq. The main hotspots in the life cycle of a prepared cup of coffee were cultivation and coffee preparation. In a second step, based on the LCA for coffee, an automated routine for calculating the results of the LCA and a blockchain solution for managing the key model parameters were developed, allowing transparent input and transmission of the input data for the LCA. A private blockchain with smart contracts was implemented and a decentralized application (DApp) with a user interface for interacting with the data was established.

The project "Coffee Blockchain" has shown that there are various possible applications of blockchain with benefits for more sustainable value chains in the agri-food business. While blockchain technology is currently also associated with various negative impacts such as high energy consumption, the technology is undergoing a major transformation and is constantly evolving. It has been shown that blockchain technology has the potential to enable simplified data management and individualized analysis for all actors within the supply chain. In principle, blockchain offers many opportunities to strengthen transparency, participation and solidarity in the agri-food business. ■

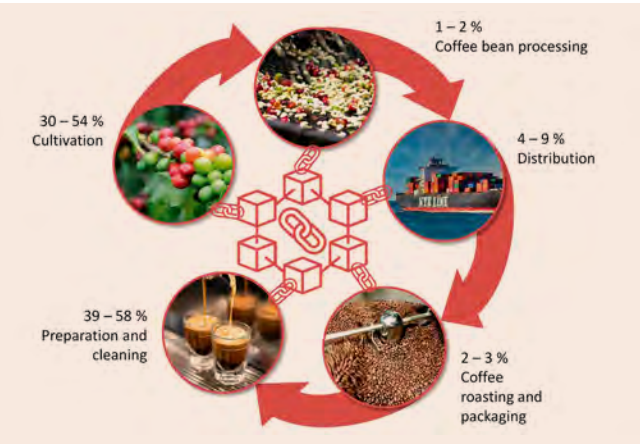


Fig. 1: Shares of a carbon footprint of a cup of coffee. Source: ZHAW & Pixaby

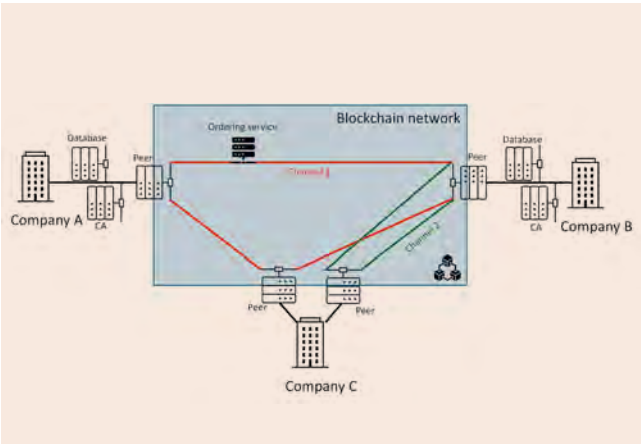


Fig. 2: Schematic representation of the implemented blockchain network. Source: ZHAW

* Institute of Natural Resource Sciences
**Institute of Computational Life Sciences

Interdisciplinary collaboration in health research

The strategic program Health Research Hub developed an institutional network by connecting research groups within the School of Life Sciences and Facility Management (LSFM) that addressed current topics in health-related research. The new interdisciplinary teams have proposed novel directions in health-related research based on the combined strengths of the contributing researchers.

Quotes of the members in the scienific comitee / *Chairman:

"Improving health and medical treatment options has been the overarching goal in many of our life-science-oriented research activities. The broad subset of involved disciplines, however, often poses a barrier to effective translational R&D. In the form of new competence centers on bacteriophage applications, collaboration platforms for digital tools in healthcare, and industry-nested projects catalyzed by HRH, the initiative continues to create impactful and lasting value."

Dr. Lukas Neutsch
Head Bioprocess Technology Research Group, Institute of Chemistry and Biotechnology, neuc@zhaw.ch

For further information about Health Research Hub and the interdisciplinary projects.

"The funding of the Health Research Hub allowed many of us to fully concentrate on a specific research project. In some cases, the results were submitted to peer-reviewed journals, which greatly enhanced our visibility to research partners in both industry and academia. Such funding is very valuable and should be extended, if possible."

Prof. Dr. Lars Fieseler
Head Center for Food Safety and Quality Management, Institute of Food and Beverage Innovation fiee@zhaw.ch

"Particularly in a heterogenous schools such as ours, we need active topic connectors and interdisciplinary matchmakers to create extraordinary R&D project partnerships. The Health Research Hub has proven that it is able play this role, and will hopefully continue to assist many more projects and initiatives in the healthcare context."

Dr. Nicole Gerber
Lecturer, Hospitality and Service Management Group, Institute of Facility Management, geri@zhaw.ch

"What started with the request to find out more on health research at LSFM, quickly grew very large, showing that health research is a more hidden pillar of the school. The activities of the Health Research Hub and the funded research projects have visualized this in an impressive manner."

Prof. Dr. Theo Smits
Head Research Group Environmental Genomics and System Biology, Institute of Natural Resource Sciences, smih@zhaw.ch

"This initiative was very effective in linking researchers within the school, within ZHAW and beyond. Here, we established the ZHAW Digital Health Lab, which is now a productive platform to coordinate grant applications, manage large interdisciplinary projects, and promote digital health nationwide."

Prof. Dr. Sven Hirsch*
Head Center for Computational Health, Institute of Applied Digital Life Sciences, hirc@zhaw.ch

Additional in the team of Health Research Hub: **Sören Werner,** former Research Associate at the Institute for Chemistry and Biotechnologie / **Athina Papadopoulou** and **Maya Barben,** program manager

Bayesian network analysis for data-driven decision support

Dr. Georg Spinner
Lecturer, Research Centre Computational Health, Institute of Computational Life Sciences,
spnn@zhaw.ch

Dr. Nicole Gerber
Lecturer, Hospitality and Service Management Group, Institute of Facility Management,
geri@zhaw.ch

Bayesian networks (BNs) are statistical models with an easy-to-understand graphical representation. They can analyze and visualize dependencies between many variables. The goal of the project was to examine the usefulness of BNs when applied to data in the health context. Intracranial aneurysms (IAs) and hospital catering processes were chosen as respective use-cases for the analysis. While BN could uncover dependencies within large and detailed medical datasets of IAs, this could not be done when applied to a much smaller, less detailed and anonymized dataset in hospital catering management. In combination with simulation replacing missing data with synthesized data, we showed that BN can potentially uncover dependencies in the hospital catering processes. The project offered not only the possibility to develop know-how in the application of BN and modeling, but also provided a basis for several affiliated initiatives and further projects, as well as interdisciplinary exchange within the school. ■

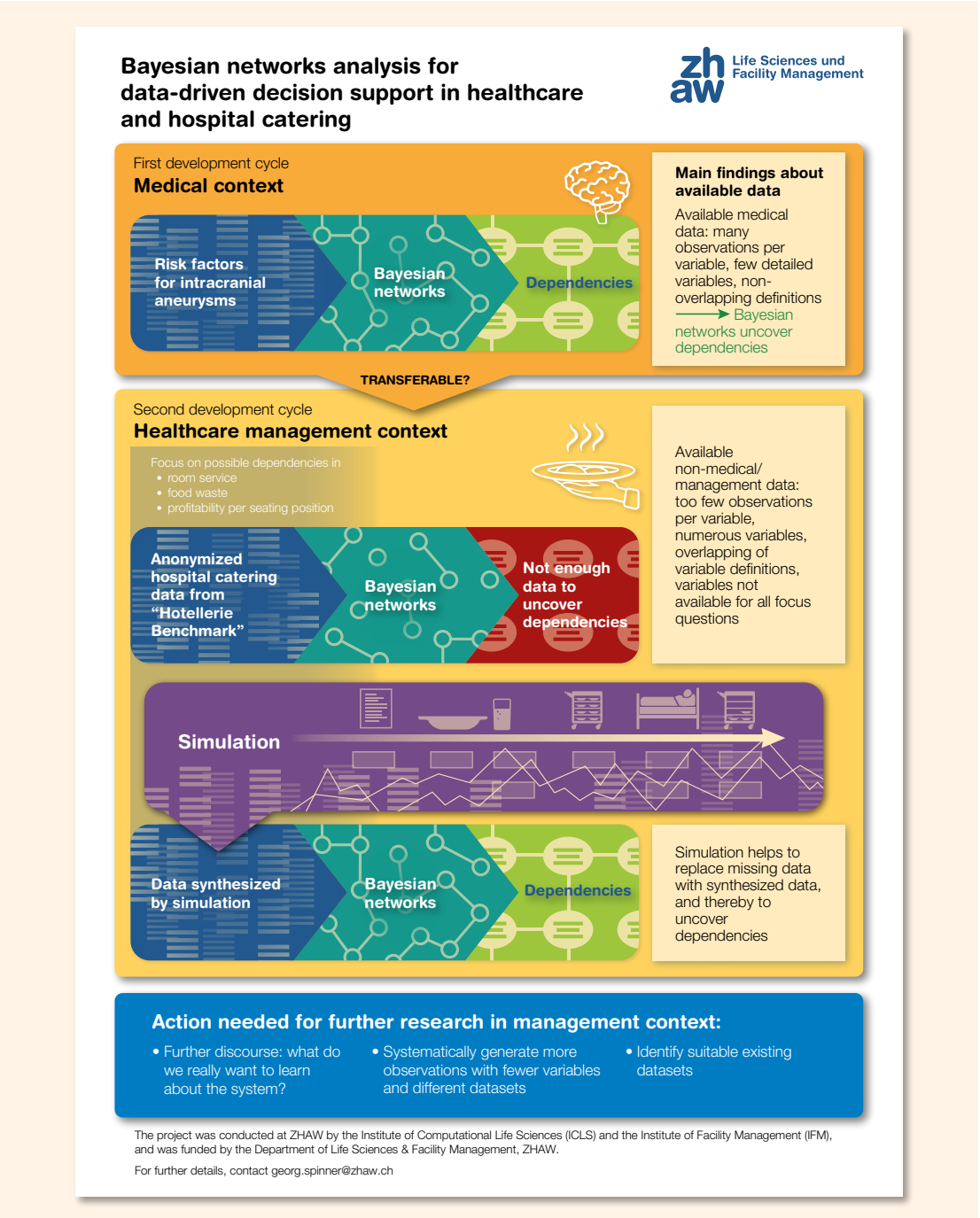


Fig.: Bayesian networks analysis for data-driven decision support in healthcare and hospital catering

Activation of biological compound production in actinomycetes

Prof. Dr. Martin Sievers
Head Centre of Molecular Biology and Microbiology, Institute of Chemistry and Biotechnology, sima@zhaw.ch

Actinomycetes strains of the ZHAW collection were analyzed in a primary and secondary screening for their ability to inhibit *Escherichia coli* and *Staphylococcus aureus.* Several known compounds with antibacterial activities were identified from the cultivated actinomycetes strains (Arn et al. 2020, doi: 10.2533/chimia.2020.382). A promising compound F108 was identified from one *Streptomyces* strain isolated from the Canton of Zurich, which is able to inhibit antibiotic resistant gram-positive bacteria. F108 was further investigated for compound novelty. To unlock the full potential of antibiotic production, the CRISPR-Cas9 plasmid pWHU2659 obtained from Prof. Yuhui Sun, Wuhan University, was used to develop a strategy for promoter exchange in an isolated *Streptomyces* strain to induce transcription of an identified silent biosynthetic gene cluster. Using the pWHU2659 plasmid in our laboratory, we deleted the *actinorhodin* biosynthetic gene cluster in *Streptomyces coelicolor* M145 to confirm that CRISPR-Cas9 is an efficient tool for gene editing in *Streptomyces.* ■

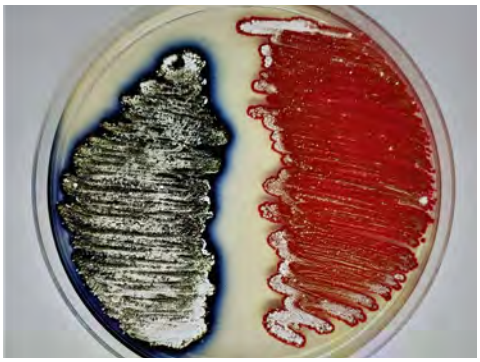


Fig.: Deletion of the *actinorhodin* biosynthetic gene cluster of *Streptomyces coelicolor* M145 using CRISPR-Cas 9 with the plasmid pWHU2569 obtained from Prof. Yuhui Sun, Wuhan University, China. The wild type *S. coelicolor* M145 has a blue color appearance based on actinorhodin pigment production. The mutated strain (ΔactI-ORF2, based on CRISPR-Cas9) showed a red color from undecylprodigiosin visible after loss of the blue pigment actinorhodin (picture from David Frasson and master thesis from Simone Coppo, 2020, ZHAW).

Strategies to reduce mycotoxins

Prof. Dr. Nadina Müller
Head Research Group for Food Technology*, munn@zhaw.ch

Prof. Dr. Susanne Miescher Schwenninger
Head Research Group Food Biotechnology*, mies@zhaw.ch

Prof. Dr. Irene Chetschik
Head Research Group Food Chemistry*, chet@zhaw.ch

Katrin Hecht
Research Associate**, hect@zhaw.ch

Wheat is part of the daily diet of a majority of people worldwide, but is often contaminated with molds, and may, in consequence, contain mycotoxins. In this project, an interdisciplinary team consisting of researchers from Food Biotechnology, Food Chemistry, Biocatalysis and Food Technology jointly tested the efficacy of two main strategies to reduce mycotoxins in wheat. The effectiveness of a pre-treatment of wheat kernels through cold needle perforation was proven through a qualitative visual analysis method. Mycotoxins were successfully degraded into less-toxic compounds by both enzymes and microorganisms, and the efficacy proven through a novel, highly sensitive analysis method. The approaches shall be developed further in consecutive projects and requirements for a market introduction will be assessed. ■

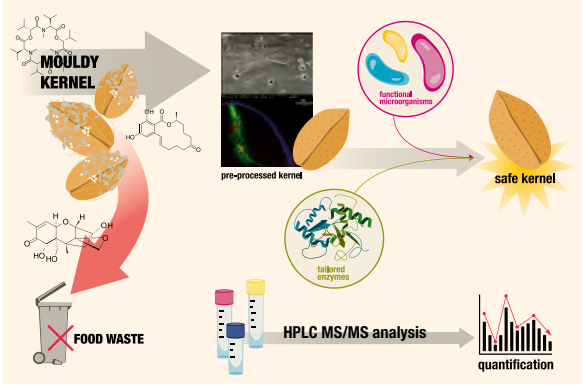


Fig.: Moldy kernels were pre-treated with cold needle perforation (CNP) before being treated with functional microoganisms and enzymes. HPLC MS/MS was employed to quantify mycotoxin reduction induced by microoganisms and enzymes.

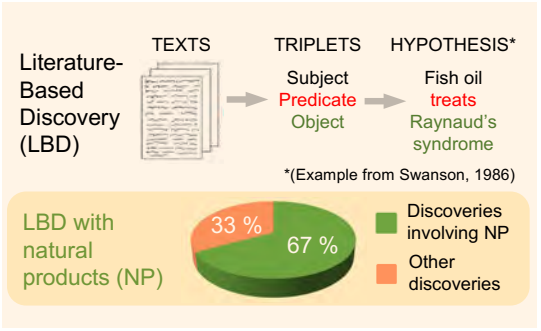
* Institute of Food and Beverage Innovation
**Institute of Chemistry and Biotechnology

Computational literature-based natural product drug discovery

Dr. Manuel Gil
Head Research Group Biomedical String Analysis, Institute of Computational Life Sciences, giln@zhaw.ch

Dr. Andreas Lardos
Head Research Group Natural Product Chemistry and Phytopharmacy, Institute of Chemistry and Biotechnology, lard@zhaw.ch

Natural products such as medicinal plants and extract mixtures have successfully supported the discovery of pharmaceuticals. Medically relevant products and their properties are often found through systematic analysis of the literature. In the 1980s, Swanson found hidden links between pieces of knowledge in the scientific literature using a manual algorithm, suggesting that literature-based discovery (LBD) can be automated. Swanson formulated clinically relevant hypotheses, which were confirmed in trials. LBD has become widespread, but little has been done to automate it in the field of natural product drug discovery. In our project, we are devising an automated LBD system for natural product drugs using state-of-the-art Semantic Web technologies. To this end, we are developing and employing state-of-the-art biomedical natural language processing. The system will reduce discovery time by saving time in evaluating literature for drug development, and is also relevant to safety and pharmacovigilance aspects.
We use Natural language processing to extract statements from biomedical scientific texts. The statements are so-called triplets of the form subject – predicate – object. Two example triplets are "fish oil" – reduces" – "vascular reactivity" and "vascular reactivity" – "is high with" – "Raynaud's syndrome". Triplets that share terms can be linked to form new hypotheses. The two example triplets can be linked via the term "vascular reactivity" to form the hypothesis "fish oil" – "treats" – "Raynaud's syndrome". About one third of all published biomedical literature-based discoveries are in the domain of natural products. ■



Natural language Processing methods extract triplets in the form subject-predicate-object from the scientific literature. Two triplets that share a term can be connected to postulate new hypotheses that are implicitly present in the literature. Most such discoveries involve natural products.

Fighting bites with bytes – Promoting public health with crowdsourced tick prevention

Prof. Dr. Theo Smits
Head Research Group Environmental Genomics and System Biology, Institute of Natural Resource Sciences, smih@zhaw.ch

People have good reasons for being afraid of ticks. They are currently on the rise and transmit several infectious diseases, leading to serious illness or even death. Since March 2015, the smartphone application "Zecke – Tick Prevention" helps people, bitten by a tick, to deal with a tick bite. In this project, the reported tick incidences were used to find out more about spatial patterns of the tick risk distribution. The machine-learning models developed in this project combine the rich but uncertain user-generated data from the app with further spatial data (e.g. population density, vegetation and land-use cover, climate/weather data) to predict tick risk across Switzerland. The newly developed model and methods will evoke the interest of the broad public due to its Citizen Science aspect, and by addressing an emotionally charged health topic that has become everyone's concern. ■

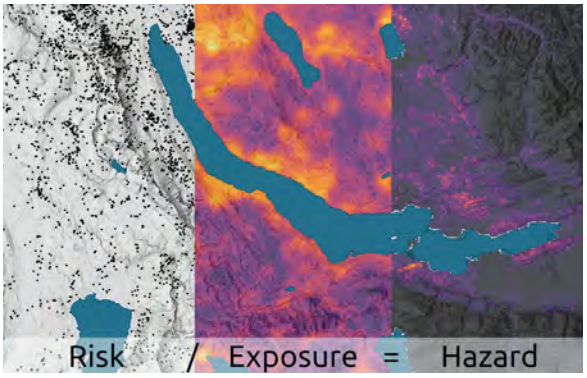


Fig.: Tick encounters ("risks"), which are derived from the reports, are normalized with human outdoor activity ("exposure") to model tick occurrence ("hazard")

Molecular mechanism of bacteriophage tailspike proteins in bacterial infection

Prof. Dr. Sabina Gerber
Head Centre for Biochemistry and Bioanalytics, Institute of Chemistry and Biotechnology, gern@zhaw.ch

Prof. Dr. Lars Fieseler
Head Center for Food Safety and Quality Management, Institute of Food and Beverage Innovation, fiee@zhaw.ch

Antibiotic resistance of human pathogens against multiple antibiotic agents is more and more becoming a serious threat to human health worldwide. Bacteriophages (phages) represent an attractive alternative to classical antibiotic drugs. However, molecular mechanism during infection is not well understood. Infection of host bacteria by phages is known to be mediated by phage proteins, so called tailspike proteins, among others. The focus of the project was to investigate the characteristics of these proteins, which would lead to a better understanding of the infection process itself. Tailpike proteins were produced as separate components from the phage and characterized with different bioanalytical methods. The data generated yielded a variety of novel insights into this class of proteins, demonstrating multiple host specificities within one phage, elevated thermal stability, requirements for catalytic activity, domain requirement for stability and activity. ■

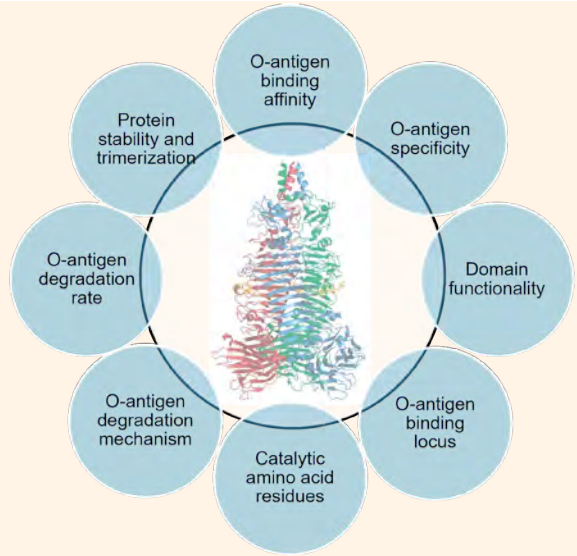


Fig.: Structural characteristics and reaction mechanism of the bacteriophage tailspike proteins. Middle: Cartoon representation of a tailspike protein crystal structure of the bacteriophage CBA120, PDB 5w6s (Pymol)

Engineered bacteriophages for the control of *E. coli* O157

Prof. Dr. Lars Fieseler
Head Center for Food Safety and Quality Management, Institute of Food and Beverage Innovation, fiee@zhaw.ch

Dr. Lukas Neutsch
Head Bioprocess Technology Research Group, Institute of Chemistry and Biotechnology, neuc@zhaw.ch

Bacteriophages are the natural enemies of bacteria. In nature, they control bacterial populations and are one of the driving forces for evolution, because they cannot only kill bacteria but also introduce novel DNA, e.g., genes, into a bacterial cell. In this research, we combine both properties. *E. coli* O157, a severe human pathogen, is controlled by a specific phage. In addition to cell lyses, the phage delivers novel factors to specifically neutralize toxins encoded by the bacteria. Thereby both, the pathogenic bacterium and its toxins, are treated in parallel. It is currently still unclear how phages are best produced for routine medical applications under strictly controlled conditions. We have therefore established new concepts for the continuous propagation of phages in bioreactor systems, similar to those used in biomedical manufacturing. Novel, high-throughput assays and sensors for monitoring the production process were used for rapid optimization of phage yields. ■

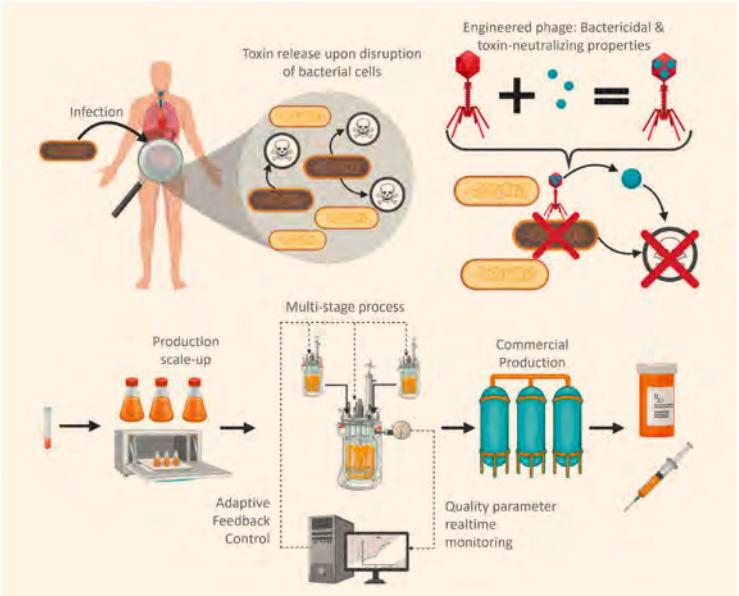


Fig.: Engineered bacteriophages for the control of *E. coli* 0157

Digital Transformation

Team Digital Transformation
from left: Daniela Lozza, Jos Hehli, Beatrice Dätwyler, Thomas Ott, all ZHAW and Barbara Schnyder, Innoversum

To the program "Digital transformation"*

The three-year strategic program "Digital Transformation" is an initiative of the ZHAW School of Life Sciences and Facility Management (LSFM). It was initiated by the Dean of the School.

Vision

The aim of the Digital Transformation program is to enable students and participants in continuing education programs to deal with digital challenges of a social and professional nature, to actively shape the digital transformation and to critically reflect upon it.
Students acquire these new competencies and skills through inquiry-based learning, which is enabled by (1) people who share this culture and mindset, (2) processes, and (3) a campus and infrastructure that supports exploratory and digital learning as well as teaching formats and content. Lecturers, researchers and administrative staff are actively involved, networked and supported as important sponsors of the initiative. In this way, we are strengthening the long-term image of the ZHAW as a forward-looking educational institution in the digital arena.

Approach

The initiative focuses on the needs of students, participants in continuing education, and employees in the context of the digital transformation. In the process, several premises of today's university organization have been consciously called into question. Operating parameters for inter-institutional collaboration were created and initiatives were launched bottom-up from established communities.

2019 – Start

From the beginning, the central question was what skills the people of the School will need in the future to master the digital transformation. The focus has been on competencies that are relevant in the context of life sciences and facility management, and do not apply to the ZHAW in general. The question was approached through interviews and workshops with students, alumni, employers, and teachers.

"Future Skills" report*

In parallel, the first projects were quickly financed and promoted by means of short pitch presentations instead of long application letters.

All project descriptions and objectives achieved can be found here*

The information derived from these activities was condensed into seven "Future Skills" that will be relevant for the School in the future.

The results from the skills phase were presented on an open day, which anyone could attend. Those present were able to actively contribute to shaping the future of the University. In order to do justice to the multidimensional nature of the transformation, the Future Skills perspective was expanded to include the concept of "People-Places-Processes". The guiding question of the second analysis was which priorities the school can and must set within the dimensions of people (e.g. role of teachers), places (e.g. physical and virtual campuses) and processes (e.g. didactics). The aim of the analysis was to work out where the School can create new educational programs in the context of digital transformation.

"People-Places-Processes" report*

The following themes emerged from the analysis:
- coaching,
- self-leadership,
- individualization,
- smart campus and flexible spaces,
- networks and collaborations.

These were the starting point for the thematic projects, and led to the further development of the ZHAW LSFM in these areas.

2020 – pandemic situation

Instead of exploring the five defined topics as scheduled, the pandemic has driven digitization forward at breakneck speed. During this time, the focus abruptly shifted to the challenges of distance learning. This resulted in a series of blog posts in which students reflect on their situation and help each other with advice and examples of best practice.

"Digital Transformation@LSFM" blog*

*Links to the web pages are only available in German

After a reorientation, the core team thought about how to carry forward the momentum and positive effects of the rapid change into the next year. Funding formats that have a bottom-up and cross-institutional effect were set up.

2021 – final

The last year of the initiative began with specific funding in the five thematic areas. Transdisciplinary teams assembled from those present at the open day in 2019 discussed the most urgent problem to be solved within the given topic areas, and searched for possible solutions by means of guided "idea workshops". The solutions were developed in agile settings and tested as prototypes. Additional smaller project ideas were facilitated and funded by means of low-threshold "braindates" and microcredits. A total of 12 larger and smaller projects within the five thematic areas were funded and supported.

The results from this last collaborative phase were presented and brought together on the second open day. The participants were once again given the opportunity to get to know each other across the institutes and to consider how the knowledge gained could be anchored at their respective institutes. ■

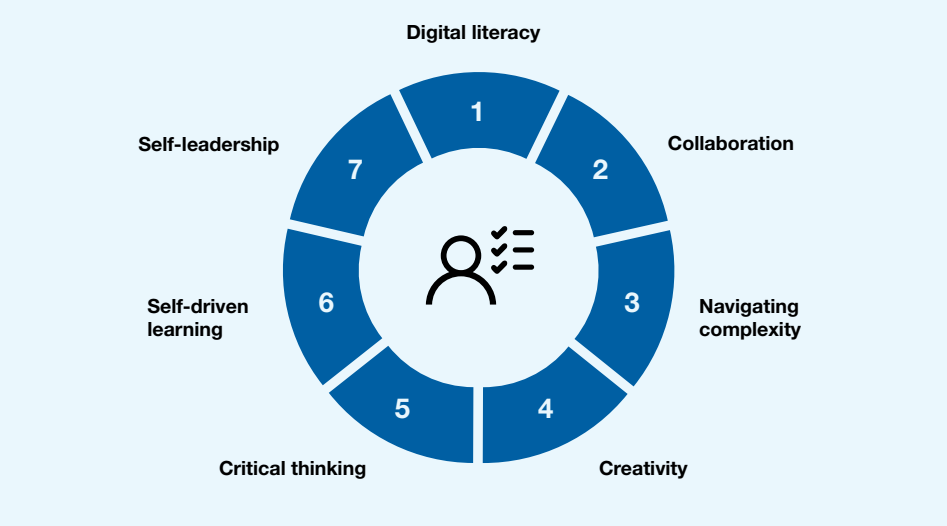


Fig. 1: Future Skills

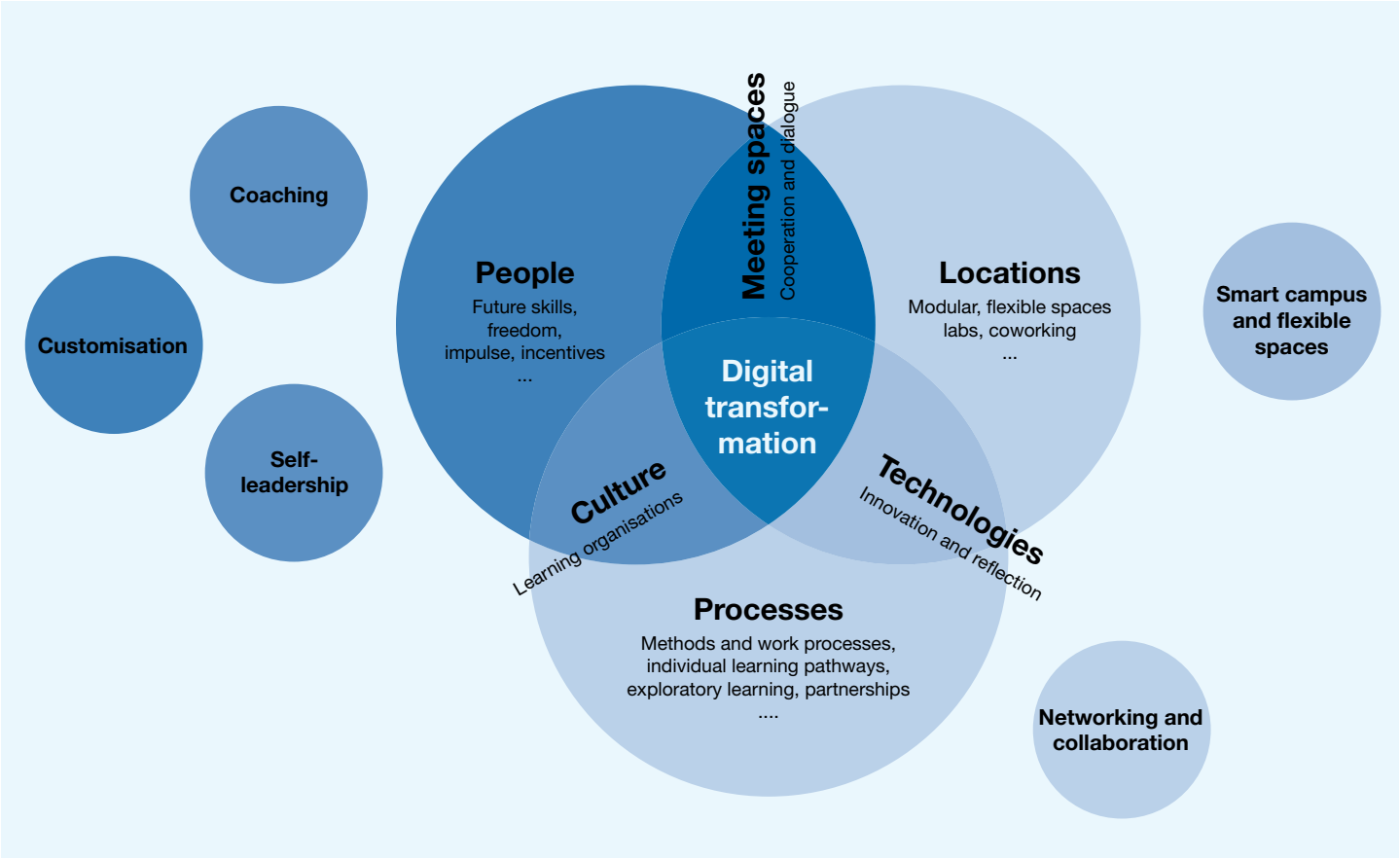


Fig. 2: Fields of action and measures

Results from the projects

Coaching

Two different coaching settings were conducted and analyzed as part of the project:
Spring semester 2021: Practice lessons in mathematics/statistics in the Bachelor's degree program in Natural Resource Sciences. This module took place online, and students were coached during the exercises by assistants acting as tutors.
Fall semester 2021: Academic and Professional English in the Bachelor's degree program in Facility Management. This module took place in person, and the coaching was carried out as part of accompanied peer reviews.
The experiences gathered with the two different coaching scenarios were summarized in a coaching guide, which can support and aid the teacher in designing coaching. It contains practical examples, recommendations, and references to the relevant literature.

Final presentation: Personalised coaching in different teaching settings*

Webinar coaching project (1st Phase Spring Semester 21)*

Self-leadership

As part of this project, a tool-finding quiz was developed in Moodle with H5P to make the selection of digital tools more systematic and considered. The tool is intended to provide students with a means to actively, efficiently, and effectively design and optimize their way of working, and to choose processes and tools that fit them personally. The recommendation takes into account empirical experience in the ZHAW teaching/learning environment, as well as aspects of data protection.

Final presentation: Self-leadership: tools and Platform*

Blog post: Self-leadership/ self-management and the digital toolbox*

Individualization

This project dealt with the processes of individualization, with a focus on improving the dialogue between students and teachers. Part of the project team dealt with the didactic foundations of individualization and developed guidelines for questions of learning process orientation, communication, presentation technology, flexibility, and support of individualized teaching and continuing education.
Meanwhile, another part of the project team developed didactic scripts to technically implement individualization on the Moodle learning platform, and to make the teachers' job easier. As a pilot, two scripts were developed for personalization through individual feedback and learning path adaptation. Using the Moodle Autopilot, a small tool was developed that can automate these labour-intensive standard tasks.

Final presentation: Customisation of lessons *

Smart campus and flexible spaces

This large thematic area was divided into several sub-projects. One team dealt with learning rooms for students, and developed solutions for the flexible use of existing rooms as student workplaces. A prototype was developed for an app that uses sensors to check room occupancy and show students where there are free spaces. In addition, flexible furniture was experimented with in order to convert classrooms into learning spaces for students when they are vacant.
A second team worked on expanding the learning spaces with virtual and augmented reality. Three different scenarios were tested in three degree programs. In the Bachelor's degree program in Food Technology, students were able to experience the influence the environment has on sensory perception with headsets and 360° videos during a taster session. In the Bachelor's degree program in Biotechnology, students were guided through the use of laboratory equipment, e.g. a bioreactor, with the help of information on a HoloLens2. The Facility Management Bachelor's program experimented with digital twin models of buildings, so that in the future, students will be able to virtually walk around the buildings they manage.

Smart Campus: HoloLens 2 Applications in Bioprocess Technology

Flexible Räume: Smart Learning Spaces for Students

Networking and collaborations

As part of this project, measures were taken to scale the Collaborative Online International Learning (COIL) within the framework of *Internationalization@home* and to anchor it in the University for the long term. COIL is a collaborative and virtual teaching and learning format that brings together students and teachers from different countries and linguistic-cultural backgrounds. In addition to promoting collaboration and intercultural understanding, it also fosters digital competencies. The Institute of Facility Management has been successfully conducting COILs with universities in Mexico, the USA, the Netherlands, China and Japan since 2017. This project created a context where other teachers could be won over to this interactive and collaborative format, and was supported as part of a "Coach the Coach" program. For example, a COIL was held for the first time in the Natural Resource Sciences degree program (Peter Marty) and in the Food Technology degree program (Anja Schnyder). To support the involved teachers, a COIL Toolbox was also set up with templates and recommendations for learning activities. To provide support, a COIL Toolbox for teachers was also set up with templates and recommendations for learning activities.

Blog post: COIL Collaborative Online International Learning*

Summary

The goal defined in the vision of *enabling students and participants in continuing education to face digital challenges of a social and professional nature, to actively shape their future and to be able to critically reflect on digitalization,* is still being pursued. The numerous projects supported all contribute in their own way to achieving this goal. The University has not yet fully succeeded in connecting the islands that have emerged in the process.
Digital transformation is an ongoing challenge, and the School is now entering a critical phase. On the one hand, the coronavirus pandemic provided great impetus and increased the digital maturity of the University; on the other hand, there is the risk of polarization in the prevailing opinions on teaching and work organization after the pandemic.
In light of the knowledge gained so far, it is of central importance to further increase the digital maturity of the School. The higher the degree of digital maturity, the better the opportunities offered by digitalization for the University. Furthermore, the ZHAW's role in society can be exploited with an agile approach. Flexible planning, short decision-making paths and a high degree of digital maturity are prerequisites for keeping pace with the dynamics of digitization. ■

*Links to the web pages are only available in German

Studying and researching in Wädenswil: practically oriented, creative, passionate and reflective

The ZHAW is one of the leading universities of applied sciences in Switzerland. The School of Life Sciences and Facility Management currently has almost 1,800 students, and employs more than 600 people. Its educational program includes bachelor's and master's degrees, as well as a wide range of further education courses.

With our expertise in life sciences and facility management, we make an important contribution to meeting societal challenges and to improving quality of life in the areas of environment, food and health. Five research-strong institutes in the fields of chemistry and biotechnology, food and beverage innovation, natural resource sciences, computational life sciences and facility management make this contribution through their research, development and services.

Environment | Food | Health | Society
Our competencies in Life Sciences and Facility Management.

Contact

ZHAW Zürcher University of
Applied Sciences
Life Sciences and Facility Management
Grüentalstrasse 14
P. O. Box
8820 Wädenswil/Switzerland
+41 58 934 50 00

zhaw.ch/lsfm/research/transfer

Pay us a visit

bilden und forschen
wädenswil

Version as of October 2022 – Subject to change – Design: Obrist und Partner – Printing CO_2-neutral on FSC paper: Theiler Druck AG – Edition 3.000