

World Food System Center Annual Report 2021





Dear Colleagues, Partners, Alumni, and Friends:

It is a great pleasure to present our Annual Report for 2021, summarizing highlights from our research, education, and outreach activities over the past year.

Supporting and promoting exchange between scientists, stakeholders, and students is a key function of our Center. Last year, connecting, interacting, and learning together was not always easy. We were, therefore, even more happy that we were able to hold both our Summer School in August and the Food Day @ETH, our annual symposium, in November in person. We also organized various online events such as webinars and a new public lecture series on agroecology to stimulate the exchange on research from members of the Center on sustainable food systems.

We are pleased that we could launch two new programs to support cross-disciplinary and solution-oriented research addressing key food system challenges. Firstly, we initiated a research program with Nestlé focusing on the reduction of greenhouse gases in dairy farming and agriculture production for climate change mitigation. Secondly, we initiated a research program with fenaco on smart sustainable farming at the interface of agriculture, sustainable production systems, robotics, and artificial intelligence. Both programs contribute to our research aiming to reduce negative impacts of food systems on human and environmental health.

Looking forward, we intend to stimulate excellent research and teaching and further engage with society, industry, and policy. We will continue to interact in diverse forums and offer educational activities such as short courses. We want the Center and its member groups to bring a food system perspective to the respective tables.

Ten years after the public inauguration event of the Center, we want to celebrate our work carried out with the support of many different partners over the years. Therefore, we are currently working hard to create an exhibition at the Mühlerama Museum for Food Culture in Zurich. In May and June 2022, families, school classes, and the interested public can take a walk through the food system and learn about research supported by our Center and ETH Zurich. By entering different thematic rooms, visitors can experience different areas of the food system, learn what the challenges are, and how science addresses them.

We are looking forward to an exciting year, many inspiring encounters and to further contribute, together with our partners, to more sustainable food systems.



Robert Finger
Chair

Professor of Agricultural
Economics and Policy at
ETH Zurich





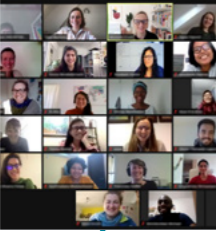













Martijn Sonneveld
Executive Director

Robert Finger
Chair

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Executive Director

Year in Review

Highlights from the Center's work in its three main activity areas of research, education, and outreach.

JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
<p>Outreach Publication of new quarterly online newsletter</p>  <p>Outreach Keynote at Impact HUB Zurich event Circular Food Systems Solutions for a successful transformation 4.3.2021</p> 	<p>Education Professional short course Designing for Food Systems Resilience: A Circular Approach</p>  <p>Research New Agriculture and Food Systems Research Program with Nestlé announced</p> 	<p>Outreach Center Phase II Report (2016-2020)</p>  <p>Education Food Security and Resilient Food Systems Course with FAO</p> 	<p>Research & Outreach Science Stories WFSC Short Films Premiere</p>  <p>Research New collaborative project Enhancing Biodiversity & Resilience in Agriculture with Bayer AG & IFPRI</p> 	<p>Outreach Public webinar Transforming Food Systems through Agroecology: Learning from Evidence, Side Event of the Science Days for the United Nations Food Systems Summit 2021</p> 	<p>Education World Food System Summer School in Rheinau, Switzerland</p> 	<p>Outreach Public webinar Changing the Food System, One Smoothie at a Time</p> 	<p>Research New research collaboration in the field of smart sustainable farming with fenaco announced</p> 	<p>Outreach Food Day @ETH and online poster session</p> 	<p>Research & Education Mercator Program on Agroecology and Organic Farming Evaluation Report 2012-2021</p> 	<p>Outreach Together for the SDGs exhibition with ETH4D, ETH Sustainability & Nadel</p> 	<p>Outreach 8 Ambassador projects for educational or professional development activities funded in 2021</p> 

We support innovations from the laboratory as well as through dialogue to create lasting positive change.

THE CENTER

ETH Zurich established the World Food System Center in 2011 to provide solutions for pressing challenges in our food system concerning food and nutrition security, environmental health, and social well-being. We believe a broader adoption of a food systems approach allows building resilient food systems capable of providing food and nutrition security over the long term.

Food Systems and the Sustainable Development Goals

Fighting hunger is a central element in the United Nations (UN) Sustainable Development Goals (SDGs) and part of the 2030 Agenda for Sustainable Development to build a better world. However, since the SDGs came into effect in January 2016, the world has actually witnessed an increase in the number of persons suffering from hunger. The COVID-19 pandemic further exacerbated the situation, with nearly one in three people in the world (2.37 billion) not having access to adequate food in 2020.

Building sustainable food systems is intricately linked to achieving the SDGs. For example, sustainable food systems can provide decent jobs and support the incomes of billions of people, empower and support women, as well as reduce deforestation and support healthy terrestrial ecosystems.

In 2021, UN Food Systems Summit was organized as the first peoples' summit and engaged hundreds of thousands of people from around the world. Over 900 Independent Dialogues, 550 Member State Dialogues, and 11 Global Dialogues were convened. As a result of the summit, a huge variety of important science-based information and evidence was brought forward in the form of over 2,200 ideas submitted to the Action Tracks by a wide range of stakeholders. One key output of the summit was the broad consensus on the importance of a food system approach. Policy makers and industry realized the urgency. However, the transformation towards more sustainable food systems is slow.

The way the world produces, consumes, and wastes food is far from sustainable. Producing, processing, and delivering food is resource- and energy-intensive, with the agricultural sector, together with forestry, actually accounting for around one-fourth of yearly total greenhouse gas emissions. In addition, the UN estimates that each year, a third of the food produced worldwide worth US \$1 trillion ends up rotting in waste bins or spoils because of poor transportation or harvesting practices. Clearly, if the world fails to increase efforts and to implement more targeted measures, the ambitious SDGs will not be achieved.



The Center and its Approach

Discourse on the global challenge of food security has historically mostly focused on how to grow enough food. This focus, however, overlooks the fact that achieving food and nutrition security requires more than just producing enough calories for all. Access for each individual to a quality and safe diet with adequate macro- and micronutrients must also be ensured. Overweight and obesity are widespread while macro- and micronutrient deficiencies affect billions, creating a triple burden of malnutrition in many countries.

In order to play a leading role in addressing the challenges of how to feed the world in a way that ensures human health, environmental sustainability, and social well-being, ETH Zurich established the World Food System Center (WFSC). The Center acts as a coordination and management platform to establish research, education, and outreach initiatives that bring its members together to collaborate in interdisciplinary ways and with a variety of external partners.

The work of the WFSC is based on the understanding that solutions to food system challenges require collaboration from stakeholders across the entire food value chain. The programs of the Center bring opportunities to students, scientists, and professors who are concerned with food systems in their research and

studies. Encouragement of inclusive and creative approaches is key, as is providing interactive platforms to engage with a wide range of local and global stakeholders from different sectors and disciplines.

Values

Seven core values dictate the organizational conduct of the Center. These core values dictate the (1) importance of academic independence and include a commitment to (2) sustainability, (3) transparency, (4) objectivity, (5) inter- and transdisciplinarity, (6) real world impact through partnerships, and (7) addressing global challenges of societal relevance.

Organization Structure

The core of the WFSC is formed by the member group, which in 2021 comprised 53 professors from eight different departments of ETH Zurich, four groups of Eawag, and one group of Empa (see Appendix). The multi-disciplinary pool of expertise of member groups is a distinct competence of the Center, and allows for solution innovation across the food system and addressing challenges across disciplines and scales.

The Steering Committee oversees the strategy and operational functions carried out by the Executive Office. It is formed by a group of maximum ten elected members and led by a Chair,

Our Vision: A healthy world through sustainable food systems.

Elements of the World Food System. The world food system is a complex system, comprised of many interconnected local and regional subsystems. Outcomes of a sustainable food system are food and nutrition security, environmental health and quality, and social well-being. These outcomes, however, are always a result of a complex interplay of various factors and trade-offs.



New Members 2021



Prof. Máté Bezdek leads the Functional Coordination Chemistry Group in the ETH Zurich Department of Chemistry and Applied Biosciences.

«It is becoming very clear that humanity must shift to sustainable agricultural practices to ensure that our planet provides food security and remains livable for future generations. Achieving this, in my opinion, is one of the greatest challenges of the 21st century. I joined the WFSC because it fosters the kind of cross-disciplinary thinking that will be essential for solving challenges of such complexity and magnitude.»



Prof. Nicholas Bokulich heads the Food Systems Biotechnology Group in the ETH Zurich Department of Health Sciences and Technology.

«Addressing the complex challenges faced by the food system will require innovative, trans-disciplinary approaches that act on multiple links in the food value chain. The WFSC provides a unique collaborative ecosystem for catalyzing the solutions needed to feed the future.»

Prof. Johanna Jacobi heads the new Agroecological Transitions Group in the ETH Zurich Department of Environmental Systems Science.

«Our globalized food system is neither sustainable nor fair. Insects, birds, and agrobiodiversity are disappearing as most people are largely excluded from decision-making that shapes food system governance. As power is becoming more and more concentrated in the food system, it is necessary to build spaces where people with an interest in sustainable and just transitions can come together and bring in their solutions in a transdisciplinary setting. The WFSC with its great expertise in food systems is in an excellent position to provide such a platform.»

Dr. Joaquin Jimenez-Martinez leads the Subsurface Environmental Processes Group at the Eawag Department of Water Resources and Drinking Water and ETH Zurich Department of Civil, Environmental and Geomatic Engineering.

«Understanding the impact of land-use changes and climate change on groundwater resources is vital for their protection and of the related ecosystems. Groundwater resources are key in food production, especially in arid regions. I joined the WFSC, a platform for cross-disciplinary research, to connect with many different experts in the food system and help to move towards a more sustainable water resources management and food production.»



Prof. Stefano Mintchev heads the Environmental Robotics Group in the ETH Zurich Department of Environmental Systems Science.

«Given the challenge of feeding a growing population under increasing climate pressure and resource depletion, new robotic methods and technologies will be needed for efficient and sustainable food production. The multidisciplinary community built by the WFSC allows us to bridge our robotic expertise with complementary research competences and develop concrete solutions to support the agricultural needs of the 21st century.»

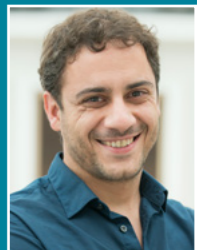
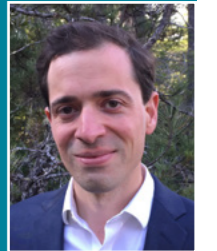
Prof. Mutian Niu leads the Animal Nutrition Group in the ETH Zurich Department of Environmental Systems Science.

«Climate change and increasing global population and food demand makes it more challenging to improve the sustainability of farms and calls for research by interdisciplinary teams. The WFSC is such a platform that fosters collaborations by bringing together ETH communities and researchers with diverse backgrounds.»



Prof. Renato Zenobi heads the group of Analytical Chemistry in the ETH Zurich Department of Chemistry and Applied Biosciences. Dr. Giannoukos Stamatios is a Senior Scientist in the group.

«The investigation of human exhaled breath in relation to nutrition and diet is of great interest, not only to better understand the impact of nutrition on metabolism but also to facilitate and promote healthy dietary habits and lifestyles. The umbrella of the WFSC enables us to chart novel scientific pathways, build up internal and external collaborations, and to add value in the progression of non-invasive, high throughput chemical analysis.»





«Innovative research for food systems needs translation from the laboratory so that society at large can benefit. Bringing in collaborative partners on research projects and broader Center initiatives is key to achieving effective and impactful translation.»

Alexander Mathys
Professor of Sustainable Food Processing, ETH Zurich
WFSC Steering Committee Member

At work in the Sustainable Food Processing Laboratory at ETH Zurich.

Partnership Approach

The WFSC strives to work together with others in partnerships to achieve together what no partner could achieve on its own. Both strategic and collaborative partnerships are developed, and the WFSC indirectly fosters new partnerships at the project level. This partnership approach has been critical to the Center's success.

In close collaboration with the ETH Zurich Foundation, the Center established its strategic partnership network specifically to engage with industry and foundation partners who support our vision and mission through programs and projects. Until 2021, the strategic partnerships of the WFSC were coordinated through a Partnership Council, whose members included Mercator Foundation Switzerland, Coop, Bühler, Migros, fenaco, Nestlé, and Syngenta Crop Protection. In 2021, a restructuring process took place. Moving forward, the Center plans to create an expert committee to identify key challenges in the food system, outline priorities, and sketch pathways to address future issues. The committee's first meeting will take place in November 2022.



Research in Action. Alexander Mathys leads the Flagship Project Novel Proteins for Food and Feed, a project with numerous industry and academic partners.

Collaborations that positively support transformation in food systems require new tools and new ways of thinking and working together.



Participants of the World Food System Summer School 2021 visit Bühler Group to discuss Sustainability as Business.

Collaborative Partnerships

Our collaborative partners are organizations that the WFSC works with regularly who bring important and complementary expertise and networks to the table. Collaborative partnerships allow the us to work together with stakeholders in a way that creates added value for both organizations without engaging in a permanent relationship involving binding commitments. In addition, the WFSC facilitates partnerships at the project level among academia and external partners and stakeholders from a variety of different sectors.

In 2021, ETH Zurich researchers and the Center joined forces with Bayer and the International Food Policy Research Institute (IFPRI) to develop nature-based solutions that counteract biodiversity loss on farms. The project [Enhancing Biodiversity & Resilience in Crop Production](#) aims to explore scenarios with farmers for biodiversity-oriented outcomes and develop the basis for decision-making and value-generation tools.

The Center is also part of the [Nutrition in City Ecosystems \(NICE\)](#) project, which launched in 2021. The project aims to improve urban diets in low- and middle-income countries. NICE promotes women and youth leadership, and places a strong emphasis on public-private engagement and income generation. The consortium includes the Swiss Tropical and Public Health Institute, Sight and Life, ETH Zurich, and the Syngenta Foundation for Sustainable Agriculture.

Representation at Food Sector Events and Forums

WFSC members and Executive Office staff regularly represent the Center at food system-themed events and forums organized by Swiss and international groups. This engagement in diverse forums and bodies allows the Center to bring a food system perspective to the respective tables. For example, Executive Director Martijn Sonneveld represents ETH Zurich in the Swiss National Committee of the UN FAO (CNS-FAO), a position nominated by the federal council. He was elected President of the committee in January 2020.

In 2021, the CNS-FAO published the discussion paper [Pathways to advance agroecology – overcoming challenges and contributing to sustainable food systems transformation](#). This paper serves to orient the Swiss Government and interested stakeholders on pathways to advance agroecology to overcome and contribute to sustainable food systems transformation, as well as on how agroecology can support the UN Food Systems Summit 2021 Action Tracks.

Further, the WFSC is also part of the Swiss Forum for International Agricultural Research (SFIAR), a multi-stakeholder platform that includes the Swiss Federal Office for Agriculture (FOAG), Swiss Development Cooperation (SDC), major Swiss agricultural research institutions, and NGOs. Executive Director Martijn Sonneveld is currently President of the forum.



The fields at the ETH Plant Science Research Station are a place to trial new methods for more sustainable agriculture.

RESEARCH

The Center aims to generate new scientific knowledge with societal, political, and industrial relevance in a manner that supports real-world impact.

The World Food System Center enables novel interdisciplinary research that contributes knowledge and solutions to key food system challenges. The Center's core research activities also strive to provide leadership and foresight on issues connected to food and nutrition security based on innovative solutions for pressing problems of the world food system. In order to do so, the Executive Office fosters and manages competitive research programs, develops and supports Flagship projects, and engages in special collaborations.

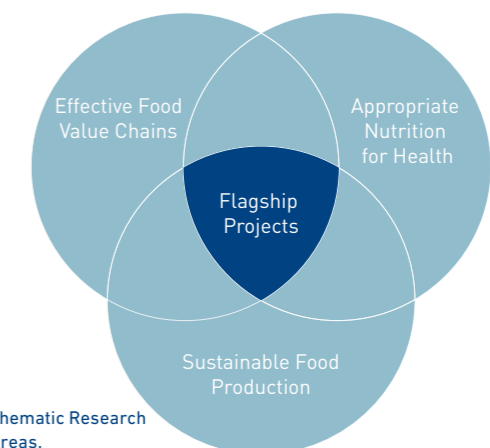
Research promotion and support builds directly on the strengths of our 53 members. Therefore, various activities are planned to promote inter- and transdisciplinary research projects and to support our members in identifying funding opportunities and in coordinating targeted activities for successful application for research funding. Research results are then incorporated in various education and outreach projects to ensure highlighting of promising pathways to support sustainable transformation of food systems. The work contributes directly to many of the United Nations Sustainable Development Goals, including Zero Hunger, Sustainable Consumption and Production, and Good Health and Well-Being.

Thematic Research Focus Areas

The WFSC adopts a systems perspective to its research that takes place within interlinked thematic focus areas: *Effective Food Value Chains*, *Appropriate Nutrition for Health*, and *Sustainable Food Production*. These areas guide the Center's research initiatives and connect them to food system challenges of societal relevance. Resilience and resource efficiency are core concepts for the Center's work on food value chains and food production systems. Diversity and safety are underlying principles for our work on food production and appropriate nutrition.

Flagship research projects showcase a food systems approach and tackle large questions at the intersection of the focus areas, where ETH Zurich is uniquely positioned to contribute to solutions for the world's pressing challenges.

We connect researchers from different disciplines with one another and with external partners.



WFSC Thematic Research Focus Areas.

Flagship Projects

Flagship projects of the WFSC should be visionary and potentially high risk; take a food systems or whole of value chain approach; involve at least three investigators from different disciplines; and involve key stakeholders from industry, government, and NGOs, in non-competitive roles.

In 2021, the Center supported the work of two Flagship projects. Enhancing Resilience in Food Systems is a project an initiative of the Sustainable Agroecosystems Group and the TdLab. Initiated in 2013. It addresses how food systems can be made more sustainable under multiple, unpredictable drivers of change.

The Flagship Novel Proteins for Food and Feed involves many member groups, with by Prof. Alexander Mathys as Principal Investigator. This project aims to develop food innovations to provide new sources of sustainable and nutritious protein for a growing world population.

Learn more at <https://worldfoodsystem.ethz.ch/research/flagship-projects>.

Future Food Initiative

ETH Zurich and EPFL launched Future Food – A Swiss Research Initiative (“Future Food Initiative”) in 2018 together with Swiss food industry leaders Bühler, Givaudan, and Nestlé. The goal of this initiative is to expand research and education in the area of food and nutrition sciences. The fellowship program within the initiative aims at bringing together competences from academic and industrial research in this field. The program is co-managed by the WFSC and the Integrative Food Science and Nutrition Center at EPFL.

The fellowship provides personal research funds for three years that enable postdoctoral fellows to work on their projects in a research laboratory with a host professor at ETH Zurich or EPFL. In total, nine fellows have started novel research projects. The initiative provides these fellows, host professors, and the Center a great opportunity to further develop collaborations with industry and EPFL. Together, all partners of the initiative are building a strong Swiss food science ecosystem.

Learn more about the program at www.futurefoodinitiative.ch.

We fund research projects that support education and training of early career scientists.

Future Food Fellows 2021: Dr. Mingqin (Parsley) Li and Dr. Shiv Ashutosh Katiyar.

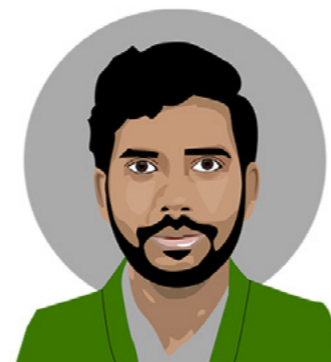
“Developing strategies to modify plant-based proteins will help to expand their application.”

Dr. Mingqin (Parsley) Li



“Applying robotics, computer vision and learning to food science will help building sustainable food systems.”

Dr. Shiv Ashutosh Katiyar

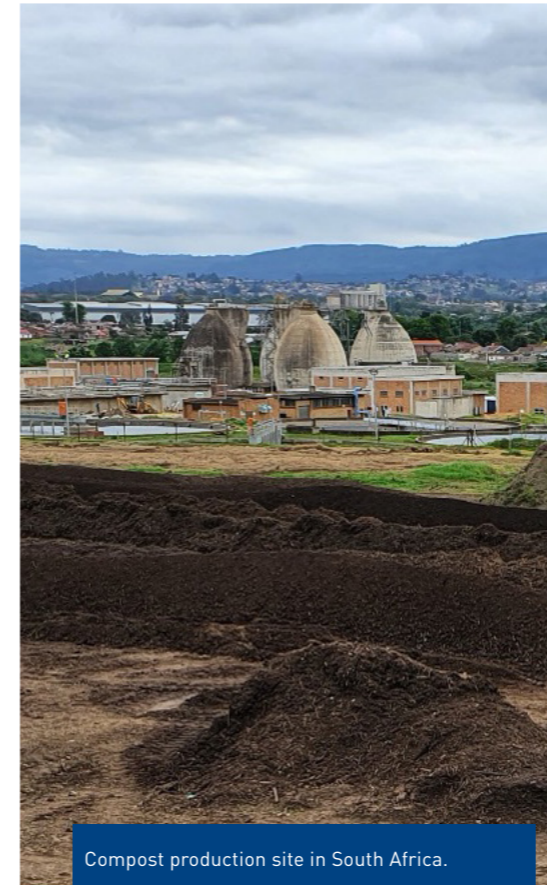


Flagship Project Update

The Flagship Project [Enhancing Resilience in Food Systems](#) seeks to directly contribute to food systems resilience by supporting decision-making in practice through stakeholder participation in case studies and academic education. The project was initiated in 2013 and is led by member Johan Six. Support for the multiple subprojects comes from a wide range of food system actors, such as the Swiss Federal Office for Agriculture (FOAG), the UN FAO, multi-national companies and organizations, and academic partners.

In 2021, despite significant challenges presented by the ongoing global pandemic, the diverse and dedicated collection of community members, municipal leaders, and researchers that are the ‘The rural-urban nexus: Establishing a nutrient loop to improve city region food system resilience’ (RUNRES) project have continued their efforts to improve the resilience of city region food systems in Arba Minch, Ethiopia, Kamonyi, Rwanda, Bukavu, DRC, and Msunduzi, South Africa. This project, funded by the Swiss Agency for Development and Cooperation (SDC), seeks to enhance resilience by capturing and processing sources of local organic waste into sustainably produced organic fertilizers.

In addition, outputs and recommendations from the project ‘Assessing the role of organic value chains in enhancing food system resilience’ were shared with key stakeholders including farmers, farmer organisations, certifiers and retailers. Other projects continue worldwide.



Compost production site in South Africa.

Flagship Project Update

The Flagship project [Novel Proteins for Food and Feed](#) started in 2016. The project aims to enable the broad exploration of microalgae and insect proteins for more sustainable food and feed. Components of the multifaceted project include defining target properties and functionalities of the envisioned novel proteins, gaining insights from a consumer perspective, and using a system-oriented approach to assess sustainability.

Various subprojects continue to move forward, and numerous publications from 2021 focus on food processing innovations of algae cultivation, increasing the performance of biowaste treatment with black soldier fly larvae, with the ultimate goal of larvae to be used as feed, as well as nutritional life cycle assessment to optimize food systems.

In addition, the new project ‘Urban Microalgae-Based Protein Production’ was announced in 2021 and aims to develop nutritious microalgae-based food products and to establish a platform to produce them efficiently in an urban facility and in a cost-effective way. To do so, the researchers will use whole value-chain approach, combining innovative production technologies and consumer insights. Collaboration with Swiss and Singapore-based food producers is key to ensure commercial viability.

Starting in January 2022, the project is led by the Singapore-ETH Centre, together with the National University of Singapore and the Singapore Institute of Food and Biotechnology Innovation. Prof. Alexander Mathys is the lead principal investigator.



Incorporating microalgae into extruded meat analogues can enhance nutritional value.



«This project allowed me to combine field data and computational tools to guide future efforts in designing sustainable water management strategies for agricultural areas.»

Sandra Pool
Eawag Subsurface Environmental Processes Group
Coop Research Program Postdoctoral Fellow



Irrigated citrus plantation in Valencia, Spain.

Research Programs

The Center's Research Programs support new cross-disciplinary and solution-oriented research to address food system challenges. All projects are subject to a rigorous evaluation and an assessment process that takes into account scientific excellence and relevance to the programs. These programs produce scientific publications and briefs for practice (see Appendix).

Learn more about all the programs at <https://worldfoodsystem.ethz.ch/research/research-programs>.

Mercator Research Program in Organic Production Systems for Global Food Security

The program aims to explore the role and potential of organic production systems (certified or non-certified) to contribute to global food security. It has supported a total of 14 doctoral research projects since 2012, with 3.7 million CHF distributed. The program is funded through a donation by the Mercator Foundation Switzerland. One example of real-world research enabled through this program is the project "Soldier Fly larvae reared on various substrates as novel protein source" (HenandFly). This project investigated and identified ways of including insect material of different origin and composition into organic diets for poultry.

Coop Research Program on Sustainability in Food Value Chains

The Coop Research Program supports research looking at ways to drive food value chains towards the goals of quality and quantity that support human and environmental health and create value for all stakeholders. Funded through a donation by the Coop Sustainability Fund, the program has supported a total of 19 two-year postdoctoral research projects, with 5 million CHF distributed. The project "Understanding the effects of irrigation modernization in water resources management of citrus production in the Jucar river basin, Spain" displays the impact of the work enabled by this program. The project, led by the Subsurface Environmental Processes Group at Eawag, produced environmental impact assessment reports and recommendations to move towards sustainability in water resources management and citrus production.

Agriculture and Food Systems Research Program

The program aims to improve sustainability of agriculture and food systems. Nestlé provided ETH Zurich with 2.8 million CHF of research funding in 2021 to support interdisciplinary projects. Research focus areas include reduction of greenhouse gases in dairy farming and agriculture production for climate change mitigation.

We strive to create actionable knowledge to be shared in dialogue with a wide audience.

Smart Sustainable Farming Research Cluster

The WFSC and the fenaco cooperative launched a joint research initiative in October 2021 at the interface of agriculture, sustainable production systems, robotics and artificial intelligence. With this initiative, fenaco is supporting the establishment of the Smart Sustainable Farming Research Cluster at the Center with a total of 1.2 million Swiss Francs over the next six years, thus enabling several interdisciplinary projects.

Joël Mesot, president of ETH Zurich, commented, "Through this new initiative, we are working together with the agricultural sector on key challenges of our time. The projects will transfer findings from robotics and artificial intelligence into agricultural practice."



Innovative research on sustainable smart farming at the ETH Research Station for Plant Sciences in Lindau, Switzerland.

Special Collaborations

The Center engages in practice-oriented research via special projects with partners to support real-world agenda setting and decision-making. The role of the WFSC in these projects is not necessarily to conduct research but rather to support the project teams by providing the Center's expertise in education and outreach. Examples of such activities include being an outreach partner for the Swiss National Research Foundation funded project MyFruitTwin, which focused on physics-based digital twins for fruits and vegetables to reduce food waste and was led by member Thijs Defraeye. The Center was also an outreach partner for the EIT Food Phenoliva Project: Treatment and valorisation of olive mill wastes, led by member Laura Nyström.

The WFSC also coordinates ETH Zurich activities as member of the Swiss Food & Nutrition Valley (SFNV), and Martijn Sonneveld is part of the executive committee. The SFNV is a nationwide initiative that fosters food innovation in Switzerland and beyond by bringing together major actors in the Swiss food ecosystem from academia, industry, start-ups, and government.



The 2021 World Food System Summer School again took place in Rheinau, Switzerland.

EDUCATION

The education activities of the Center focus on building capacity in the next generation of decision makers to provide leadership for sustainable food systems issues.

The World Food System Center aims to support young talents from ETH Zurich and the world to become the next generation of leaders to tackle complex food system challenges. The Center focuses, therefore, on supplementing ETH Zurich curricula with innovative approaches to education that teach participants to navigate complexity and build sustainable food systems.

The Center organizes a range of education activities including intensive summer schools and extra-curricular courses and excursions. All of these activities are built on an interdisciplinary, critical thinking approach that emphasizes a food systems perspective and involves innovative teaching methods. From these activities, we create and foster a global, interdisciplinary community of WFSC alumni.

Summer Schools

The educational programs of the Center are developed for students and young professionals and designed to explore all aspects of the food system. Since 2013, the cornerstone of the Center's educational activities is the World Food System (WFS) Summer School program that brings together 20-25 students and young professionals from ETH Zurich and universities from around the world for a two-week intensive course. The course has been hosted in Switzerland, India, South Africa, and Côte d'Ivoire.

Participants explore food system challenges and solutions first-hand and learn to better understand their own role in driving a sustainable transformation. The course incorporates a diversity of interactive teaching methods, such as first-hand exchanges with stakeholders and practitioners, group work, concept mapping, policy impact analysis, role playing, panels, and hands-on practical applications. Instructors include ETH Zurich faculty, international researchers, and practitioners from industry, public, and non-profit sectors. This ensures the courses balance academic content and rigor with an immersion and experiential learning context.

Find out more: <https://worldfoodsystem.ethz.ch/education/summer-schools>.

Our education courses support and inspire future change makers in the food system.

Professional Short Course

In 2021, the Center held its first short course targeted as professionals working in agriculture and food systems. The course 'Designing for Food Systems Resilience: A Circular Approach' in February was centered around how the concepts of a circularity and solidarity economy can build more resilient food systems.

Resilience, circularity, and solidarity are central elements of the concept of agroecology, which has been identified by the UN FAO as a holistic approach to facilitate transformative change towards not only sustainable agriculture but food systems as a whole.

The WFSC and its member groups have a wealth of expertise in exploring the potential of agroecological elements to transform food systems. Therefore, with this course, the Center aims to play a role in connecting practitioners working in the fields of agriculture, food, and nutrition to the knowledge and methods that have emerged from research, at ETH Zurich and beyond. The course is again planned for 2022.

Learn more at <https://worldfoodsystem.ethz.ch/education/wfsc-courses.html>.

Education Tools- From Beans to Bars Game

The Center aims to translate the latest research at ETH Zurich into education tools in order to assist in teaching sustainability issues. In 2021, the education board game 'From Beans to Bars' was developed. Based on research done in member groups of the WFSC, the game uses the cocoa value chain as a starting point to explore food systems. Players take on the role of various actors along the value chain: the farmer, merchant, processor, and retailer. Decisions each player makes has multiple effects on others, as well as sustainability.

The game was presented at a public workshop at Scientifica/Science Days of ETH Zurich in September. In October, secondary teachers also enjoyed the game at a workshop at the University of Zurich Center for Continuing Education, in collaboration with the Life Science Zurich Learning Center.

Our courses motivate life-long learning and engagement in creating change.



Summer school participants present the outcomes of their design thinking process projects.

At the teacher workshop 'Bittersweet Stories of Chocolate,' teachers interested in bringing the theme of sustainable food systems into the classroom learned about elements of the world food system and drivers of change as well as about the cocoa value chain and the stakeholders involved.



World Food System Summer School 2021 Food Systems in Transition

The 2021 Summer School brought together 22 participants representing 12 nationalities and 17 disciplines at Gut Rheinau, Switzerland's largest organic and biodynamic farm. This provided an opportunity to directly experience food production and the challenges of sustainable agriculture in the field. In addition, a number of off-farm excursions were organized, including a visit to Migros to understand the role of retailers in building sustainable food systems. A day at the AgroVet-Strickhof facility and the ETH Research Station for Plant Sciences in Eschikon allowed the students to delve into the latest research insights to tackle food system challenges.

The program was designed to help participants build their knowledge and skills not only in theory but also in practice. They worked together with stakeholders in Switzerland who are designing and innovating for sustainable and equitable food value chains. The participants were guided through a combined design and systems thinking process to co-create solutions with the stakeholders. This process was motivating for participants, as they could see the results of their work potentially implemented on the ground after the program. Bringing these participants together highlighted the unique role of summer school settings to build the interpersonal skills needed to create change in complex systems.

Professional Short Course Designing for Food Systems Resilience: A Circular Approach

At the course in February 2021, 35 professionals from 20 countries came together to learn and collaborate in a highly interactive online program, developed by the World Food System Center in cooperation with the ETH Zurich Sustainable Agroecosystems Group.

Redesigning food value chains, using the concepts of both circularity and solidarity, has the potential to increase both the resilience and sustainability of food systems. In the course, participants learned how to use systemic and transdisciplinary approaches to transform waste into resources, create shared value, and leverage interconnections to design interventions that build resilience.

The program included short expert inputs on the concepts of agroecology, circularity, solidarity, and resilience, but focused primarily on having participants engage with tools from transdisciplinary and systems thinking. They applied these tools to map the systems around a specific case study: tomato value chains in Morocco.

The course provided the participants a chance to connect with like-minded professionals from around the world and engage in interactive and creative skill building opportunities. Space for personal reflection about how to apply the presented concepts in life and work settings was built into the program.



Participants of the professional course meet online.



World Food System Network fermentation workshop in Amsterdam, Netherlands.

«Over the last pandemic years, I think we have come to an even bigger realization that food systems are endangered through several factors. I find it therefore even more exciting to see that the WFSCAN members engage in projects covering different food system levels and are always trying to keep on learning, interacting and contributing to the ever-changing food system environment surrounding us. I hope the network will continue both the internal learning and external outreach of the expertise from its members.»

Roelinda Jongstra
World Food System Network Community Coordinator
(2021-2022)

Food Security and Resilient Food Systems at FAO

Since 2014, the WFSC has collaborated with the Food and Agriculture Organization of the United Nations (FAO) and the Sustainable Agroecosystems Group to offer a three-day course for ETH Zurich Master's students at the FAO headquarters in Rome.

The course in April 2021 explored the contribution of sustainable food systems to achieve the Sustainable Development Goals. Topics closely linked to the five Action Tracks formulated by the organizers of the Food System Summit were discussed.

Due to restrictions stemming from the global pandemic, a physical visit to Rome and the FAO was not possible. Instead, virtual meetings with experts from FAO, the International Fund for Agricultural Development (IFAD) and other organizations took place and allowed for lively discussions.

World Food System Center Alumni

Through the Center's educational activities, a growing interdisciplinary and global community of alumni has been created. In 2021, this community boasted more than 200 alumni from over 50 countries.

In 2019, the WFSC alumni community founded the World Food System Network. The vision of the organization is to cultivate a collaborative international network that inspires and leads change towards sustainable food systems. The mission is to support alumni-driven initiatives that encourage connecting, learning, and contributing.

Three board members run the organization. Key activities in 2021 included a transition of the community coordinator and organizational structure, a new website, opening of regional hubs, and numerous activities. The membership platform was updated to now allow for members to share content, ideas, or open a topic to get input from other members.

Alumni connect at <https://wfscalumni.com>.

We create and foster a global, interdisciplinary community of WFSC alumni.



Participants of the World Food System Summer School 2021, now members of the World Food System Network.

Alumni activities in 2021 included a multiple-day workshop on permaculture, organized by local members in Kenya. The group's community garden in Zurich continued for its third year and provided members the opportunity to personally learn about sustainable gardening. Numerous Swiss members also met in a local forest for a mushroom cultivation workshop. Besides Zurich, another local hub was established in the Netherlands, where members come together on a regular basis. The Dutch hub organized a brainstorming session where ideas were shared on how to make a closed plant growing environment (terrarium). During a fermentation workshop, participants learned about the usefulness of traditional food preservation.

Food System Stories Blog

The Center launched a blog in 2016 featuring the voices and perspectives of the WFSC alumni network. This creative space offers them a platform to share short stories and communicate their observations, experiences, and food system interests in an informal way. It also provides a space to showcase outputs and lessons learned from the Center's Mercator Ambassador Program. Nine blogs were posted in 2021.

Read the stories at www.foodsystemstories.org.



Alumni at work during the permaculture workshop in Kenya.



Researchers shared their work at the joint ETH4D/WFSC 'Innovation for Sustainable Development' booth, including the Sustainable Agroecosystems Group.

OUTREACH

The Center engages with a broad audience to increase awareness about challenges in the world food system and approaches to creating solutions.

The World Food System Center (WFSC) strives to create actionable knowledge to be shared in dialogue with a wide audience. Such dissemination accelerates the transformation of food systems and thereby supports the achievement of the UN Agenda 2030 Sustainable Development Goals (SDGs). The Center's outreach activities aim to increase awareness and dialogue around the challenges of the world food system and possible solutions.

Diverse stakeholders are engaged by using varied platforms and venues, ranging from public events and lectures, exhibitions and guided tours, webinars, and direct discussions. Such activities have reached thousands and, along with the Center communication channels, have made visible the expertise at ETH Zurich and its contribution to global challenges.

By allowing a broad scope for outreach, the Center is able to explore the breadth of the food system, complementing the expertise of its members with the experience of colleagues and peers from outside ETH Zurich.

We aim to make food system research accessible to a wide audience.

Public Events and Research Symposium

The Center organizes numerous scientific events aimed at increasing awareness of the informed public about both the challenges of the world food system and system-based approaches to addressing them. In 2021, the Center organized or co-organized 11 events plus a public lecture series consisting of 12 webinars, reaching a total of nearly 2500 people (see Appendix). Many events were jointly organized with WFSC members and partner centers and institutions. To comply with restrictions due to the COVID-19 pandemic, virtual events continued until October. A highlight of the year was the return of the annual research symposium, Food Day @ETH, to the main building at ETH Zurich in November.

Scientifca. At the ETH/UZH Scientifica "Science Days" in September 2021, ETH for Development (ETH4D) initiative and the WFSC organized a collaborative booth. Researchers from ETH Zurich, Eawag, and Empa were on hand to share their research on focused on 'Innovation for Sustainable Development.' At the weekend event, visitors could test an app that helps to keep food fresh longer in home refrigerators or test water from a chlorination device.

Together for the SDGs. In November 2021, guests celebrated the opening of the exhibition 'Together for the SDGs' in the main hall of ETH Zurich. The exhibition featured 17 unique artistic images representing the 17 goals, commissioned by the Swiss Agency for Development and Cooperation. The images were enriched by stories from various projects from ETH that contribute to global sustainable development. With the exhibition, the organizers, ETH4D, ETH Sustainability, Nadel - Center for Development and Cooperation, and the WFSC, hoped to further inspire action and promote collaboration towards the SDGs at ETH Zurich and beyond.

Public Lecture Series: Agroecology and the Transition to Sustainable Food Systems. Over 12 weeks from September to December, this [online series](#) offered the interested public a deeper insight into the fundamentals of agroecology and its potential role in transforming food systems. The whole of the series was structured along the ten elements of agroecology, proposed by the Food and Agriculture Organization of the United Nations. Each element was discussed in depth for one lecture, with scientific inputs from researchers from ETH Zurich and partner institutions enriched with actors from society and industry.

Learn more at <https://worldfoodsystem.ethz.ch/out-reach-and-events/public-and-scientific-events>.

We seek opportunities to disseminate results and raise awareness for work of ETH Zurich on food system challenges.



The panel discussion at Food Day @ETH focused on the role of science in food system transformation.

Food Day @ETH 2021

In 2016, the Center established an annual research symposium to highlight food system research at ETH Zurich and feature presentations from concluding research projects supported by its Research Programs. Food Day @ETH 2021 took place on 05 November 2021 and focused on how collaborative research at ETH Zurich is contributing to food system transformation. The presentations focused on (1) Adapting to Water Scarcity across Europe and (2) Assessing Organic Production Systems: 'Irrigation modernization and implications for sustainable water resources management in Mediterranean agriculture' ([IRRIWAM](#)) by Sandra Pool; 'Assessing the impacts of summer drought on soil ecology and cropping systems' ([RELOAD](#)) by Emily Oliveira; 'Black soldier fly larvae as an alternative feed ingredient for poultry' ([HenandFly](#)) by Maike Heuel; and 'Enhancing small-holder farmer climate resilience in cocoa and banana global food value chains' ([OrRes](#)) by William Thompson.

The panel discussion brought together perspectives from academia, civil society, policy, and industry to discuss the role of science in food system transformation.

The networking poster session showcased twelve selected poster finalists. At the event, three poster prizes were awarded. An [online poster session](#) allowed all to view this important research. Many of the posters were accompanied by a commentary by the researchers, available on the Center [YouTube channel](#).

During the public lecture series 'Agroecology and the Transition to Sustainable Food Systems,' 43 contributors shared their knowledge and insights with the audience of over 1000 participants.





Human and Social Values
Tuesday, 19 October 2021

Contributors

Agroecology and the Transition to Sustainable Food Systems
A Public Lecture Series
Tuesdays, 18:00 - 19:00 CET
21 September - 07 December 2021
Zoom Webinar



Johanna Jacobi
Assistant Professor of Agroecological Transitions,
ETH Zurich



Rachel Bezner Kerr
Professor of Development Sociology,
Cornell University



Patrick Honauer Klauer
Co-Founder,
BachserMärt



Alan Heinze Yothers
Researcher, Center for Research and Assistance in
Technology and Design of the State of Jalisco (CIATEJ)



Carole Nordmann
Project Manager for International Social Responsibility,
Bio Suisse & Co-Founder, Crowd Container

www.worldfoodsystem.ethz.ch



Science Stories WFSC Short Films Premiere

On 25 May, the WFSC presented Science Stories, an event focused on sharing of insights from food systems research projects at ETH Zurich. Guests first learned about the craft of visual storytelling from videographer Marius Born (Born Media) and then gained insight about using different platforms to share science from Center Vice Chair Emma Wetter Slack.

All then watched the premiere of several of WFSC short films. The premieres were paired with discussions with the young researchers who stepped in front of the camera to bring their science stories to life. A networking area then allowed for exchanging with all that attended the online event. Braida Thom, producer of the films, moderated the event.

The films:

- [Teaming up with soil microbes](#), starring Lukas Wille
- [Fighting Vitamin A deficiency and soil depletion](#), starring Rafaela Feola Conz
- [Red clover for sustainable livestock production](#), starring Mike Ruckle
- [Rooibos - Looking beneath the surface](#), starring Josep Ramoneda Massagué
- [Growing food without land](#), starring Iris Haberkorn and Alexander Mathys
- [Bringing buckwheat back into our fields and kitchens](#), starring Eduardo Pérez and Michelle Nay
- [Rethinking human waste](#), starring Ben Wilde



Young researchers stepped in front of the camera to share findings from their Center supported projects.



A chlorination device from the groups of Safe Water Promotion and Water Supply and Treatment from Eawag Sandec was pumping at Scientifica to demonstrate how drinking water is treated in the Global South with the help of low-cost technologies.

«The WFSC showed that we hold the potential for improvements in our hands and that change and impact come from sharing the work with others. Outreach events with the WFSC provide the perfect framework to bridge between science and society.»

Kanaha Schoji and Jörg Schemminger
Simulating Biological Systems Group, Empa



At Scientifica, visitors talked with researchers about innovations for sustainable development and food systems.

Research Dissemination and Dialogue

The Center prepares content, discovers opportunities for dissemination, and ensures that the Center with all its activities and projects communicates strategically and in coordination with ETH Corporate Communications efforts. The Center has established and manages its own communication platforms to further support these efforts.

The Center aims to be a point of reference for food system research at ETH Zurich. The [Center's website](#) is a venue to communicate news and findings. The Center also produces a quarterly newsletter, bringing news highlights and member updates to a network of over 1750 interested subscribers. In 2021, the Center's social media presence included several growing platforms:

- @ethzwfsc
- World Food System Center, ETH Zurich
- World Food System Center ETH Zurich

Additionally, Center members and Executive Office staff regularly contribute to food system-themed events and exhibits. This participation allows for an increased inclusion of science into the societal dialogue on food system challenges. Highlights in 2021 included Executive Director Martijn Sonneveld joining a panel focused on nutrition at [Swiss National Climate Day](#). In addition, the art science exhibit 'Helvetia and the Journey of the Cocoa Bean' brought art together with research from the ETH Zurich Sustainable Agroecosystems Group, displayed in a campus greenhouse.



The art science exhibit 'Helvetia and the Journey of the Cocoa Bean' brought art from Marie Van Berchem and Braida Thom together with research from the Sustainable Agroecosystems Group.

Enabling Grants

Through targeted Enabling Grants, ranging from a several hundred to several thousand Swiss francs, the WFSC supports early-career scientists and students to engage in auxiliary education and research activities. These grants are available to WFSC member groups and alumni of the World Food System Summer School program and are supplied through two mechanisms. The WFS Fund supports education and research at the ETH Zurich in fields relevant to the world food system. The Ambassadors Program, which is a core outreach activity for the Mercator Program since 2014, supports small projects and short-term educational or professional development activities. Examples of Enabling Grants project outcomes can be found on our [Food System Stories blog](#).

Our grants open new doors to opportunities that would have otherwise been unattainable.

WFSC Enabling Grants 2012 - 2021	2021	TOTAL
Grants distributed		
- WFS Fund Program	3	38
- Ambassadors Program	8	49
Funding (CHF)	39'562	283'592

Appendix

World Food System Center Members

Members
 * Indicates Member of Steering Committee
 ** Indicates Chair of Steering Committee

D-USYS

D-USYS

D-USYS

D-USYS

D-USYS & D-MTEC

D-MTEC

D-HEST

D-HEST

D-ARCH

D-BAUG

D-BIOL

D-CHAB

D-GESS

Eawag

Empa

Appendix

Executive Office Staff

The Executive Office is responsible for the management and operation of the Center and its research, education, outreach, and communication activities. Together with the Steering Committee, the Executive Office develops and implements the strategy of the Center and builds strategic partnerships and collaborations. It is the central hub for facilitating exchange between members and external partners from academia, industry, government, and the not-for-profit sector.

Dr. Martijn Sonneveld
 Executive Director

Michelle Grant
 Education Director

Toya Bezzola
 Project Manager Education and Research (joined in 2021)

Dr. Ivonne Blossfeld
 Project Manager Outreach (joined in 2021)

Monika Piessens
 Education Manager

Braida Thom
 Project Manager (left in 2021)

Dr. Jeanne Tomaszewski
 Communications Manager

Total full-time equivalents (end 2021): 4.5

2021 ANNUAL REPORT

Summary of Consolidated Financials (Infrastructure and Program)

Income	
TOTAL INCOME	741'683
ETH Zurich Infrastructure Funding	250'000
Member Fees	61'000
Management Support Funding from ETH Sources	275'000
Management Support Funding from Third Party Sources	54'245
Donations through ETH Foundation	135'500
WFS Fonds (former "Fonds Agroalimentaire")	10'400
Miscellaneous	5'538
Expenses	
TOTAL EXPENSES	688'760
Programs and Projects	
- Research	40'000
- Education	76'937
- Outreach	22'376
Management and Infrastructure	
- Personnel (including social benefits)	531'062
- Office and Administration	13'874
- Travel	640
- Communications	1'167
- Miscellaneous	2'705

Appendix

Selected Publications from WFSC Research Programs and Flagship Projects 2021

Aichinger, G. (2021) Natural dibenzo- α -pyrones: Friends or foes? (2021) *International Journal of Molecular Sciences*, 22: 13063.

Benabderrazik, K.; Kopainsky, B.; Tazi, L.; Joerin, J.; Six, J. (2021) Agricultural intensification can no longer ignore water conservation – A systemic modelling approach to the case of tomato producers in Morocco. *Agricultural Water Management*, 256: 107082.

Bertsch, P.; Böcker, L.; Mathys, A.; Fischer, P. (2021) Proteins from microalgae for the stabilization of fluid interfaces, emulsions, and foams. *Trends in Food Science & Technology*, 108: 326.

Canelli, G.; Kuster, I.; Jaquenod, L.; Buchmann, L.; Martínez, P.M.; Rohfritsch, Z.; Dionisi, F.; Bolten, C.J.; Nanni, P.; Mathys, A. (2021) Pulsed electric field treatment enhances lipid bioaccessibility while preserving oxidative stability in *Chlorella vulgaris*. *Innovative Food Science & Emerging Technologies*, 75: 102897

Canelli, G.; Martínez, P.M.; Austin, S.; Ambühl, M.; Dionisi, F.; Bolten, C.J.; Carpine, R.; Neutsch, L.; Mathys, A. (2021) Biochemical and morphological characterization of heterotrophic *Cryptocodium cohnii* and *Chlorella vulgaris* cell walls. *Journal of Agricultural and Food Chemistry*, 69: 2226.

Chen, C.; Chaudhary, A.; Mathys, A. (2021) Nutrient adequacy of global food production. *Frontiers in Nutrition*, 8: 739755.

Conz, R.F.; Six, J.; Andrade, M.I.; Pereira, E.I.P. (2021) Soil fertility maintenance with organic amendments to orange fleshed sweetpotato. *Nutrient Cycling in Agroecosystems*, 119: 213.

Costerousse, B.; Quattrini, J.; Grüter, R.; Frossard, E.; Thonar, C. (2021) Green manure effect on the ability of native and inoculated soil bacteria to mobilize zinc for wheat uptake (*Triticum aestivum* L.). *Plant and Soil*, 467: 287.

Defraeye, T.; Shrivastava, C.; Berry, T.; Verboven, P.; Onwude, D.; Schudel, S.; Bühlmann, A.; Cronje, P.; Rossi, R.M. (2021) Digital twins are coming: Will we need them in supply chains of fresh horticultural produce? *Trends in Food Science & Technology*, 109: 245.

Fenzi, M.; Couix, N. (2021) Growing maize landraces in industrialized countries: from the search for seeds to the emergence of new practices and values. *International Journal of Agricultural Sustainability*, DOI: 10.1080/14735903.2021.1933360

Fenzi, M.; Zurita-Benavides, M.G.; Prado, J.Q.A. (2021) Intersecting perspectives on Mexican maize landscapes. *Revue d'ethnoécologie*, 2.

Foyer, J.; Fenzi, M. (2021) Rendre la conservation de l'agrobiodiversité mexicaine gouvernable ou le difficile transcodage des savoirs scientifiques. *Revue d'ethnoécologie*, 2.

Garland, G.; Banerjee, S.; Edlinger, A.; Miranda Oliveira, E.; Herzog, C.; Wittwer, R.; Philippot, L.; Maestre, F. T.; van der Heijden, M. G. A. (2021) A closer look at the functions behind ecosystem multifunctionality: A review. *Journal of Ecology*, 109: 600–613.

Gold, M.; Fowles, T.; Fernandez-Bayo, J.D.; Miner, L.P.; Zurbrügg, C.; Nansen, C.; Bischel, H.N.; Mathys, A. (2021) Effects of rearing system and microbial inoculation on black soldier fly larvae growth and microbiota when reared on agri-food by-products. *Journal of Insects as Food and Feed*, 8: 113.

Green, A.; Nemecek, T.; Smetana, S.; Mathys, A. Reconciling regionally-explicit nutritional needs with environmental protection by means of nutritional life cycle assessment. *Journal of Cleaner Production*, 312: 127696.

Haberkorn, I.; Off, C.L.; Besmer, M.D.; Buchmann, L.; Mathys, A. (2021) Automated online flow cytometry advances microalgal ecosystem management as in situ, high-temporal resolution monitoring tool. *Frontiers in Bioengineering and Biotechnology*, 9: 642671.

Haberkorn, I.; Siegenthaler, L.; Buchmann, L.; Neutsch, L.; Mathys, A. (2021) Enhancing single-cell bioconversion efficiency by harnessing nanosecond pulsed electric field processing. *Biotechnology Advances*, 53: 107780.

Hao, B.; Oñate Narciso, J.; Nyström, L. (2021) Extraction and identification of phospholipids from whole grain kabog millet flour and predictive effects on starch binding and retrogradation. *LWT*, 152: 112406.

Heuel, M.; Kreuzer, M.; Sandrock, C.; Leiber, F.; Mathys, A.; Gold, M.; Zurbrügg, C.; Gangnat, I.D.M.; Terranova, M. (2021) Transfer of lauric and myristic acid from black soldier fly larval lipids to egg yolk lipids of hens is low. *Lipids*, 56: 423.

Heuel, M.; Sandrock, C.; Leiber, F.; Mathys, A.; Gold, M.; Zurbrügg, C.; Gangnat, I.D.M.; Kreuzer, M.; Terranova, M. (2021) Black soldier fly larvae meal and fat can completely replace soybean cake and oil in diets for laying hens. *Poultry Science*, 100: 101034.

Keller, M.; Reidy, B.; Scheurer, A.; Eggerschwiler, L.; Morel, I.; Giller, K. (2021) Soybean meal can be replaced by faba beans, pumpkin seed cake, spirulina or be completely omitted in a forage-based diet for fattening bulls to achieve comparable performance, carcass and meat quality. *Animals*, 11: 1588.

Lagneaux, E.; Jansen, M.; Quaedvlieg, J.; Zuidema, P.A.; Anten, N.P.R.; García Roca, M.R.; Corvera-Gomringer, R.; Kettle, C.J. (2021) Diversity bears fruit: Evaluating the economic potential of undervalued fruits for an agroecological restoration approach in the Peruvian Amazon. *Sustainability*, 13, 4582.

Le Goff, U.; Sander, A.; Lagana, M.H.; Barjolle, D.; Phillips, S.; Six, J. (2021) Raising up to the climate challenge – Understanding and assessing farmers' strategies to build their resilience. A comparative analysis between Ugandan and Swiss farmers. *Journal of Rural Studies*, 89: 1.

Longepierre, M.; Widmer, F.; Keller, T.; Weisskopf, P.; Colombi, T.; Six, J.; Hartmann, M. (2021) Limited resilience of the soil microbiome to mechanical compaction within four growing seasons of agricultural management. *ISME Communications*, 1:44.

Messmer, L.; Thom, B.; Kruetli, P.; Dawoe, E.; Assefa, K.; Six, J.; Joerin, J. (2021) Beyond feasibility—the role of motivation to implement measures to enhance resilience. *Mitigation and Adaptation Strategies for Global Change*, 26: 19.

Pool, S.; Francés, F.; Garcia-Prats, A.; Pulido-Velazquez, M.; Sanchis-Ibor, C.; Schirmer, M.; Yang, H.; Jiménez-Martínez, J. (2021) From flood to drip irrigation under climate change: Impacts on evapotranspiration and groundwater recharge in the Mediterranean region of Valencia (Spain). *Earth's Future*, 9: e2020EF001859.

Ramonedá, J.; Le Roux, J.; Stadelmann, S.; Frossard, E.; Frey, B.; Gamper, H.A. (2021) Soil microbial community coalescence and fertilization interact to drive the functioning of the legume-rhizobium symbiosis. *Journal of Applied Ecology*, 58: 2590.

Sun, Q.; Gilgen, A.K.; Signarbieux, C.; Klaus, V.H.; Buchmann, N. (2021) Cropping systems alter hydraulic traits of barley but not pea grown in mixture. *Plant Cell Environment*, 44: 2912.

Sun, Q.; Klaus, V.H.; Wittwer, R.; Liu, Y.; van der Heijden, M.G.A.; Gilgen, A.K.; Buchmann, N. (2021) Water uptake patterns of pea and barley responded to drought but not to cropping systems. *Biogeosciences Discussions*, preprint.

Surchat, M.; Wezel, A.; Tolon, V.; Breland, T.A.; Couraud, P.; Vian, J.F. (2021) Soil and pest management in French Polynesian farming systems and drivers and barriers for implementation of practices based on agroecological principles. *Frontiers in Sustainable Food Systems*, 5. doi: 10.3389/fsufs.2021.708647.

Wille, L.; Kurmann, M.; Messmer, M.M.; Studer, B.; Hohmann, P. (2021) Untangling the pea root rot complex reveals microbial markers for plant health. *Frontiers in Plant Science*, 12: 737820.

Wittwer, R.A.; Bender, S.F.; Hartman, K.; Hydbom, S.; Lima, R.A.A.; Loaiza, V.; Nemecek, T.; Oehl, F.; Olsson P.A.; Petchey, O.; Prechsl, U.E.; Schlaeppli, K.; Scholten, T.; Seitz, S.; Six, J.; Van Der Heijden, M.G. (2021) Organic and conservation agriculture promote ecosystem multifunctionality. *Science Advances*, 7: eabg6995.



Buckwheat growing at the ETH Plant Science Research Station.

Appendix

Public and Specialist Events Organized by WFSC and Partners 2021

Event	Date	Location	Participants	Speakers	Organizers
Science Stories- WFSC Short Films Premiere	May 2021	Online	106	Braida Thom, Lukas Wille, Rafaela Feola Conz, Josep Ramoneda Massagué, Iris Haberkorn, Alexander Mathys	WFSC
The Need for Climate Resilient Food Systems	Jun 2021	Online	39	Johan Six, Fabrizio Arigoni	GreenBuzz Zürich, Plant Science Center, WFSC
Public Webinar: Bending the Curve of Biodiversity Loss: How Can Agriculture Become Part of the Solution?	Jun 2021	Online	119	Michael Glemnitz, Bärbel Hundt, Sebastian Lakner, Sergei Schaub, Marc Sneyders, Wei Zhang, Claude Garcia	Ecosystem Management Group, Sustainable Agroecosystems Group, Agricultural Economics and Policy Group, WFSC
Public Webinar: Seafood that Never Saw the Sea	Jun 2021	Online	200	Lou Cooperhouse, Michael Siegrist	Embassy of the United States in Bern.WFSC
Public Webinar: Transforming Food Systems through Agroecology: Learning from Evidence	Jun 2021	Online	118	Fabrice De Clerk, Emma Siliprandi, Rachel Bezner Kerr, Martijn Sonneveld, Shangchuan Jiang, Evelyn Ohanwusi, Sebastian Treyer, Mamadou, Goïta, Urs Niggli, Ann Tutwiler	Bioversity-CIAT, World Food Forum, UN FAO, IDDRI, Food System Economics Commission, WFSC
Exhibit 'Innovation for Sustainable Development' at ETH Zurich and University of Zurich Science Days (Scientifica)	Sep 2021	University of Zurich	600	Empa Simulating Biological Systems Group, Eawag Safe Water Promotion and Water Supply and Treatment Groups, Sustainable Agroecosystems Group, Food Biochemistry Group	ETH4D, WFSC
Workshop ' Fair Chocolate 4All' at ETH Zurich and University of Zurich Science Days (Scientifica)	Sep 2021	ETH Zurich	10	Braida Thom, Charlotte Kaufmann	WFSC
Public Webinar: Agroecology and the Transition to Sustainable Food Systems Introduction to Agroecology	Sep 2021	Online	1000 (entire series)	Martijn Sonneveld, Marcela Quintero, Million Belay, Stefanie Pondini	WFSC
Public Webinar: Agroecology and the Transition to Sustainable Food Systems Efficiency	Sep 2021	Online		Achim Walter, Adrian Müller, Dominik Klauser	WFSC
Public Webinar at Global Climate Action Symposium: Changing the Food System, One Smoothie at a Time	Sep 2021	Online	100	Iris Haberkorn, Kanaha Shoji, Concrete Jungle	Georgia Tech, Embassy of the Switzerland in Atlanta, Concrete Jungle, WFSC
Public Webinar: Agroecology and the Transition to Sustainable Food Systems Diversity	Oct 2021	Online		Jaboury Ghazoul, Marianna Fenzi, Roseline Remans, Eva Zand	WFSC
Public Webinar: Agroecology and the Transition to Sustainable Food Systems Resilience	Oct 2021	Online		Kenza Benabderrazik, Helmy Abouleish, Lucas Worsdell, Georges Felix	WFSC
Public Webinar: Agroecology and the Transition to Sustainable Food Systems Human and Social Values	Oct 2021	Online		Johanna Jacobi, Rachel Bezner Kerr, Patrick Honauer, Alan Heinze Yothers, Carole Nordmann	WFSC

Event	Date	Location	Participants	Speakers	Organizers
Public Webinar: Agroecology and the Transition to Sustainable Food Systems Synergies	Oct 2021	Online		Christian Schöb, Akanksha Singh, Gabriel Orrego Astorga	WFSC
Art Science Exhibition: Helvetia and the Journey of the Cocoa Bean	Nov 2021	ETH Zurich	25 (opening event)	Braida Thom, Marie Van Berchem	Sustainable Agroecosystems Group, WFSC
Exhibition Opening: Together for the SDGs	Nov 2021	ETH Zurich	80	Sarah Springman, Nicolas Radin, Frank Odhiambo, Isabel Günther	ETH4D, ETH Sustainability, Nadel, WFSC
Food Day @ETH	Nov 2021	ETH Zurich	85	Emily Oliveira, Sandra Pool, Maike Heuel, Will Thompson, Robert Finger, Carmen Thönnissen, Eliana Zamprogna, Isabel Sommer, Billie Hauser, Christina Senn-Jakobsen	WFSC
Public Webinar: Agroecology and the Transition to Sustainable Food Systems Co-Creation and Sharing of Knowledge	Nov 2021	Online		Emmanuel Frossard, Jehane Akiki, Benjamin Gräub, Johanna Herrigel	WFSC
Public Webinar: Agroecology and the Transition to Sustainable Food Systems Recycling / Circularity	Nov 2021	Online		Ben Wilde, Linda Grieder, Christian Zurbrugg	WFSC
Public Webinar: Agroecology and the Transition to Sustainable Food Systems Culture and Food Tradition	Nov 2021	Online		Caitlin Morgan, Toya Bezzola, Louisa Aarrass, Mariann Basseby-Orovwuje	WFSC
Public Webinar: Agroecology and the Transition to Sustainable Food Systems Responsible Governance	Nov 2021	Online		Rachael Garrett, Leonida Odongo, Anne-Sophie Gindroz, Namukolo Covic	WFSC
Public Webinar: Agroecology and the Transition to Sustainable Food Systems Circular and Solidarity Economy	Nov 2021	Online		Tobias Joos, David Jacobsen, Fabienne Vukotic	WFSC
Public Webinar: Agroecology and the Transition to Sustainable Food Systems Agroecology, The Way Forward	Dec 2021	Online		Yodit Kebede, Ken Giller, Fergus Sinclair, Frank Eyhorn	WFSC
Total: 23 events			2'482		

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Content Jeanne E. Tomaszewski, Roelinda Jongstra
Layout Jeanne E. Tomaszewski
Cover Visitors at the ETH/UZH Scientifica could view videos celebrating 150 Years of Agricultural Science at ETH Zurich. Image: ETH/UHZ/Alessandro Della Bella.
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ETH Zurich, March 2022