

ETH zürich

World Food System Center

Member Booklet 2016



World Food System
Center

Contents

Overview of the Members of the World Food System Center		7
Prof. Alfredo Brillembourg	Architecture and Urban Design	9
Prof. Hubert Klumpner	Architecture and Urban Design	9
Prof. Nina Buchmann	Grassland Sciences	11
Prof. Jan Carmeliet	Building Physics	13
Prof. Consuelo De Moraes	Biocommunication and Entomology	15
Prof. Peter Edwards	Singapore-ETH Centre	--
Prof. Robert Finger	Agricultural Economics and Policy	17
Prof. Emmanuel Frossard	Plant Nutrition	19
Prof. Jaboury Ghazoul	Ecosystem Management	21
Prof. Wilhelm Gruissem	Plant Biotechnology	23
Prof. Isabel Günther	Development Economics	25
Prof. Stefanie Hellweg	Ecological Systems Design	27
Prof. Michael Kreuzer	Animal Nutrition	29
Dr. Pius Krütli	USYS TdLab – Transdisciplinarity Lab	31
Prof. Christophe Lacroix	Food Biotechnology	33
Prof. Wolfgang Langhans	Physiology and Behavior	--
Prof. Martin Loessner	Food Microbiology	35
Prof. Andreas Lüscher	Forage Production and Grassland	37
Prof. Alexander Mathys	Sustainable Food Processing	39
Prof. Bruce McDonald	Plant Pathology	41
Prof. Raffaele Mezzenga	Food and Soft Materials	43
Dr. Adrian Müller	Environmental Policy and Economics	45
Prof. Laura Nyström	Food Biochemistry	47
Prof. Anthony Patt	Climate Policy	49
Prof. Gerhard Schmitt	Information Architecture	51
Prof. Rainer Schulin	Soil Protection	53
Prof. Sonia Seneviratne	Land-Climate Dynamics	55
Prof. Michael Siegrist	Consumer Behavior	57
Prof. Johan Six	Sustainable Agroecosystems	59
Dr. Christian Stamm	Environmental Chemistry	61
Prof. Bruno Studer	Molecular Plant Breeding	63
Prof. Shana Sturla	Toxicology	65
Prof. Susanne E. Ulbrich	Animal Physiology	67
Prof. Stephan Wagner	Logistics Management	69
Prof. Achim Walter	Crop Science	71
Prof. Erich Windhab	Food Process Engineering	73
Prof. Hong Yang	Water, Environment and Food Security	75
Prof. Sam Zeeman	Plant Biochemistry	77
Prof. Michael Zimmermann	Human Nutrition	79
Dr. Christian Zurbrügg	Water and Sanitation	81

Members of the World Food System Center

D-USYS



PROF. N. BUCHMANN
Grassland Sciences



PROF. C. DE MORAES
Biocommunication and Entomology



PROF. P. EDWARDS
Singapore-ETH Centre



PROF. E. FROSSARD
Plant Nutrition



PROF. J. GHAZOUL
Ecosystem Management



PROF. M. KREUZER
Animal Nutrition



DR. P. KRÜTLI
USYS TdLab

D-USYS



PROF. A. LÜSCHER
Forage Production and Grassland



PROF. B. McDONALD
Plant Pathology



DR. A. MÜLLER
Environmental Economics and Policy



PROF. A. PATT
Climate Policy



PROF. R. SCHULIN
Soil Protection



PROF. S. SENEVIRATNE
Land-Climate Dynamics



PROF. J. SIX
Sustainable Agroecosystems

D-USYS



PROF. B. STUDER
Molecular Plant Breeding



PROF. S. E. ULBRICH
Animal Physiology



PROF. A. WALTER
Crop Sciences



PROF. R. FINGER
Agricultural Economics and Policy



PROF. S. WAGNER
Logistics Management



PROF. W. GRUISSEM
Plant Biotechnology



PROF. S. ZEEMAN
Plant Biochemistry

D-MTEC & D-USYS

D-MTEC

D-BIOL

D-HEST



PROF. C. LACROIX
Food Biotechnology



PROF. W. LANGHANS
Physiology and Behavior



PROF. M. LOESSNER
Food Microbiology



PROF. A. MATHYS
Sustainable Food Processing



PROF. R. MEZZENGA
Food and Soft Materials



PROF. L. NYSTRÖM
Food Biochemistry

D-HEST



PROF. M. SIEGRIST
Consumer Behavior



PROF. S. STURLA
Toxicology



PROF. E. WINDHAB
Food Process Engineering



PROF. M. ZIMMERMANN
Human Nutrition



PROF. S. HELLWEG
Ecological Systems Design



PROF. I. GÜNTHER
Development Economics

D-BAUG

D-GESS

D-ARCH



PROF. A. BRILLENBOURG
PROF. H. KLUMPNER
Architecture and Urban Design



PROF. J. CARMELIET
Building Physics



PROF. G. SCHMITT
Information Architecture



DR. C. STAMM
Environmental Chemistry



PROF. H. YANG
Water, Environment and Food Security



DR. C. ZURBRÜGG
Water and Sanitation

eawag



A food store set up by residents of Torre David, a squatted 45 story skyscraper in Caracas.

ARCHITECTURE AND URBAN DESIGN

Addressing the challenges faced by informal urban settlements in the global south.



Research Areas

- Design practice of contemporary architecture and urbanism;
- Informal settlements in the global south;
- Sustainable urban solutions for marginalized populations.

Regions

Latin America, Caribbean, Vietnam, South Africa, and Switzerland.

Partners

Inter-American Development Bank, Swiss State Secretariat for Economic Affairs, Municipality of Port of Spain, Rio de Janeiro, Sao Paulo, Caracas, Schindler, Holcim, Doppelmayr, and Audi.

Contact

ETH Zurich
 Chair of Architecture and Urban Design
 ONA J 17
 Neunbrunnenstrasse 50
 8050 Zurich

u-tt.com →

Contribution to the WFSC

The Architecture and Urban Design group addresses the challenges faced by informal settlements in the global south: social inequality, uneven distribution of resources, inadequate urban services. They tackle these urban phenomena and provide socially and ecologically sustainable design solutions for marginalized populations. The interrelated themes of food, nutrition, sanitation and health remain central issues in slums today.



Prof. Alfredo Brillembourg & Prof. Hubert Klumpner





Seasonality at Oensingen, one of the Swiss Fluxnet sites.

GRASSLAND SCIENCES

Ensuring a sustainable resource use in the world food system.



Research Areas

- Ecosystem biogeochemistry;
- Plant & ecosystem physiology;
- Functional plant diversity;
- Policy advice.

Regions

Mainly in Switzerland and Germany, and Panama in the past.

Partners

Universities of Zurich, Bern and Basel, PSI, Agroscope, WSL, MPI Biogeochemistry, Friedrich-Schiller-Universität, Jena, Universities of Innsbruck and Vienna, University of California, Berkely, and ANU Canberra.

Contact

ETH Zurich
 Grassland Sciences
 LFW C 56
 Universitätstrasse 2
 8092 Zurich

www.gl.ethz.ch →

Contribution to the WFSC

The group of Grassland Sciences analyzes terrestrial ecosystems and their provision of ecosystem services in a process- and system-oriented approach. The research and teaching is divided into the two pillars of availability/sustainable production and stability/environmental change, focussing on ensuring a sustainable resource use in the world food system.



Prof. Nina Buchmann





Exploring new packaging concepts and cold-chain protocols for citrus fruit via full-scale experiments in South Africa.

BUILDING PHYSICS

Understanding the interaction of food materials with their environment to improve the postharvest supply chain.



Research Areas

- Understanding drying-rehydration of biological materials by multiphysics modelling and non-destructive imaging;
- Development of innovative cold-chain protocols and novel food packaging concepts;
- Multiscale evaluation of plant-atmosphere exchange processes;
- Urban heat island mitigation strategies.

Regions

Switzerland and South-Africa.

Partners

Empa, University of Stellenbosch, KU Leuven, and Citrus Research International.

Contact

ETH Zurich
Chair of Building Physics
HIL E 46.2
Stefano-Franscini-Platz 5
8093 Zurich

www.carmeliet.arch.ethz.ch →

Contribution to the WFSC

The chair of Building Physics aims at understanding coupled hygrothermal-mechanical-chemical transport processes in porous materials and their interaction with the environment. For foods, the group applies this expertise to develop new packaging concepts for fresh fruits and vegetables, alternative cold-chain protocols and improved food drying processes. Such strategies to enhance postharvest life and quality of food support the WFSC in developing more resource-efficient, energy-smart food value chains.



Prof. Jan Carmeliet





Striped cucumber beetle feeding on foliage (Photo: Nick Stoff).

BIOCOMMUNICATION AND ENTOMOLOGY



Answering important basic science questions about the role of chemical signaling in ecology that have practical relevance for sustainable food production and other pressing societal challenges.

Research Areas

- Plant-insect interactions;
- Chemical ecology of vector-borne disease;
- Chemically mediated interactions between plants;
- Plant responses to olfactory cues;
- Evolutionary ecology of plant signaling and defense;
- Biological communication and information-mediated ecological interaction.

Regions

Switzerland, Kenya, USA, Greece, and Brazil.

Partners

International Center of Insect Physiology and Ecology (ICIPE), Kenya, Pennsylvania State University, University of Virginia, and Instituto Nacional de Ciência e Tecnologia - Centro de Energia, Ambiente e Biodiversidade (INCT-CEAB), Brazil.

Contribution to the WFSC

The Biocommunication and Entomology group explores the role of chemical signaling in mediating ecological interactions among species, with a particular focus on characterizing olfactory cues and signals and their role in information transfer. Most of the work focuses on multitrophic interactions among plants, insects, and microbes, and on the interactions of insect disease vectors with their plant and animal hosts. The

diverse empirical techniques employed range from molecular biology and analytical chemistry to ecological field studies. The overarching goal is to answer key basic-science questions in ecology and evolution with implications for human health and the sustainable management of natural and agricultural ecosystems.

Contact

ETH Zurich
Biocommunication and Entomology
LFO G 18 | Schmelzbergstrasse 9
8092 Zurich
www.biocommunication.ethz.ch →



Prof. Consuelo De Moraes





The agricultural and food sector.

AGRICULTURAL ECONOMICS AND POLICY



Improving the understanding of production and risk management decisions for better policies in the agricultural and food sector.

Research Areas

- Agricultural economics;
- Agricultural policy evaluation and design;
- Risk management in agriculture;
- Ecosystem service supply and demand.

Regions

Mainly Switzerland and other European countries.

Partners

University of Zurich, University of Bonn, Wageningen University, Agroscope, WSL, University of Goettingen, and University of Grenoble.

Contribution to the WFSC

The Agricultural Economics and Policy group analyzes linkages between policies and production and risk management decisions taken in the agricultural and food sector. Our research contributes to improve policies and support instruments to ensure sustainable resource use in the world food system. Building upon microeconomic theory and models, the research conducted in the group employs different methodological approaches including econometric analysis, economic experiments and surveys as well as farm- and regional level optimization modeling.

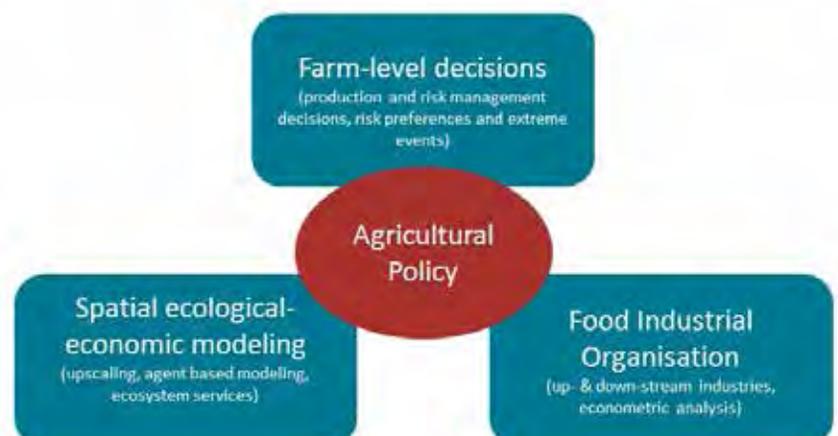


Prof. Robert Finger

Contact

ETH Zurich
 Agricultural Economics and Policy
 SOL D 2
 Sonneggstrasse 33
 8092 Zurich

www.aecp.ethz.ch →





Intercropping of rice and legume *Stylosanthes guianensis* to investigate N and P dynamics in a rice-legume based crop rotation, Madagascar highlands (Photo: Oliver Zemek).

PLANT NUTRITION



Understand nutrient dynamics to develop nutrient management systems that preserve and enhance the natural resource base and contribute to food security.

Research Areas

- Role of abiotic processes in phosphorus (P) and heavy metals cycling;
- Microbial functions in soil nutrient dynamics;
- Functional molecular ecology of arbuscular mycorrhizas and other soil microbes; use of ^{18}O to assess P fluxes and processes at ecosystem level;
- Phosphorus and nitrogen (re-)cycling in agro-ecosystems and development of integrated nutrient management schemes.

Regions

Switzerland, Burkina Faso, Colombia, Côte d'Ivoire, Iran, Madagascar, and Sri Lanka.

Partners

CIRAD, CSRS Côte d'Ivoire, Deltares, CIAT, IITA, INERA, CAS, LRI, FOFIFA, U.C. Santa Cruz, University of Calgary, University of Jerusalem, University of Peradeniya, Isfahan University of Technology, and Universities of Sydney and Adelaide.

Contact

ETH Zurich
Plant Nutrition
Eschikon 33
8315 Lindau

www.plantnutrition.ethz.ch →

Contribution to the WFSC

Integrated nutrient management schemes are necessary to achieve food security. Crops and grasslands need to be provided with sufficient nutrients in appropriate forms to be productive. Also, nutrient management affects food quality as plant nutrition directly impacts the technological or nutritional value of the products. Furthermore, ecological stability is affected by nutrient management, as nutrient losses trigger environmental degradation, and resources such as soil or phosphorus are not renewable on the human time scale. These challenges meet the mission of the group of plant nutrition.



Prof. Emmanuel Frossard





Pollination services - *Apis dorsata* on a coffee flower.

ECOSYSTEM MANAGEMENT



Understanding ecological and evolutionary processes to ensure sustainable food production and biodiversity conservation in forested landscapes.

Research Areas

- Agroforestry and land use change;
- Tropical rainforest ecology;
- Pollination services;
- Conservation genetics.

Regions

India, Malaysia, Seychelles, and Indonesia.

Partners

Centre for International Forest Research (CIFOR), World Agroforestry Centre (ICRAF), University of Agricultural Sciences Bangalore, University of Aberdeen, and Sepilok Forest Research Centre Sabah.

Contact

ETH Zurich
Ecosystem Management
CHN G 74.1
Universitätstrasse 16
8092 Zurich

www.ecology.ethz.ch →

Contribution to the WFSC

The Ecosystem Management group seeks to determine how the goals of food production and biodiversity conservation can be achieved in context of rapid land transitions, climate change and growing demands for agricultural products. This is a core objective of the WFSC, and responds to the global need to address global food security challenges while sustaining a wide range of environmental values and services.



Prof. Jaboury Ghazoul





Nutritionally enhanced rice growing in the greenhouse facility at ETH Zurich.

PLANT BIOTECHNOLOGY



Improving plant function and performance in order to provide solutions for major staple crop problems in the world food system.

Research Areas

- Cassava and rice nutritional improvement for human health;
- Engineering cassava and rice resistance to fungal, bacterial and viral pathogens;
- Technology transfer to Africa and Asia.

Regions

China, India, Indonesia, Kenya, Tanzania, Philippines, South Africa, and Vietnam.

Partners

BECA Kenya, Institute Teknologi Bandung, Institute of Agricultural Genetics, IRRI Philippines, MARI Tanzania, Punjab Agricultural University, and SCCB China.

Contribution to the WFSC

The group of Plant Biotechnology focuses its research on central questions related to the regulation of plant development and improvement of their performance, in particular, research is done on the development of disease-resistant and nutritionally improved cassava and rice cultivars to increase yield stability and improve human health. These efforts directly contribute to food security and nutritional quality and therefore relate strongly to the mission of the WFSC.

Contact

ETH Zurich | Plant Biotechnology
LFW E 56 | Universitätstrasse 2
8092 Zurich



Prof. Wilhelm Gruißsem

wgruissem@ethz.ch

www.pb.ethz.ch →





DEVELOPMENT ECONOMICS



Analyze development challenges and develop solutions to address global poverty.

Research Areas

- Poverty and inequality;
- Effectiveness of development policies;
- Technologies for poverty reduction;
- Economics of food security and child health.

Regions

Sub-Saharan Africa.

Partners

EAWAG, University of Zurich, Swiss TPH, Göttingen University, Harvard University, Makerere University, University d'Abomey Calavi, Swiss Development Cooperation (SDC), UNDP, German Development Bank (KfW), and NGOs working in international cooperation.

Contact

ETH Zurich
NADEL - Center for Development and Cooperation
CLD B 9
Clausiusstrasse 37
8092 Zurich

www.nadel.ethz.ch →

www.dec.ethz.ch →

Contribution to the WFSC

The Development Economics group conducts empirical and experimental research in economics to understand which policies and technologies can contribute to reduce poverty and inequality. They try to link research with policy and hence often collaborate with international development organizations to contribute to evidence-based policy making. Moreover, the work is closely linked to the Center of Development and Cooperation that offers students an inspiring environment to learn about global development challenges and state-of-the-art methods to find innovative solutions to address those challenges.



Prof. Isabel Günther





Application of pesticides to develop dynamic plant uptake models for Life Cycle Assessment.

ECOLOGICAL SYSTEMS DESIGN



Modelling and analyzing of food production systems to assess overall impacts of food products.

Research Areas

- Life Cycle Assessment method development;
- Environmental decision-support tools for industry and authorities;
- Combination of methodological work with actual case studies (agricultural production, wood, consumer products, waste management, energy supply and use, nanotechnology).

Regions

Europe, Asia, Africa, and the Americas.

Partners

Coop, Syngenta, and International Center for Tropical Agriculture (CIAT).

Contact

ETH Zurich
Ecological Systems Design
HIF C 41
Stefano-Franscini-Platz 3
8093 Zurich

www.esd.ifu.ethz.ch →

Contribution to the WFSC

The group of Ecological Systems Design provides expertise in Life Cycle Analysis and other methods like Material Flow Analysis and Scenario Assessment, which allows for environmental evaluation of food production systems throughout their whole value and impact chain. These methods combined provide a comprehensive view of the environmental impacts associated with food, therefore providing the WFSC with methods for modelling, analyzing, evaluation and improving the resource efficiency and environmental impacts of food products.



Prof. Stefanie Hellweg





Teaching animal nutrition.

ANIMAL NUTRITION

Investigating the role of livestock for sustainable agriculture and food production.



Research Areas

- Tropical livestock nutrition;
- Sustainability of feeding and quality of food;
- Rumen physiology and environment;
- Poultry nutrition.

Regions

Brazil, Bolivia, China, Columbia, Ethiopia, Kenya, Nepal, Nicaragua, Peru, Sri Lanka, Switzerland, Syria, Thailand, and Vietnam.

Partners

Consultive Group of International Agricultural Research (CGIAR), Agroscope, FiBL, and Vetsuisse Zurich and Bern.

Contact

ETH Zurich
Animal Nutrition
LFW B 56
Universitätstrasse 2
8092 Zurich

www.an.ias.ethz.ch →

Contribution to the WFSC

The group of Animal Nutrition focusses on food security and quality issues from a livestock perspective. This includes efficient production of healthy milk, meat and eggs in a way which is environmentally sound and suitable for the local conditions available. The research ranges from rumen microbiology to whole-farm approaches concerning the role of animal nutrition in nutrient cycling, using integrative approaches to solve research problems of agricultural systems.



Prof. Michael Kreuzer





CCES Winterschool "Science meets Practice" - Students interacting with stakeholders.

USYS TdLab – TRANSDISCIPLINARITY LAB



Developing new educational and research approaches to solve complex problems at the interface between academia and society.

Teaching

- Offer and coordination of teaching activities addressing topics from a problem oriented perspective;
- Training of USYS's Bachelor, Master and PhD students in theory, methods and practice of transdisciplinary research for sustainable development (TDforSD).

Research Areas

Transdisciplinary research projects in

- Energy;
- Waste management;
- Urban transformation;
- Health;
- Agriculture.

Regions

Benin, Columbia, Ethiopia, Ghana, Guatemala, Seychelles, Singapore, and Switzerland.

Contact

ETH Zurich
USYS TdLab
CHN K 78
Universitätstrasse 22
8092 Zurich

www.tdlab.usys.ethz.ch →

Partners

Teaching and research groups within the ETH domain, universities, governmental and non-governmental bodies, stakeholders from civil society and business in the respective countries, and cantonal and federal administration in Switzerland.

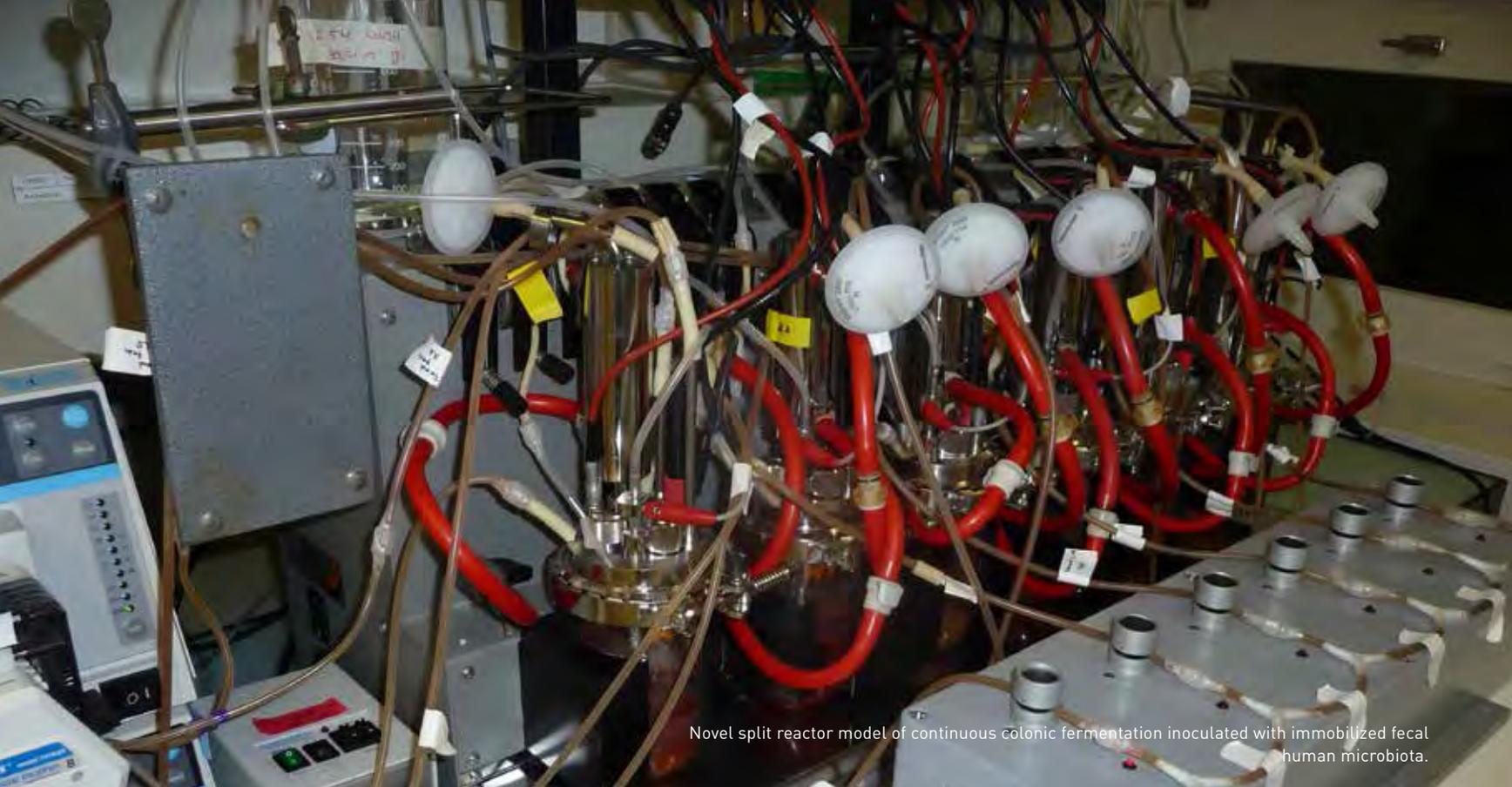
Contribution to the WFSC

The TdLab provides interdisciplinary teaching courses at the science-society interface at BSc, MSc and PhD level, methodologies to integrate knowledge from both different disciplines and praxis, and a framework to engage with stakeholders in the research process.



Dr. Pius Krütli, Co-Director





Novel split reactor model of continuous colonic fermentation inoculated with immobilized fecal human microbiota.

FOOD BIOTECHNOLOGY



Characterization and mechanisms of beneficial microbes and their development for high quality, safe and healthy food and health products.

Research Areas

- Functional microbes useful for food and health;
- Role and functions of the complex human gut microbiota in health and disease;
- Development of innovative microbial technologies for fastidious microbes, food fermentation and bio ingredient production.

Regions

Switzerland, France, Kenya, Ivory Coast, Mali, South Africa, Mexico, and USA.

Partners

Nestlé, Bioforce, Rapelli, Lonza, Bakels, Coop, Tilsiter, UBS-Optimus, Danisco DK, Grupo Industrial Lala ME, Alltech USA, Danone FR, Universities of Zurich and Bern, STIH Basel, Cantonal Laboratories of Zurich and Basel, Université Laval, INRA Clermont-Ferrand,

Wageningen University, Cedars Sinai Medical Center of Los Angeles, Harbor-UCLA Medical Center, University of Nairobi, and Centre Suisse de Recherche Scientifique Abidjan.

Contribution to the WFSC

The group of Food Biotechnology works on the functional, molecular and technological characterization of high potential microbes in order to develop robust industrial processes, high quality, safe and healthy foods and products that prevent and treat intestinal infections in human and animals. This application of beneficial microbes are providing the world food system with innovative technologies to enhance global food quality, extend shelf-life, and impact on people health both for developing and developed countries.

www.fbt.ethz.ch →

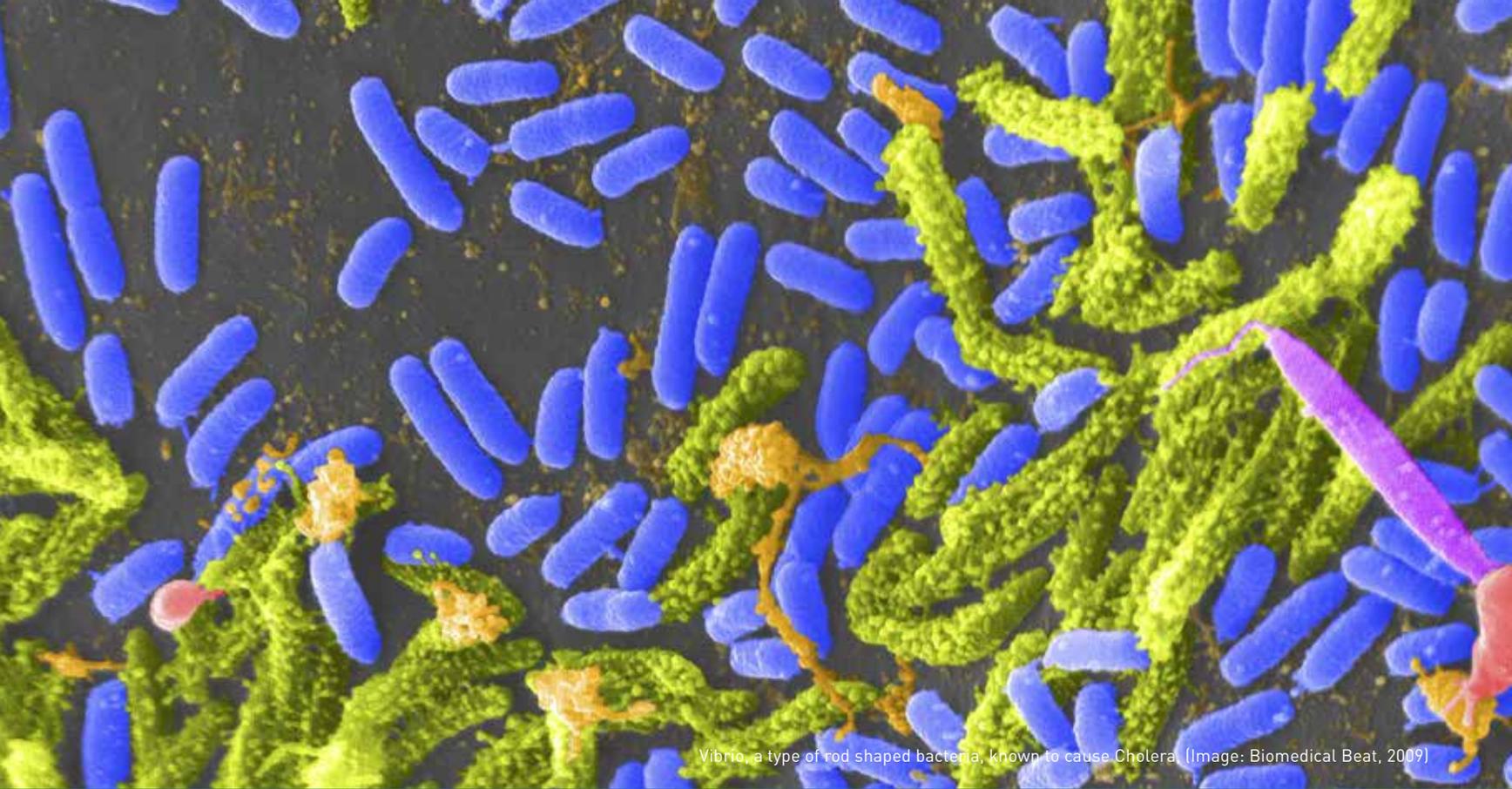


Prof. Christophe Lacroix

Contact

Food Biotechnology
LFV C 20
Schmelzbergstrasse 7
8092 Zurich





Vibrio, a type of rod shaped bacteria, known to cause Cholera. (Image: Biomedical Beat, 2009)

FOOD MICROBIOLOGY

Ensuring a safe food supply without pathogens for developing and developed countries.



Research Areas

- Food safety, pathogenic microorganisms that occur in food and feed;
- Fundamental research in molecular biology and microbial ecology;
- Development of rapid diagnostic procedures for detection of foodborne pathogens;
- Novel biocontrol measures to restrict contamination with, and development of, pathogens in foods.

Regions

Switzerland, Germany, USA, and UK.

Partners

Other academic groups and various SME.

Contact

ETH Zurich
Food Microbiology
LFV B 20
Schmelzbergstrasse 7
8092 Zurich

www.foodmicrobiology.ethz.ch →

Contribution to the WFSC

The group of Food Microbiology focuses their research on microbial pathogens in food and the corresponding bacteriophages, developing new, cutting-edge methods for detection and control of these bacteria. Further, they construct and use genetically engineered microorganisms for manufacturing and preservation of food. This helps to secure food safety for a healthy food supply in developing and developed countries.



Prof. Martin Loessner





Studying the performances of different grass-legume-herb mixtures and grass pure stands when cut or grazed (FP7 Project 244983: MultiSward).

FORAGE PRODUCTION AND GRASSLAND



Developing sustainable grassland-based forage production systems to ensure global food security.

Research Areas

- Species composition of grasslands and their provision of ecosystem services;
- Species richness and composition (functional biodiversity) as a driver of ecosystem functioning and as an adaptation and mitigation option to climate change;
- Weed species and poisonous plants in grasslands;
- Forage production technology and grass-legume seed mixtures.

Regions

Switzerland, 17 European countries, and Mongolia.

Partners

Other agroscope research groups, ETH, universities and applied universities of Switzerland, Swiss Grassland Society (AGFF), Agridea, European universities and research institutes, SDC, Mongolian research institutes.

Contact

Agroscope
Forage Production and Grassland
Reckenholzstrasse 191
8046 Zürich

andreas.luescher@agroscope.admin.ch
www.agroscope.ch →

Contribution to the WFSC

The group of Forage Production and Grassland contributes to food security by developing forage production strategies that optimize the use of farm-own resources (biodiversity, manure, farm grown forage), minimize the need of external inputs (fertilizers, pesticides, feed stuff) and allow strategies of adaptation and mitigation to climate change. They contribute to the development of productive yet environmentally friendly grassland-based forage production systems.



Prof. Andreas Lüscher





Modular scalable process development based on continuous micro process systems including inline and online process control.

SUSTAINABLE FOOD PROCESSING



System oriented food process development via the consideration of the total value chain including emerging needs in society and their environmental, economic and social impact.

Research Areas

- Emerging multi hurdle technologies for gentle preservation of healthy and high quality food;
- Novel protein based biorefineries, with focus on algae and insects, for more sustainable food production;
- Modular micro process engineering approaches to improve upscaling;
- Nutritional combined environmental life cycle assessment.

Regions

Europe, USA, China, Nigeria, Kenya, South Africa, and Australia.

Partners

Bühler AG, Migros, Nestlé SA, German Institute of Food Technologies (DIL), TU Berlin, GIZ, IUFoST, IFT, and EAFE.

Contribution to the WFSC

The Sustainable Food Processing group focuses on a system oriented approach in production via the consideration of the total value chain including emerging needs in society and their environmental, economic and social impact. Life cycle sustainability assessment (LCSA) as guidance tool is the foundation of the emerging food process development. Selected mechanical, biotechnological, thermal and non-thermal techniques

to realize biomass use efficiency, waste reduction and high quality food production are evaluated based on the WFSC approach. Innovative raw materials from algae and insects are utilized within urban farming and processing concepts to enable new ways of sustainable food supply.

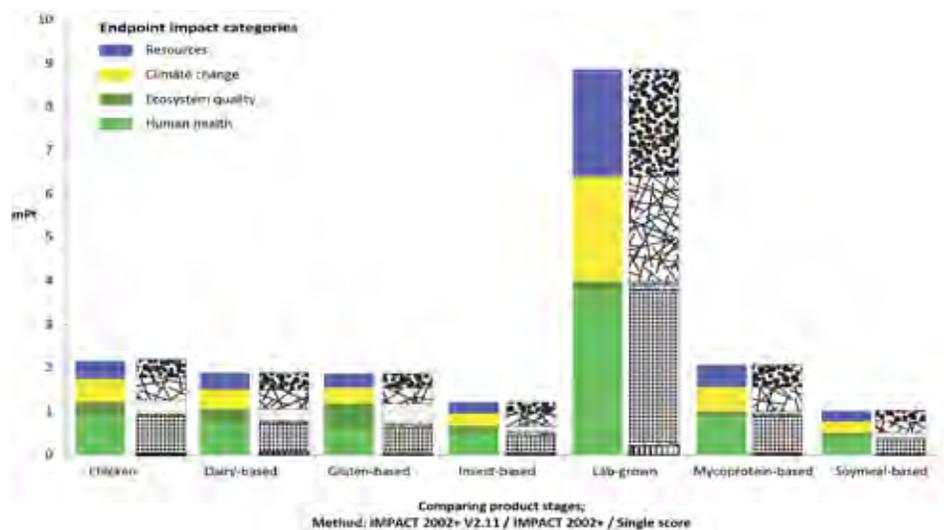
Contact

ETH Zurich
Sustainable Food Processing
LFO E 12.2
Schmelzbergstrasse 9
8092 Zurich

www.sfp.ethz.ch →



Prof. Alexander Mathys





Applying digital image analysis to measure pathogen virulence.

PLANT PATHOLOGY

Controlling plant pathogens to reduce losses of staple food crops.



Research Areas

- Pathogen population genetics and evolutionary biology;
- Biological control of soil-borne pathogens;
- Diseases of perennial crops;
- Resistance breeding strategies;
- Pathogen origins and emergence.

Regions

Italy, Germany, Denmark, The Netherlands, USA, Brazil, Australia, Iran, New Zealand, and China.

Partners

INRA, USDA, Australian National University, CSIRO Plant Industry, Curtin University (Australia), UNESP (Brazil), and FAFU (China).

Contact

ETH Zurich
Plant Pathology
LFW B 16
Universitätstrasse 2
8092 Zurich

www.path.ethz.ch →

Contribution to the WFSC

The group of Plant Pathology works on major diseases infecting the important food crops (wheat, barley, rice) in order to reduce disease losses. The research spans the spectrum in agriculture, from molecular- to ecosystem-orientation, which allows for a highly cross-disciplinary and global orientation which fits with the objectives of the WFSC. The focus is on delivery of fundamental knowledge in key areas of plant pathology in a problem-solving, innovative manner.



Prof. Bruce McDonald





Small-Angle X-ray Scattering (SAXS) machine, measuring the interaction of a sample with X-rays to study its nanostructure.

FOOD AND SOFT MATERIALS



Developing healthy, functional foods with affordable and sustainable processes and materials.

Research Areas

- Food physics, nanotechnology and food materials science;
- Self-organization of proteins, polysaccharides and lipids;
- Understanding structure-properties relationship in complex food systems;
- Characterization of structure in processed foods;
- Design of functional foods from proteins and lipids.

Regions

Switzerland.

Partners

Australia, New Zealand, India, China, Israel, Finland, Germany, UK, Romania, Spain, Canada, and Kenya.

Contact

ETH Zurich
Food & Soft Materials
LFO E 22
Schmelzbergstrasse 9
8092 Zurich

www.fsm.ethz.ch →

Contribution to the WFSC

The group of Food and Soft Materials develops nanotechnology and material science concepts that can be exploited to improve structure and quality of processed and natural foods. Understanding the structure-properties relationship in complex food systems helps to develop healthy, functional foods. The study of model food systems originating from sustainable ingredients and affordable processes is closely aligned with the thematic focus areas of the WFSC.



Prof. Raffaele Mezzenga





Soil subsidence due to soil carbon loss in drained peatlands covered by forests
(Photo: Cédric Bader)

ENVIRONMENTAL POLICY AND ECONOMICS



Integrating economics and ecosystem modelling in the analysis of environmental policy design for sustainable food systems.

Research Areas

- Policy and economics of ecosystem services;
- Policy instrument design for environmental management;
- Food system modelling;
- Economic analysis of agro-ecosystems.

Regions

Switzerland, Brazil, Ethiopia, India, and West Africa.

Partners

Agroscope Reckenholz-Tänikon, Food and Agriculture Organization of the United Nations (FAO), University of Aberdeen, Alpen-Adria University, and Research Institute of Organic Agriculture (FiBL).

Contact

ETH Zurich
Environmental Policy and Economics
CHN K 72.1
Universitätstrasse 22
8092 Zurich

www.pepe.ethz.ch →

Contribution to the WFSC

The Environmental Policy and Economics group analyzes incentive schemes for sustainable environmental and resource management and how this contributes to assure ecosystem services provision and long-term food security. A particular focus thereby is to investigate and develop promising policy options for adaptation to and mitigation of climate change in agriculture and meeting food demand for over 9 billion people in 2050 in a sustainable way. Such policy analysis is a key contribution to the mission of the WFSC to address food and nutrition security while assuring environmental and social wellbeing.



Dr. Adrian Müller





Research in the laboratory for food biochemistry.

FOOD BIOCHEMISTRY

Enhancing the nutritional value of plant-based foods and grains.



Research Areas

- Dietary fibres and associated minor phytochemicals in cereal grains;
- Oxidative degradation and modification of polysaccharides, especially cereal beta-glucan;
- Plant sterol conjugates, their biochemical reactions and bioactive properties.

Regions

Switzerland.

Partners

University of Helsinki, University of Copenhagen, University of Aix-Marseille, and USDA Eastern Regional Research Center.

Contact

ETH Zurich
Food Biochemistry
LFO D 19
Schmelzbergstrasse 9
8092 Zurich

www.foodbiochem.ethz.ch →

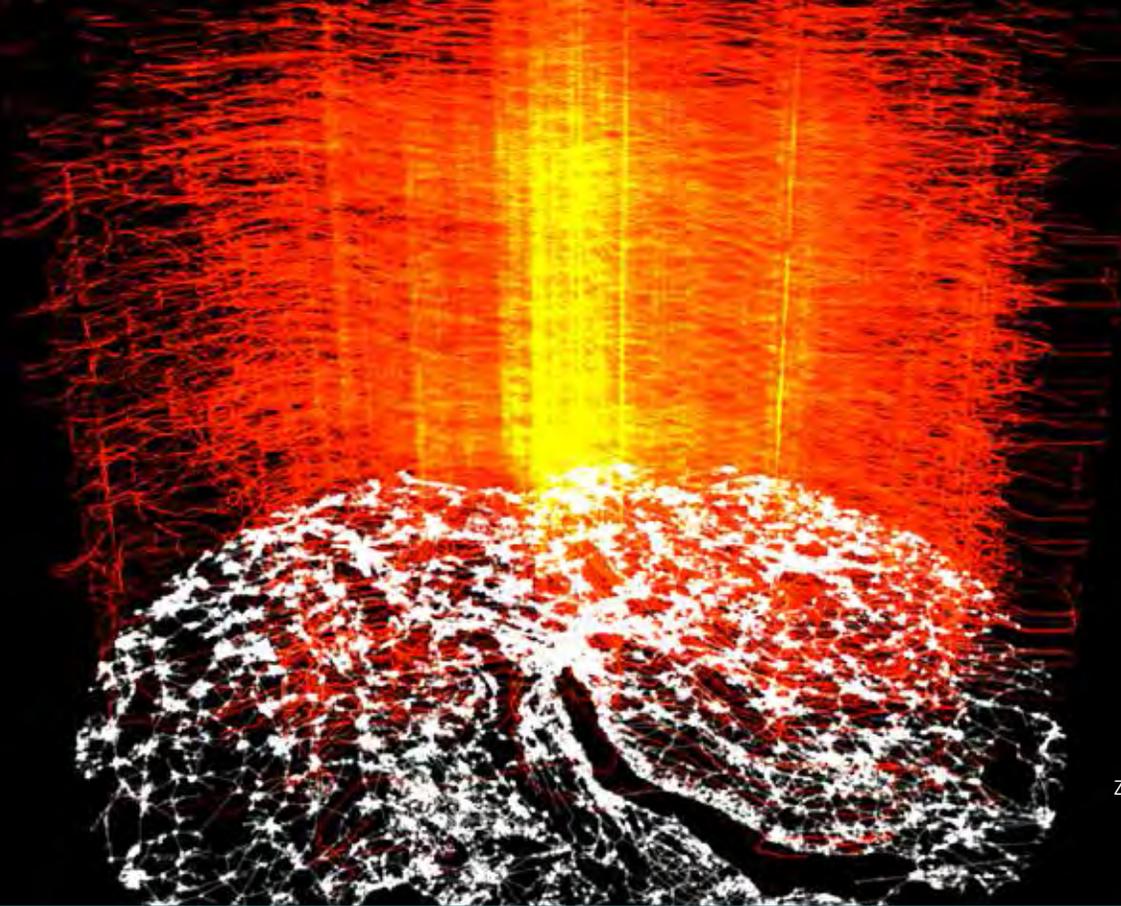
Contribution to the WFSC

The group of Food Biochemistry conducts research on grain fibres and associated phytochemicals which helps optimizing the nutritional quality, processability and stability of staple foods. By optimizing the nutritional value of grain based foods and other edible plants seeds, health benefits can be achieved once consumed. The focus is mostly on plant based raw materials and ways to optimize their processing parameters to maximize nutritional quality and stability.



Prof. Laura Nyström





Spatiotemporal visualization of simulated traffic in the city of Zurich, by Dr. Stefan Müller Arisona/Christian Schneider (ETH Zürich), Afian Anwar (MIT), Wei Zeng (NTU). Data courtesy of: Prof. Kay Axhausen (ETH Zürich)..

INFORMATION ARCHITECTURE

Planning sustainable future cities is closely related to food security.



Research Areas

- Integrated modeling of the sustainable, well-functioning city of the future;
- Sustainable urban development patterns and participatory urban planning processes;
- Climate impact of future city developments;
- Mobile crowd sourcing for optimization of pedestrian movement in urban environments.

Regions

Switzerland, Singapore, and South-East Asia.

Partners

National University of Singapore (NUS), Nanyang Technological University Singapore (NTU), National Research Foundation Singapore (NRF), TU München, CTI, and SNF.

Contact

ETH Zurich
Information Architecture
HIT H 31.8
Wolfgang-Pauli-Strasse 27
8093 Zurich

www.ia.arch.ethz.ch →

Contribution to the WFSC

The group of Information Architecture models the city of the future. Cities are the largest consumers of food, their location and metabolism directly impacts food security. In addition, urban farming does influence the layout and functioning of a city. Therefore, a sustainable future city planning is closely related to global food security. The group is intensively working on the preparation of the 3rd research program of the Singapore-ETH Centre „Future Food Security“.



Prof. Gerhard Schmitt





Field trial IUT

SOIL PROTECTION

Sustaining and managing the quality of soil as an essential basis for human and other life.



Research Areas

- Effects of soil degradation and pollution by trace elements on soil and waters;
- Phytomanagement of polluted soils;
- Soil-plant interactions under conditions of trace element toxicity and deficiency;
- Agronomic biofortification of food crops.

Regions

Iran, Philippines, and China.

Partners

Isfahan University of Technology (IUT), International Rice Research Institute (IRRI), Nanjing University, Chinese Academy of Sciences (CAS), COST Action FA 0905.

Contact

ETH Zurich
Soil Protection
CHN F 31.1
Universitätstrasse 16
8092 Zurich

www.soilprot.ethz.ch →

Contribution to the WFSC

The group of Soil Protection works on the optimization of soil for agricultural crop production for staple foods and feeds. The quality of soil is important for the nutritional quality of plant products and is therefore important for food security. Establishing scientific knowledge to ensure a sustainable soil management and soil protection fits well with the goals of the WFSC. The WFSC also provides the unique opportunity to carry out research on biofortification of food crops in an interdisciplinary setting.

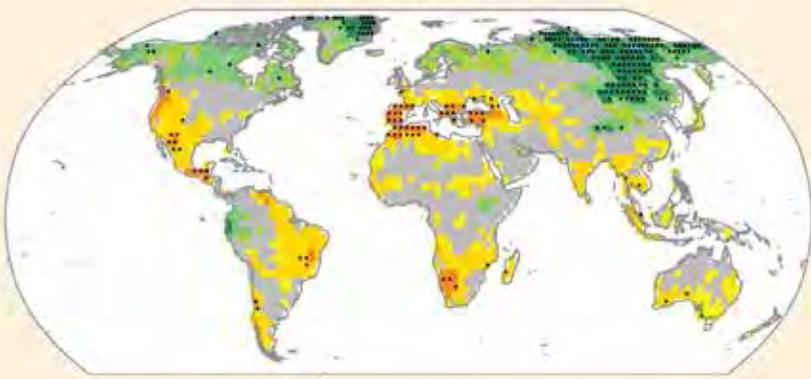


Prof. Rainer Schulin



Change in consecutive dry days (CDD)

2046 - 2065



Soil moisture anomalies (SMA)

2046 - 2065

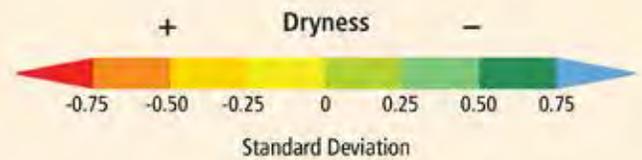
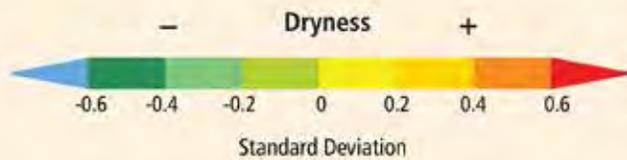
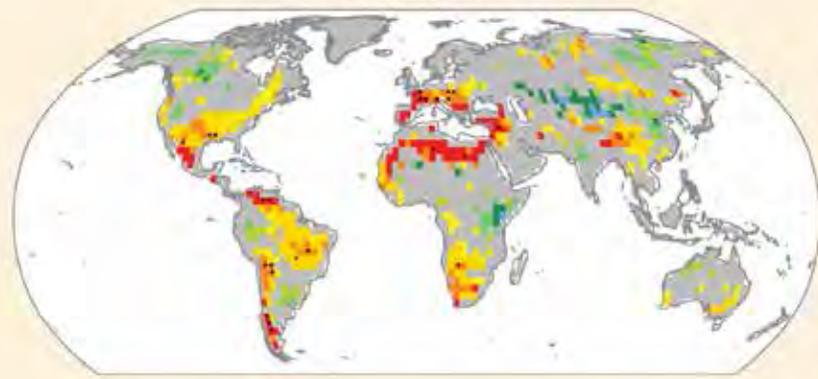


Figure of summary for policy makers of IPCC SREX (2012) report (adapted from Orłowsky and Seneviratne 2012, Clim. Change).

LAND-CLIMATE DYNAMICS

Investigating drought-related impacts on food systems.



Research Areas

- Land-climate interactions;
- Drought dynamics;
- Climate change and extreme events.

Regions

Europe, Global.

Partners

C2SM, MeteoSwiss, Agroscope, SwissRe, WSL, LSCE/CEA, NASA/GSFC, MPI-Meteorology, and MPI-Biogeochemistry.

Contribution to the WFSC

The group of Land-Climate Dynamics investigates drought dynamics and climate related drought variability. This research is highly relevant for world food security, as it provides tools to investigate drought dynamics in present and future climate. Understanding these dynamics is central for determining potential impacts on agricultural production systems.



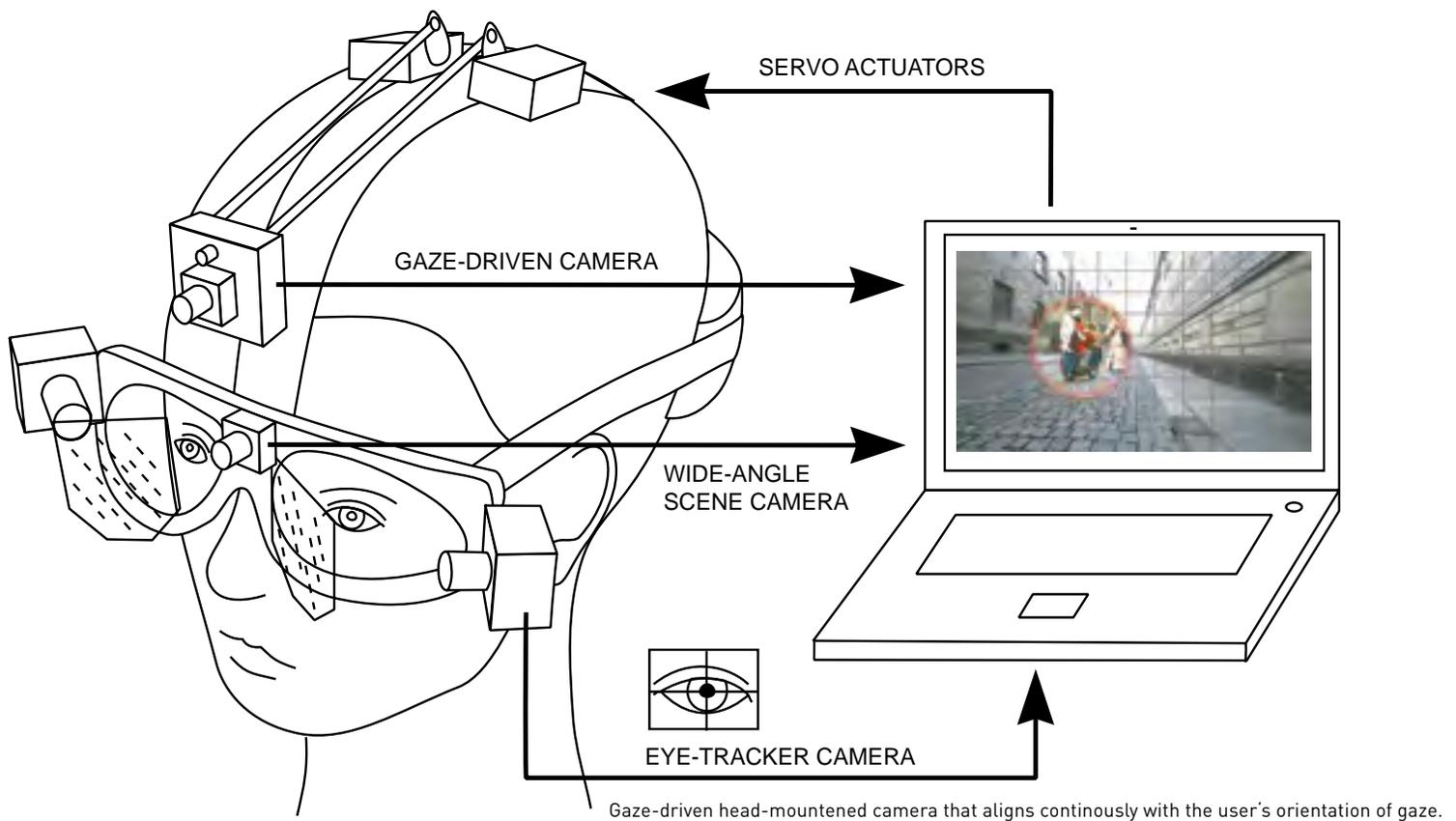
Prof. Sonia Seneviratne

Contact

ETH Zurich
Land-Climate Dynamics
CHN N 11
Universitätstrasse 16
8092 Zurich

www.iac.ethz.ch →





CONSUMER BEHAVIOR

Understanding consumer behavior and decision-making processes in the food domain.



Research Areas

- Lay people's acceptance of new food technologies;
- Modelling consumer behavior in the food domain;
- Risk and health communication.

Regions

Switzerland.

Partners

BAG and BLV.

Contact

ETH Zurich
 Consumer Behavior
 CHN J 76.3
 Universitätstrasse 16
 8092 Zurich

www.cb.ethz.ch →

Contribution to the WFSC

The group of Consumer Behavior contributes to a better understanding of individual and organizational decision making in the food domain. Research ranges from individual to social level decision-making processes, focussing on consumer decision-making in the domain of food products. A better understanding of consumers attitudes and risk perception towards emerging food technologies is crucial to understand the needs of a society.



Prof. Michael Siegrist





Integrated Soil Fertility Management trial for maize production in Embu, Kenya.

SUSTAINABLE AGROECOSYSTEMS



Elucidating and improving of sustainable agroecosystems across the world.

Research Areas

- Effect of land use change and management on greenhouse gas fluxes and feedbacks between ecosystem management options, global change, and biogeochemical cycling;
- Interactions between soil, plant traits and soil biota; carbon, nitrogen, and phosphorus cycling;
- Bioeconomic modeling to address policies for sustainable agriculture from both a biophysical and economic standpoint.

Regions

Belgium, Brazil, Burkina Faso, Cambodia, Canada, China, DR Congo, Finland, Ghana, Honduras, Indonesia, Kenya, Malawi, Mexico, Namibia, New Zealand, South Africa, Uganda, US, Vietnam, and Zimbabwe.

Partners

Tropical Agriculture Institutes in Nigeria, Colombia and Kenya, Universities in the US, the Netherlands, Belgium, China, and Zimbabwe.

Contact

Sustainable Agroecosystems
TAN F 4
Tannenstrasse 1
8092 Zürich

www.sae.ethz.ch →

Contribution to the WFSC

Illuminating the feedbacks between ecosystem management options (e.g., tillage, cover cropping, green manuring, sustainable farming, and grazing), global change (e.g., elevated CO₂ and climate change), and biogeochemical cycling (carbon, nitrogen, and phosphorus) in agricultural, grassland, and forest ecosystems. Conducting experimental work at both the plot and landscape levels and subsequently integrating it with simulation modeling to predict ecosystem responses to global change at the field, landscape and regional scale.



Prof. Johan Six





Studying the environmental fate of agrochemicals like veterinary antibiotics includes controlled field experiments under real-world conditions linking input to soils with transport to water bodies.



ENVIRONMENTAL CHEMISTRY

Developing site-adapted production systems that minimize negative side-effects on water quality.



Research Areas

- Quantification of exposure of water bodies with agrochemicals (pesticides and veterinary antibiotics);
- Modelling exposure of water bodies due to diffuse pollution from agriculture;
- Investigating spacial heterogeneity of loss process at the catchment scale and consequence for mitigation;
- Impact of agricultural activities on water bodies in general.

Regions

Europe with a main focus on Switzerland.

Partners

Agroscope Reckenholz-Tänikon, Swiss Federal Office for the Environment (FOEN), Swiss Federal Office for Agriculture (FOAG), and ETH Zurich.

Contact

Eawag
Environmental Chemistry
Überlandstrasse 133
Postfach 611
8600 Dübendorf

www.eawag.ch/forschung/uchem →

Contribution to the WFSC

The group of Environmental Chemistry at Eawag works on understanding the exposure of the aquatic environment to anthropogenic organic pollutants and the fate of these pollutants in the water cycle. Food and water issues are closely related: food production relies on sufficient water of acceptable quality, on the other hand food production may impair water resources. Sustainable solutions for food production for the future have to consider water-related issues.



Dr. Christian Stamm





Cross pollination of selected Italian ryegrass (*Lolium multiflorum*) genotypes in isolation fields.

MOLECULAR PLANT BREEDING



We know that traditional crop breeding works, molecular breeding is using tools to do the same but more efficiently.

Research Areas

- Molecular biology;
- Genetics and genomics;
- Molecular breeding;
- Reproduction biology.

Regions

Arable and grasslands in Switzerland, Europe, and temperate regions worldwide.

Partners

Agroscope Reckenholz-Tänikon, Aarhus University, Aberystwyth University, Iowa State University, Oak Park Research Centre, Institute of Experimental Botany, Czech Republic, Helmholtz Center Munich (MIPS), and DLF Trifolium A/S.

Contact

ETH Zurich
Molecular Plant Breeding
LFW A 3
Universitätstrasse 2
8092 Zurich

www.mpb.ethz.ch →

Contribution to the WFSC

The Molecular Plant Breeding group at ETH Zurich mainly aims at developing genetic and genomic tools that can assist plant breeding. Recent technical advancements have enabled to characterize the genetic diversity that is available for plant breeding at high resolution and allow more efficient selection based on single DNA markers or high-density genome profiles. This “molecular breeding” approach, a non-GMO strategy to increase breeding progress in crop species, is a sustainable way to improve plant productivity.



Prof. Bruno Studer





Isolation of chicken liver DNA (Image courtesy: M. Kradolfer).

TOXICOLOGY

Contributing knowledge to improve human health and disease prevention strategies.



Research Areas

- Dietary carcinogenesis;
- Food-drug interactions;
- Toxicology of nano-sized nutrients;
- Nucleic acids chemistry and bioanalysis.

Regions

USA, Switzerland, Europe, and Global.

Partners

University of Zurich, University of Minnesota, and Stanford University.

Contact

ETH Zurich
Toxicology
LFO D 15.1
Schmelzbergstrasse 9
8092 Zurich

www.toxicology.ethz.ch →

Contribution to the WFSC

The Laboratory of Toxicology contributes knowledge regarding how components of the human diet impact chronic disease risk and treatment. The modern chemical and biochemical analytical approaches developed in the lab, and the fundamental understanding of mechanisms of toxicity, may be directly linked with applications for promoting global food security.



Prof. Shana Sturla



Bovine embryo interacting with the maternal environment.

ANIMAL PHYSIOLOGY

Understanding embryo development as the prelude to life, most vulnerable to environmental influences that can impact the health and disease of the individual and future generations.



Research Areas

- Female reproductive biology;
- Maternal effects on postnatal development;
- Epigenetics and reproduction;
- Endocrine disruptors.

Regions

Europe, Australia, and India.

Partners

Vetsuisse Zurich-Bern, Technische Universität München, Ludwig-Maximilians-Universität München, Institute for Zoo and Wildlife Research Berlin (IZW), and Robinson Institute of the University of Adelaide.

Contact

ETH Zurich
Animal Physiology
LFW B 58.1
Universitätstrasse 2
8092 Zurich

www.ap.ethz.ch →

Contribution to the WFSC

The group of Animal Physiology focuses on understanding the complex regulation of growth and performance in livestock. The research addresses reproductive challenges at the very beginning of the animal food production chain and includes an epigenetic perspective on development. Understanding metabolic partitioning for efficient foodstuff production is of utmost importance as livestock significantly and increasingly contributes to worldwide food security, but as well to environmental problems.



Prof. Susanne E. Ulbrich





Fresh Food Logistics.

LOGISTICS MANAGEMENT

Ensuring efficient food logistics.



Research Areas

- Management of supply chain sustainability risks;
- Supplier management (supplier evaluation, selection, development, and integration) for sustainability;
- Carbon avoidance in operations and supply chain management;
- Innovation, risk, entrepreneurship, strategy, and more generally behavior in supply chains at the level of the relationship or the network.

Regions

Around the world (e.g., Switzerland, Germany, Russia, China, and sub-Saharan Africa).

Partners

Georgia Institute of Technology, Ohio State University, Michigan State University, National University of Singapore, Indian Institute of Technology Bombay, University of Oxford, University of Mannheim, Kühne Foundation, and various other partners.

Contact

ETH Zurich
Logistics Management
WEV F 123
Weinbergstrasse 56/58
8092 Zurich

Contribution to the WFSC

Food supply chains and networks are an important context in the Chair's research areas. They look at them mostly from a business and management perspective, seeking insights on collaboration processes between actors, on economic incentives for firms, as well as on social pressures on their behavior. By analyzing conflicts of target between green and social criteria on the one hand and economic criteria on the other hand, we can increase the feasibility of novel solutions to sustainability-related problems in food supply chains.

www.scm.ethz.ch →



Prof. Stephan Wagner





Field experiments with wheat and soy in Eschikon.

CROP SCIENCE

Developing site-adapted crops to improve efficiency and sustainable plant production.



Research Areas

- Crop phenotyping;
- Plant breeding;
- Agronomy;
- Plant growth analysis.

Regions

Switzerland, Germany, and Europe.

Partners

Several Agroscope research groups, Delley Semences et Plantes (DSP), Research Center Juelich, and Koubachi.

Contact

ETH Zurich
Crop Science
LFW C 54.1
Universitätstrasse 2
8092 Zurich

www.kp.ethz.ch →

Contribution to the WFSC

The group of Crop Science contributes to finding optimal crops or cropping systems for different ecological niches or climate/soil situations, which is a requirement of the sustainable production of crops. It is relevant to improve the physiological basis of the understanding of plant growth processes to be better prepared for improving efficiency and sustainability of plant production. Finding efficient crop systems for different regions of the world is in a strong context with the WFSC.



Prof. Achim Walter





Shear induced polymorph transformation in triglyceride systems for confectionery and nutrient encapsulation processing.

FOOD PROCESS ENGINEERING



Designing new processes for high quality, fortified or functionalized foods to improve human health.

Research Areas

- Design of processes for functional food structure generation;
- Evaluation of multi-scale process-structure-property relationships;
- Sustainable processing concepts for personalized functional foods;
- Functionalization concepts for food materials;
- Gastro-intestinal engineering for metabolic response optimization.

Regions

Europe, USA, Japan, and Oceania.

Partners

Nestlé SA, Bühler AG, Dupont/Solae Ltd., Lindt & Sprüngli, Emmi Schweiz AG, AstraZeneca AG, Kinematica AG, Alpha Laval AB, Kraft Foods Inc., SIK/Chalmers University, Hokkaido University, TIT, YKI, MIT, John's Hopkins, EU-Commission, FAO, DFG, and CTI.

Contact

ETH Zurich
Food Process Engineering
LFO E 18
Schmelzbergstrasse 9
8092 Zurich

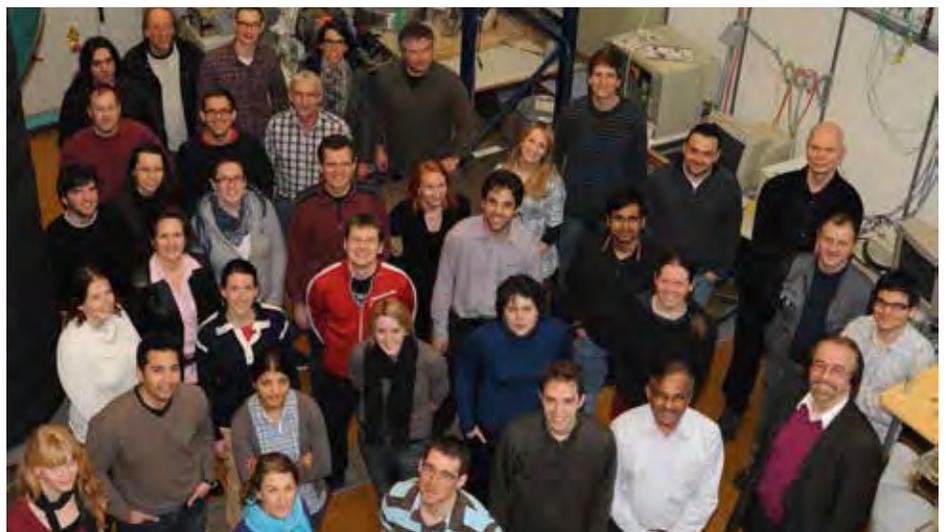
www.fpe.ethz.ch →

Contribution to the WFSC

The group of Food Process Engineering conducts research of multi-scale process-structure-property relationships along the agri-food value chain, including sustainable process optimization activities. New food structure and concept development for protein-based food optimization or longer shelf life supports the WFSC approach to a more sustainable food value chain. Developing fortified or functional foods with increased biomass use efficiency will improve quality and help address health issues.



Prof. Erich Windhab





Agriculture accounts for 70% of global freshwater withdrawals.

WATER, ENVIRONMENT AND FOOD SECURITY



Enhancing water management in order to enable food security.

Research Areas

- Water and environmental policies;
- Integrated analysis and modelling for decision support;
- Water and food relations;
- Water scarcity, food security and virtual water trade;
- Adaptation to climate change in agricultural water management.

Regions

South Africa, Northern African countries, Ethiopia, China, Iran, and Australia.

Partners

Chinese Academy of Sciences, Beijing Normal University, Beijing Agricultural University, Isfahan University of Technology, and Addis Ababa University.

Contact

Eawag
Water, Environment and Food Security
Überlandstrasse 133
Postfach 611
8600 Dübendorf

www.eawag.ch/en/department/siam/main-focus/water-environment-and-food-security →

Contribution to the WFSC

The group of Water, Environment and Food Security examines water in relation to food production systems, water scarcity and virtual water trade. Water is the life-line of agricultural production, and is in many places of the world a constraining resource. Improving water management is key to increase crop yield and production, and thus food security.



Prof. Hong Yang





Laboratory experiments with cassava.

PLANT BIOCHEMISTRY

Developing higher-value crops through biotechnology and conventional breeding.



Research Areas

- Photosynthesis and carbohydrate metabolism;
- Sugar and starch biosynthesis;
- Metabolic regulation and cellular signalling.

Regions

Switzerland.

Partners

USA, Spain, Italy, Germany, UK, South Africa, Taiwan, China, and Australia.

Contact

ETH Zurich
Plant Biochemistry
LFW E 53.1
Universitätstrasse 2
8092 Zurich

www.pbc.ethz.ch →

Contribution to the WFSC

The group of Plant Biochemistry works on the metabolic pathways that lead to the production of key carbohydrate components of our food, most significant of which is starch. With the gained knowledge, it is possible to increase the produced amount of starch in potato or other crops. This can be done through biotechnological means or - in some cases - by conventional breeding. This can lead to increased yields and higher-value crops, contributing to an improved production system.



Prof. Sam Zeeman





Interventions to address micronutrient deficiencies.

HUMAN NUTRITION

Understanding micronutrient metabolism, food fortification and supplementation for food and nutrition security.



Research Areas

- Micronutrient metabolism, health effects of deficiencies and correction strategies;
- Stable isotope techniques for mineral absorption, metabolism and excretion;
- Nanotechnology in food and nutrition;
- Food fortification and biofortification;
- Interactions of obesity and micronutrient deficiency.

Regions

Switzerland, UK, The Netherlands, Sweden, Morocco, Kenya, South Africa, Rwanda, Côte d'Ivoire, Benin, Burkina Faso, Malawi, Thailand, Nepal, and India.

Partners

Universities, university hospitals, governmental organizations (WHO, UNICEF), non-governmental organizations (GAIN, HarvestPlus), food and nutrition industry.

Contact

ETH Zurich
Human Nutrition
LFV D 20
Schmelzbergstrasse 7
8092 Zurich

www.humannutrition.ethz.ch →

Contribution to the WFSC

The Laboratory of Human Nutrition works on the improvement of food and nutrition security through deeper understanding of micronutrient metabolism, effective food fortification and supplementation. This focus on nutrition research and food security relates to developing countries and countries in transition, but also to developed countries where micronutrient deficiencies are also a challenge.



Prof. Michael Zimmermann





Drip irrigation system in Nepal using nitrogen rich supernatant after urine struvite precipitation.

WATER AND SANITATION

Developing efficient waste treatment solutions and reuse possibilities in agriculture.



Research Areas

- Sustainable water and sanitation concepts;
- Technologies for water supply and environmental sanitation;
- Recovery of nutrients, energy and water from waste and reuse in agriculture.

Regions

Senegal, Cameroon, Ghana, Uganda, Thailand, Vietnam, Costa Rica, Ethiopia, Tanzania, Bangladesh, India, Nepal, Indonesia, and South Africa.

Partners

In the above mentioned countries the group collaborates mostly with local universities, research organizations, NGOs, utilities, and development agencies.

Contact

Eawag
Water and Sanitation in Developing Countries
Überlandstrasse 133
Postfach 611
8600 Dübendorf

www.eawag.ch/forschung/sandec →

Contribution to the WFSC

The group of Water and Sanitation in Developing Countries tries to find concepts for extracting value from waste products for reuse in agriculture or other food production systems. Strengthening the synergies between waste treatment and productive use is key to develop sustainable water and sanitation solutions. Sanitary engineering and agriculture need to interact strongly to develop better integrated approaches and solutions for the world food system.



Dr. Christian Zurbrugg



Contact

ETH Zurich
World Food System Center
ADM B 4
Auf der Mauer 2
8092 Zurich

www.worldfoodsystem.ethz.ch