



World Food System Center 2018 Research Symposium

Program and Abstracts

Thursday, 8 November 2018 | 17:15-21:00 | ETH Zurich, Audi Max (HG F 30)

This public event showcases food systems research happening at ETH Zurich. The main program will feature presentations from concluding research projects focused on sustainable food value chains followed by insights from our education initiatives. A networking poster session focusing on ongoing research and Center activities offers you the chance to interact directly with researchers.

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www.worldfoodsystem.ethz.ch

Program

17:15 Welcome and Introduction

17:25 Session 1: Sustainable Food Value Chains

Featuring concluding postdoctoral projects supported by the Coop Research Program

Presented by

Iodine in milk and dairy products in relation to iodine in feed and the contribution to iodine intakes in Swiss adults

Olivia van der Reijden
Laboratory of Human Nutrition

Inactivation of microorganisms on seeds for sprout production using cold atmospheric pressure plasma

Dr. Markus Schuppler
Laboratory of Food Microbiology

Soft matter approach to effective preservation of African leafy vegetables by drying

Dr. Leonie van 't Hag
Laboratory of Food and Soft Materials

Assessing the resilience of tef and cocoa farmers against drought in Ethiopia and Ghana

Dr. Jonas Joerin
Climate Policy

Giants of the Amazon: Why consumers should be going "nuts" for more sustainable food systems

Dr. Chris Kettle
Ecosystem Management

18:40 Session 2: World Food System Center Education Initiatives

Presented by

Tackling food system challenges through experiential education: The World Food System Summer School

Michelle Grant
Dr. Jonna Cohen
World Food System Center

19:00 Concluding remarks

19:15 Networking Poster Session and Reception

20:45 Voting for Poster Prizes Closes

21:00 Symposium Ends

Posters

1-OM **Increasing genetic gain in climbing bean breeding** Beat Keller, Bodo Raatz, Hector F. Buendia, Daniel Ariza, Eliana Macea and Bruno Studer

2-OM **Exploiting new plant breeding techniques for more sustainable apple production** David Stähli, Simon E. Bull, Bruno Studer and Giovanni Broggin

3-OM **Biological control: fighting below ground insect pests with *Pseudomonas* bacteria** Anna Spescha

4-OM **Improving disease resistance of pea - clues from plant-microbe interactions** Lukas Wille, Pierre Hohmann, Monika M. Messmer and Bruno Studer

5-OM **Towards nutritional security through organic management of soil fertility in orange-fleshed sweetpotato systems in Mozambique** Rafaela Feola Conz, Engil Pereira, Maria I. Andrade and Johan Six

6-OM **The impact of soil properties and farming practices on water accessibility - the soil as a dynamic environment in the context of climate change** Emily Oliveira Hagen, Raphaël Wittwer, Nina Buchmann, Thomas Keller and Marcel van der Heijden

7-OM **Assessment of ecosystem services of arable land in response to farming practice and drought** Yujie Liu, Gicele Silva Duarte Sá, Valentin Klaus, Anna K. Gilgen, Emily Oliveira Hagen, Raphaël Wittwer and Nina Buchmann

8-OM **Plant water relations under drought in organic and conventional farming systems** Qing Sun, Anna K. Gilgen, Valentin H. Klaus, Constant Signarbieux and Nina Buchmann

9-OM **Character displacement of annual crops in monoculture and mixture cropping** Laura Stefan, Nadine Engbersen and Christian Schöb

10-OM **A case study on plant vigour and soil enhancement in dynamic agroforestry systems with cocoa in Côte d'Ivoire** Katja Degonda and Severin Wiens

11-OM **Assessing the resilience of organic, 'climate smart' and conventional cocoa production systems in Ghana to drought** William Thompson, Jonas Joerin, Erik Chavez, Birgit Kopainsky, Evans Dawoe and Johan Six

12-OM **Nitrified urine fertilizer: a transdisciplinary approach to solutions-oriented community development** Ben Wilde, Eva Lieberherr, Astrid Oberson, Isadora Pereira, Alfred Odindo and Johan Six

13-OM **Creating a nutritionally and environmentally conscious food production system through life cycle assessment approaches** Ashley Green, Thomas Nemecek, Abhishek Chaudhary and Alexander Mathys

14-OM **Microalgae utilization in innovative food products** Martín P. Caporgno and Alexander Mathys

- 15-0M **Black soldier fly larvae as a novel protein and energy source in egg and poultry meat production** Maike Heuel, Christoph Sandrock, Alexander Mathys, Moritz Gold, Christian Zurbrügg, Michael Kreuzer and Melissa Terranova
- 16-0 **Does the supplementation of dairy cows with the microalgae *Spirulina* improve protein supply of the cow and affect milk fat composition and the sensory quality of milk and milk products?** Elisa Manzocchi, Michael Kreuzer and Katrin Giller
- 17-0 **Does maternal algae intake affect the metabolic health of the offspring? – Search for potential transgenerational effects of a superfood** Rosamaria Lugarà, Michael Kreuzer and Katrin Giller
- 18-0 **Value through functionality – characterizing short time high temperature stability of blue microalgae proteins: phycocyanin** Lukas Böcker, Sebastian Ortmann, Elena Leeb, Kai Reineke and Alexander Mathys
- 19-0 **How can high-quality beef be sustainably produced under Swiss production conditions?** Magdalena Kurrig, Michael Kreuzer, Beat Reidy, Matthias Wyss, Andreas Scheurer and Katrin Giller
- 20-0 **Hazel leaves as environmentally friendly novel feed for ruminants** Melissa Terranova, Shaopu Wang, Lukas Eggerschwiler, Michael Kreuzer and Angela Schwarm
- 21-0 **Plants + Science = Meat** Eric P. Stirnemann and Erich J. Windhab
- 22-0 **Insights into the dehydration of soft cellular food using multiscale modeling** Kevin Prawiranto, Thijs Defraeye, Dominique Derome and Jan Carmeliet
- 23-0 **Mango quality evolution inside cold chains: a predictive multiphysics model** Giorgia Tagliavini, Thijs Defraeye and Jan Carmeliet
- 24-0 **Application of *Lactobacillus reuteri* and glycerol as a novel approach to control *Campylobacter* colonization in chicken gut** Paul Tetteh Asare, Anna Greppi, Clarissa Schwab, Annelies Geirnaert, Katharina Brenig and Christophe Lacroix
- 25-0 **Wheat seed lipase heritability** Chunyue Wei, Andreas Hund and Laura Nyström
- 26-0 **When evolution works against the future: disgust's contributions to the acceptance of new food technologies** Aisha Egolf, Christina Hartmann and Michael Siegrist
- 27-0 **Real or not real? A virtual reality study on food disgust** Jeanine Ammann, Christina Hartmann and Michael Siegrist
- 28-0 **How to measure knowledge about food sustainability?** Christina Hartmann, Gianna Lazzarini and Michael Siegrist
- 29-0 **Determinants of collective climate change mitigation in agriculture: a Swiss case study** Cordelia Kreft, Robert Huber and Robert Finger
- 30-0 **The effect of political institutions on agri-environmental outcomes** David Wuepper, Pasquale Borrelli and Robert Finger

31-0 **Optimizing cocoa agroforests** Wilma J. Blaser, James Oppong , Simon P. Hart, Jonas Landolt, Edward Yeboah and Johan Six

32-0 **Evaluating models for the simulation of sustainable production systems** Kathrin Fuchs, Lutz Merbold, Nina Buchmann, Lorenzo Brillì, Nuala Fitton, Katja Klumpp, Mark Lieffering, Raphaël Martin, Paul C.D. Newton, Robert M. Rees, Pete Smith, Susanne Rolinski and Val Snow

33-0 **Soil moisture satellite data to reduce basis risk of weather index insurances** Willemijn Vroege, Tobias Dalhaus, Janic Bucheli and Robert Finger

34-0 **Irrigation modernization - an integrated perspective across spatiotemporal scales** Sandra Pool, Hong Yang, Mario Schirmer and Joaquin Jimenez-Martinez

35-0 **Developing a model to assess the viability of action measures to enhance resilience, a case study in Ethiopia and Ghana** Luzian Messmer, Braida Thom, Assefa Kebebew, Evans Dawoe, Johan Six, Jonas Joerin and Pius Kruetli

36-0 **Assessing the resilience of vegetable growers in a country facing rapid environmental and socio-economic changes, the case of fresh tomato in Morocco** Kenza Benabderrazik, Birgit Kopainsky, Jonas Joerin, Lina Tazi and Johan Six

37-0 **Building farm system resilience in Canton Vaud, Switzerland** Ulysse Le Goff, Dominique Barjolle, Johan Six, Nathanaël Dériaz and Abraham Monnier

38-0 **Resilience of the Swiss food system** Elena Monastyrnaya, Jonas Joerin and Johan Six

39-0 **Facing rice challenge by As and Cd in southern China: from origin to soil based prediction** Xu Fang, Anna Muntwyler, Peng Wang, Fangjie Zhao, Christoph Hofer, Iso Christl and Ruben Kretzschmar

40-0 **Trace metal(loid) bioavailability and mapping of chemical gradients in the rhizosphere of rice (*Oryza sativa*)** Christoph Hofer, Xu Fang, Sylvain Bouchet, Fang-Jie Zhao, Peng Wang, Iso Christl and Ruben Kretzschmar

41-0 **Tree-to-maize nutrient transfer via mycorrhizae?** Janina Dierks, Hannes A. Gamper, Wilma J. Blaser and Johan Six

42-0 **Magic beans – disease resistant common beans for smallholder farmers** Michelle M. Nay, Bodo Raatz, Clare Mukankusi and Bruno Studer

43-0 **Improving southern anthracnose resistance in red clover** Lea Frey, Roland Kölliker, Franz X. Schubiger and Bruno Studer

44-0 **Sex reversal in papaya** Tiago L. Meier and Ueli Grossniklaus

World Food System Center Mercator Research Program World Food System Center

Edible research: hands on learning for sustainability in agroecosystems and food value chains Tiago L. Meier Anett Hofmann, Anna K. Gilgen, Manuel Stamm, Luna Urio, Martina Binder, Laura Schnegg, Eva Penz, Michelle Grant and Johan Six

A journey into food systems in Ivory Coast: WFSC Summer School 2018 World Food System Center Summer School Alumni

World Food System Summer School Alumni Jonna Cohen, Annet Westhoek, Pienaar du Plessis and Rhea Cordeiro

PRESENTATION ABSTRACTS

MIOD

Iodine in milk and dairy products in relation to iodine in feed and the contribution to iodine intakes in Swiss adults

Olivia L. van der Reijden^a, Valeria Galetti^a, Christophe Zeder^a, Adam Krzystek^a, Isabelle Herter-Aeberli^a, Michael B. Zimmermann^a, Max Haldimann^b, Michael Kreuzer^c, Joel Berard^c and Patrick Schlegel^d

^aLaboratory of Human Nutrition, ETH Zurich

^bDivision of Risk Assessment, Federal Food Safety and Veterinary Office

^cAnimal Nutrition, ETH Zurich

^dAgroscope Posieux

ABSTRACT

Milk and dairy products are important iodine sources. Their contribution to daily iodine intake varies widely (25-70%). We assessed the effect of cow's iodine intake on milk iodine by supplementing cows with 0-2 mg I/kg dry matter (DM) and measuring iodine in resulting milk. We investigated the effect of milk processing by measuring iodine in two semi-hard cheeses, two fresh cheeses and yoghurt produced from milks with various iodine levels, and the effect of cellar ripening by measuring iodine in core drills from semi-hard cheeses during ripening. Median milk iodine (17-302 µg/L for 0-2 mg I/kg DM) increased linearly with feed iodine ($p < 0.001$). Dairy iodine increased linearly with milk iodine ($p < 0.001$) and ripening had no effect ($p > 0.05$). Desirable iodine concentrations are achieved by adjusting cow's feeding formulations. Based on Swiss consumption, milk and dairy products from cows fed 0.5-2 mg I/kg DM contribute 13-51% of the adult iodine recommended intake.

This research is supported by the WFSC Coop Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/CRP/miod.html>.

microPLASMA

Inactivation of microorganisms on seeds for sprout production using cold atmospheric pressure plasma

Denis Butscher^a, Alexandra Waskow^b, Gina Oberbossel^a, Annette Büttner-Mainik^c, Martin Loessner^b, Philipp Rudolf von Rohr^a and Markus Schuppler^b

^aInstitute of Process Engineering, ETH Zurich

^bLaboratory of Food Microbiology, ETH Zurich

^cSeed Quality, Agroscope Reckenholz

ABSTRACT

The consumption of fresh fruit and vegetable products has strongly increased during the past few decades. However, inherent to all minimally processed products is the short shelf life and the risk of foodborne diseases. In particular, sprouts are frequently identified as a source for pathogenic bacteria, because of the potential for pathogen growth during the sprouting process. The current lack of consistent and effective but sustainable seed disinfection technologies demonstrates the urgent need for research on relevant prevention and intervention technologies in sprout production that guarantee food safety and prolonged shelf life. Because cold atmospheric pressure plasma (CAPP) has the potential to address these demands, the project microPLASMA focused on different CAPP treatment systems for decontamination of seeds and investigated their impact on seedling attributes. In conclusion, CAPP treatment resulted in a highly efficient reduction of microorganisms, while preserving the germination properties of seeds, at least for moderate treatment times.

This research is supported by the WFSC Coop Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/CRP/microPLASMA.html>.

SoLVeD

Soft matter approach to effective preservation of African leafy vegetables by drying

Leonie van 't Hag^a, Gibson P. Mutuli^b, Stephan Handschin^a, Duncan Mbugue^b and Raffaele Mezzenga^a

^aLaboratory of Food and Soft Materials, ETH Zurich

^bDepartment of Environmental and Biosystems Engineering, University of Nairobi, Kenya

ABSTRACT

African leafy vegetables (ALVs) are indigenous plants in sub-Saharan Africa. They are rich in nutrients and for this reason they play an important role in the dietary intake of vitamins and minerals of local populations. They are highly liable to spoil once harvested, however, and an affordable preservation method is urgently needed. One approach is to use drying for their effective preservation. The moisture sorption isotherms of fresh and rehydrated leaves of five ALV species were determined and the maximum microbial safe moisture content for storage was calculated based on modelling of these results. Additionally, the effect of drying on the micro- and nano-structure of the leaves was investigated to explain changes in moisture desorption and adsorption of fresh and dried leaves.

This research is supported by the WFSC Coop Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/CRP/SoLVeD.html>.

AERTCvc

Assessing the resilience of tef and cocoa farmers against drought in Ethiopia and Ghana

Jonas Joerin^{a,b}, Samuel Hauenstein^b, Kenza Benabderrazik^b, Evans Dawoe^c, Samuel Aning^c, Assefa Kebebew^d, Pius Kruetli^e and Johan Six^b

^aClimate Policy, ETH Zurich

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^cKwame Nkrumah University of Science and Technology in Kumasi, Ghana

^dEthiopian Institute of Agricultural Research, Debre Zeit

^eTransdisciplinarity Lab, ETH Zurich

ABSTRACT

Improving the resilience of farmers enables them to better avoid losses and manage shocks. However, little is known about the key resilience factors that explain how smallholder farmers avoid (robustness), absorb (redundancy), recover (rapidity), and adapt (resourcefulness) to drought. In this project, we adopted a transdisciplinary research approach to co-develop farmer surveys together with local stakeholders from the tef value chain in Ethiopia and cocoa value chain in Ghana. Results from the surveys show that farmers with high drought exposure in both locations are associated with implementing more farm management practices that provide resilience against drought. However, farmers with high drought exposure are more likely to farm on soils with lower quality, have lower yields, and have less financial resources to recover from a drought. A key finding from this study is that farmers with higher resilience have more financial resources, but do not have necessarily more knowledge or larger farms.

This research is supported by the WFSC Coop Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/CRP/AERTCvc.html>. It is part of the WFSC Flagship Project Enhancing Resilience in Food Systems: <http://www.resilientfoodsystems.ethz.ch/>.

SUSTAIN

Giants of the Amazon: Why consumers should be going “nuts” for more sustainable food systems

Merel Jansen^{a,b}, Manuel Guariguata^b, Fidel Chiriboga^a, Julia Quaedvlieg^b, Carmenza Robledo^a, Juan Andres Santelices, Gabriela Wiederkehr Guerra^a, Ricardo Bardales^c, Ronald Corvera^c, Mishari García Roca^d, Pieter Zuidema^e, Yann Clough^f, Marc Moraine^g, Niels Anten^e, Flor Vargas^d, Eriks Arroyo Quispe^d, Nils Atapaucar^d, Saraí Vargas^d, Maria Camila Álvarez Romero^a, Maxime Blomberg^e, Anna Borgensen^a, Ennia Bosshard^a, Rens Brouwer^e, Alessia Capurso^e, Francisco Ehrenberg^e, Sara Hellström^f, Elisabeth Lagneaux^{e,g}, Jolijn Miedema^e, Daniel Navarro Pérez^d, Jiska Schaaf^e, Simona Zahner^a and Chris Kettle^{a,h}

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^eWageningen University, Netherlands

^fLund University, Sweden

^gIsara Lyon, France

^hBioversity International, Italy

ABSTRACT

Unsustainable food systems drive global deforestation and land degradation. The SUSTAIN project uses an interdisciplinary and participatory research approach to explore the sustainability of Brazil nut production in Peru. Brazil nuts, the seeds of the emergent tropical rainforest tree *Bertholletia excelsa*, are the most important globally traded non-timber forest product in the world. The highly nutritious nuts have the highest concentration of selenium (an essential trace element) in any food. Wild harvested throughout the Amazon basin, Brazil nuts provide vital income to rural populations and a healthy food source for people worldwide. We 1) evaluated the effect of forest degradation on the reproductive ecology of the Brazil nut tree, 2) analysed relations of power between stakeholders along the value chain and 3) developed management solutions to improve socio-ecological sustainability. For maximum impact, results of the project are currently being shared with a variety of stakeholders in several activities organized by SUSTAIN.

This research is supported by the WFSC Coop Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/CRP/SUSTAIN.html>.

Tackling food system challenges through experiential education: The World Food System Summer School

Michelle Grant and Jonna Cohen
World Food System Center, ETH Zurich

ABSTRACT

In 2013, the World Food System Center established an innovative new food systems education initiative called the 'World Food System Summer School'. The two-week intensive course aims to build the capacity of the next generation of leaders, creating a network of individuals that drive and inspire change towards sustainable food systems. This presentation will outline the theory of change and design criteria used to develop the course and provide insight into how these principles were put into practice running the program in four different countries. The findings from a recent alumni evaluation process will also be presented, highlighting the mid-term impact of the program and the value for participants. Finally, the plans to leverage the potential of the community created from the 189 alumni from 53 different countries will be discussed.

POSTER ABSTRACTS

Poster Prizes

Best Overall Poster Prize: 1000 CHF award to be used for any food system related research, education, or outreach activity; and

The Mercator Poster Prize: 1000 CHF to be used for any organic food or agriculture related research, education, or outreach activity. To be considered for this award, a poster should touch on the role of organic production systems in addressing food security.

-O denotes a poster is eligible for only the Best Overall Poster Prize

-OM denotes a poster is eligible for both prizes

The audience is kindly requested to cast their vote for which poster they would like to receive each prize. Ballot slips are available for all participants. Please place in the corresponding ballot box by 20:45.

Poster 1-0M

Increasing genetic gain in climbing bean breeding

Beat Keller, Bodo Raatz, Hector F. Buendia, Daniel Ariza, Eliana Macea and Bruno Studer
Molecular Plant Breeding, ETH Zurich; International Center for Tropical Agriculture (CIAT),
Colombia

ABSTRACT

Common bean (*Phaseolus vulgaris* L.) is the most important grain legume and protein source for direct human consumption. Beans are of particular relevance for the diet and income of smallholder farmers in the tropics. Climbing beans, a distinct subgroup of common beans, produce significantly higher yields compared to bush types and showed positive effects on soil fertility. The International Center for Tropical Agriculture (CIAT) in collaboration with the ETH Zurich reinforces breeding activities in this neglected climbing type. In the current project, statistical models are developed in order to quickly predict performance of climbing bean genotypes based on genetic marker data. The model-based selection of suitable parental genotypes allows to create superior new breeding lines in a precise manner. The implementation of this recent bioinformatic approaches enables efficient improvement of climbing beans regarding yield and nutrition quality.

This research is supported by the WFSC Coop Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/CRP/IncreBean.html>.

Poster 2-0M

Exploiting new plant breeding techniques for more sustainable apple production

David Stähli, Simon E. Bull, Bruno Studer and Giovanni Broggini
Molecular Plant Breeding, ETH Zurich

ABSTRACT

Apple (*Malus domestica*) is the most important fruit in Switzerland and the second most important fruit worldwide. However, apple is susceptible to diseases such as powdery mildew and fire blight, causing significant economic losses and requiring extensive chemical protection for disease control. Unfortunately, heterozygosity, a long breeding cycle and the high demands on fruit uniformity and quality make it challenging to rapidly improve cultivars for disease resistance and adaptation to changing environmental conditions. With genome editing, we are now able to favorably modify genes to improve crops with selected traits. Here, we aim to use genome editing in Gala Galaxy to improve resistance to powdery mildew. Transient transfection of apple protoplasts by Cas-mediated ribonucleoprotein complexes will modify gene expression and allow production of transgene-free apple plants. This would have wide-spread implications on the apple breeding process and contribute to a more sustainable apple production in changing environmental conditions.

Poster 3-0M

Biological control: fighting below ground insect pests with *Pseudomonas* bacteria

Anna Spescha
Plant Pathology, ETH Zurich

ABSTRACT

Below ground pests are difficult to control because either no effective control methods exist or suitable insecticides are or will be banned due to their negative effects on the soil and non-target organisms. So far, mostly *Bacillus thuringiensis* was used in biological control of insect pests but resistance against major Bt toxins has been reported. Some plant beneficial *Pseudomonas* bacteria express insecticidal activity and have already been successfully tested against various insect species. This project aims at developing new *Pseudomonas*-based biological control methods against the cabbage root fly *Delia radicum*, an important pest in vegetable production. We will screen for best *Pseudomonas* biocontrol strains and combine them with entomopathogenic fungi and entomopathogenic nematodes to increase the reliability and efficacy of biocontrol measures. This completely new approach combining different biocontrol agents hopefully leads to the development of a new strategy to control *D. radicum* and other important below ground insect pests.

This research is supported by the WFSC Mercator Research Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/MRP/BeneComb.html>.

Poster 4-0M

Improving disease resistance of pea - clues from plant-microbe interactions

Lukas Wille, Pierre Hohmann, Monika M. Messmer and Bruno Studer
Molecular Plant Breeding, ETH Zurich; Plant Breeding and Variety Testing, Research Institute of Organic Agriculture (FiBL)

ABSTRACT

Pea (*Pisum sativum* L.) is a valuable protein source for food and feed. Pea is able to significantly improve soil fertility and, hence, represents an ecologically important crop in low-input farming systems. Despite their importance, pea cultivation remains below expectations due to low and unstable yields caused by a complex of soil-borne pathogens. The goal of this project is to improve our understanding of resistance mechanisms of pea against soil-borne diseases. To achieve this goal, more than 300 pea lines were evaluated for resistance in pot-experiments and a subset of susceptible and resistant pea genotypes has been identified. In a next step, key pathogens and beneficials in the pea rhizosphere and the role of root exudates in determining the occurrence of these microbes will be investigated. The study will shed light on the complex interactions between pea genotypes and soil microbes, and promote resistance breeding programmes for legumes.

This research is supported by the WFSC Mercator Research Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/MRP/ResPEAct.html>.

Poster 5-0M

Towards nutritional security through organic management of soil fertility in orange-fleshed sweetpotato systems in Mozambique

Rafaela Feola Conz, Engil Pereira, Maria I. Andrade and Johan Six
Sustainable Agroecosystems, ETH Zurich

ABSTRACT

In rural communities of Mozambique orange-fleshed sweetpotato (OFSP) is a nutritious food source used to combat malnutrition. Despite the crop's high requirements for soil nutrients to achieve potential yield, cultivation is commonly performed without nutrient replenishment, causing soil degradation and threatening food security. In this resource-limited scenario this project evaluates the use of (i) accessible organic amendments, (ii) fallow period and (iii) incorporation of weed biomass after fallow to secure the nutritional quality and improve yield of storage root and build up soil fertility after harvest. Poultry manure and inorganic fertilizer produced the best crop performance compared to all farm-available amendments tested. The fallow period allowed for recovery of soil nitrogen and carbon, specially with weed biomass incorporation. After the second harvest, soil nitrogen, phosphorus and potassium accumulated in treatments with weed biomass incorporation, showing the potential to restore soil fertility using residual plant biomass.

This research is supported by the WFSC Mercator Research Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/MRP/ormasp.html>.

Poster 6-0M

The impact of soil properties and farming practices on water accessibility - the soil as a dynamic environment in the context of climate change

Emily Oliveira Hagen, Raphaël Wittwer, Nina Buchmann, Thomas Keller and Marcel van der Heijden

Plant-soil Interactions Group, Agroscope Reckenholz; Grassland Sciences, ETH Zurich; University of Zurich; Swedish University of Agricultural Sciences, Sweden; Utrecht University, Netherlands

ABSTRACT

It is still unclear how climate change will affect arable farming in Switzerland. The amount of precipitation, for example, is not directly translated to water accessibility for plants, which is influenced by soil properties and management practices. In this project, we simulated drought with rainout shelters in the 'Farming system and Tillage experiment'. This experiment compares four cropping systems: conventional cropping with intensive tillage or no tillage, and organic cropping with intensive tillage and reduced tillage. To better understand the ability of these different systems to resist drought, we investigated management effects on soil physical and hydraulical properties that influence the magnitude of drought effects (e.g. resistance to penetration under drying conditions, water retention curve, least limiting water range). It is important to consider the soil environment in combination with climate and management information to bring forth the best strategic responses to prospective abiotic stresses, such as those related to climate change.

This research is supported by the WFSC Mercator Research Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/MRP/RELOAD.html>.

Poster 7-0M

Assessment of ecosystem services of arable land in response to farming practice and drought

Yujie Liu, Gicele Silva Duarte Sá, Valentin Klaus, Anna K. Gilgen, Emily Oliveira Hagen, Raphaël Wittwer and Nina Buchmann
Grassland Sciences, ETH Zurich

ABSTRACT

Agroecosystems are confronted with degradation due to unsustainable management intensification and climate change. Drought events are expected to increase in frequency and severity, with strong effects on ecosystem service provision. Organic farming is seen to better cope with recent agricultural challenges. However, whether organic farming can solve the trade-off between production and non-production services remains unclear. Likewise, conservation-tillage might have considerable benefits compared to conventional tillage, but the contribution of different tillage methods to the resilience of agroecosystems towards drought needs further investigation. The objective of this study is to assess the response of ecosystem services in organic and conventional cropping systems with conventional and conservation tillage to simulated drought. Several provisioning, supporting and regulating ecosystem services are being measured. First results show drought effects on decomposition, an important measure of nutrient cycling, that was assessed via the Tea Bag method in two different crops (with and without legume presence).

This research is supported by the WFSC Mercator Research Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/MRP/RELOAD.html>.

Poster 8-0M

Plant water relations under drought in organic and conventional farming systems

Qing Sun, Anna K. Gilgen, Valentin H. Klaus, Constant Signarbieux and Nina Buchmann
Grassland Sciences, ETH Zurich; Laboratory of Ecological Systems, EPF Lausanne

ABSTRACT

In Switzerland, the main farming systems are organic and conventional, with different tillage strategies, i.e., intensive and conservation tillage. Adaptations of farming practices to climate change require assessing and improving the resilience of agricultural systems to ensure food security. In order to understand the responses of different farming systems to drought, this work assesses if crop water relations significantly change in different farming systems given different soil water availabilities. Drought periods are simulated with portable shelters. Water stress was estimated using measurements of plant vulnerability to xylem embolism with the cavitron technique. Preliminary results indicate that the grown pea-barley mixture was generally more resistant to drought under intensive tillage compared to conservation tillage, and organic farming compared to conventional farming. The outcome of this work will help to inform farmers and other stakeholders about necessary adaptations of soil and crop management to future climatic conditions.

This research is supported by the WFSC Mercator Research Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/MRP/RELOAD.html>.

Poster 9-0M

Character displacement of annual crops in monoculture and mixture cropping

Laura Stefan, Nadine Engbersen and Christian Schöb
Agricultural Ecology Group, ETH Zurich

ABSTRACT

Increasing diversity in plant communities positively affects plant interactions which in turn influence ecosystem functioning. These ecological concepts are well studied in natural ecosystems, but are rarely applied to agricultural settings such as intercropping. Here, we present data of a biodiversity experiment with annual crop species (wheat, oat, lentil, lupine, quinoa, coriander, flax & camelina in 2- & 4 species mixtures and monocultures) where we quantified changes in functional trait patterns in intercropped plots and monocultures compared to single plants. We expected functional traits (specific leaf area, dry matter content and plant height) of mixtures to differ from monocultures. Functional traits have been shown to be a helpful proxy to assess interactions between plants for resources. Finding higher variability of traits in mixtures compared to monocultures indicates a higher level of niche differentiation in intercropped plots, suggesting that individuals in mixtures use resources more efficiently.

Poster 10-0M

A case study on plant vigour and soil enhancement in dynamic agroforestry systems with cocoa in Côte d'Ivoire

Katja Degonda and Severin Wiens
Sustainable Agroecosystems, ETH Zurich

ABSTRACT

More than half of the world's cocoa supply is grown in unsustainable monocultures in Côte d'Ivoire and Ghana. This comes with major disadvantages as it leads to large-scale losses of tropical forests, a decrease in biodiversity, degraded soils, high prevalence of pests and diseases, as well as vulnerability to climate change and subsequently unsustainable livelihoods of the farmers. Dynamic agroforestry systems (DAFS) seem promising in combating many of these negative effects through higher biodiversity, increased nutrient cycling and diversification of cash crops. We assessed a four-year-old DAFS with cocoa (*Theobroma cacao*) in Côte d'Ivoire in terms of soil fertility enhancement, and checked whether the system created conditions suitable for cocoa growing. Sampling included climatic factors, soil parameters, biodiversity indices, as well as cocoa growth and vigour.

Poster 11-0M

Assessing the resilience of organic, 'climate smart' and conventional cocoa production systems in Ghana to drought

William Thompson, Jonas Joerin, Erik Chavez, Birgit Kopainsky, Evans Dawoe and Johan Six

Sustainable Agroecosystems, ETH Zurich; Imperial College London, United Kingdom; University of Bergen, Norway; Kwame Nkrumah University of Science and Technology in Kumasi, Ghana

ABSTRACT

Climate related shocks to food systems are predicted to increase in the future. These shocks cause food insecurity and cement poverty traps for vulnerable smallholder producers, as well as causing many other negative impacts for the broader food systems they serve. This research compares the ability of different production systems of cocoa in Ghana, namely; organic, 'climate smart' and conventional, to deliver resilience against drought. This assessment uses a producer survey (n=480) and biophysical on farm assessments (n=70) to make the comparison. Preliminary results are presented here.

This research is supported by the WFSC Mercator Research Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/MRP/OrRes.html>. It is part of the WFSC Flagship Project Enhancing Resilience in Food Systems: <http://www.resilientfoodsystems.ethz.ch/>.

Poster 12-0M

Nitrified urine fertilizer: a transdisciplinary approach to solutions-oriented community development

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ABSTRACT

Rapidly growing informal settlements in low and middle-income countries currently face major development crises, two of which are the inadequate provision of basic sanitation and chronic food insecurity. Although traditionally viewed as distinct matters to be solved with disparate solutions, there is growing awareness that technologies designed to close the nutrient loop offer a means to simultaneously improve both issues. In particular, a system designed and tested at the Swiss Federal Institute of Aquatic Science and Technology (EAWAG), shows great promise as an ecologically sustainable, hygienically safe, and socially equitable alternative to traditional sanitation management that can, through the separation and biological processing of N- and P-rich urine, provide sustainably sourced fertilizer to close the agricultural nutrient cycle. This project will seek to continue testing the potential of this nitrification technology. By conducting trans-disciplinary, solutions-oriented research, this work will quantify both the biophysical and social implications of using processed human urine as a fertilizer for agricultural cropping systems.

This research is supported by the WFSC Mercator Research Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/MRP/NUFSOC.html>.

Poster 13-OM

Creating a nutritionally and environmentally conscious food production system through life cycle assessment approaches

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Sustainable Food Processing, ETH Zurich; Life Cycle Assessment, Agroscope Reckenholz

ABSTRACT

Nutritional and environmental outcomes, such as the double burden of malnutrition and climate change, from our food production system will continue to cause global productivity losses. The aim of this study is to assess these outcomes, by developing and testing a framework based on Life Cycle Assessment methods (e.g., functional unit equivalency). This study aims to (i) analyze the influence of various food production systems (e.g., organic vs. conventional) on the nutritional composition (e.g., antioxidants) of foods, (ii) examine the impacts of protein, and other nutrients like omega-3, substitutes on the basis of more representative valuation measures such as amino acid profiling and nutritional indices, (iii) quantify nutritional flows throughout production and distribution chains, and (iii) link these options to health outcomes, when possible. The end goal is to provide methods and data that can help transform our food system into one that is more sustainable.

Poster 14-OM

Microalgae utilization in innovative food products

Martín P. Caporgno and Alexander Mathys
Sustainable Food Processing, ETH Zurich

ABSTRACT

Microalgae have demonstrated potential to meet the population's need for a more sustainable food supply. They are promising protein sources and present several advantages over other currently exploited raw materials: highly efficient biomass production rates, minimal fresh water consumption or even the possibility of growing on wastewater. Additionally, microalgae can be cultivated in organic production systems when harvested from wild areas or in other production systems, both guaranteeing high quality products and respect for the environment. Microalgae exploitation for food applications still presents several drawbacks. The Sustainable Food Processing Laboratory, working on food concept development as part of the NewAlgae project, evaluates the application of high moisture extrusion to produce meat like structures based on microalgae protein. Although this process is currently applied to process soy, pea and lupine proteins, much needs to be done for an improved process understanding and especially its applicability for microalgae based products.

This research is supported by the WFSC Coop Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/CRP/NewAlgae.html>. It is part of the WFSC Flagship project Novel Proteins for Foods and Feed: <http://www.worldfoodsystem.ethz.ch/research/flagship-projects.html>.

Poster 15-0M

Black soldier fly larvae as a novel protein and energy source in egg and poultry meat production

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Animal Nutrition, ETH Zurich; Animal Nutrition, Research Institute of Organic Agriculture (FiBL); Swiss Federal Institute of Aquatic Science and Technology (Eawag)

ABSTRACT

The study investigates the utility of insects as ingredients of organic diets for poultry as potential novel protein and energy source. The insect material (protein meal and larval fat) will be obtained from black soldier fly larvae fed with different substrates (e.g. household food waste) and used as a replacement for soy protein and/or vegetable oil in the diet of broilers and layers. Potential transfer of substrate contaminants (mycotoxins, heavy metals) in the food chain from the substrate to the larvae to meat or eggs will be determined – this separately for broilers and layers. Overall, various performance characteristics, protein and energy utilization, as well as meat and egg quality and the residues of contaminants will be analyzed. The outcome shall help to quantify the value of larval protein and fat as replacements of food grade ingredients and to determine risk of transfer of contaminants through the production chain.

This research is supported by the WFSC Mercator Research Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/MRP/HenandFly.html>. It is part of the WFSC Flagship project Novel Proteins for Foods and Feed:

<http://www.worldfoodsystem.ethz.ch/research/flagship-projects.html>.

Poster 16-0

Does the supplementation of dairy cows with the microalgae *Spirulina* improve protein supply of the cow and affect milk fat composition and the sensory quality of milk and milk products?

Elisa Manzocchi, Michael Kreuzer and Katrin Giller

Animal Nutrition, ETH Zurich

ABSTRACT

The cyanobacterium *Spirulina* (*Arthrospira platensis*), listed as one of the microalgae, is a promising novel protein source, which could replace part of the not sustainably produced soybean meal that is used extensively in diets for dairy cows. Indeed, microalgae can be produced on marginal or non-arable land reducing the exploitation of arable land for feed production. Furthermore, due to its high proportion of nutritionally favorable fatty acids, *Spirulina* might improve the nutritional quality of the milk. However, very few studies investigated the practicability of *Spirulina* supplementation and its effects on the animal and the food produced by the cows. This project aims at investigating the effect of soybean meal substitution with *Spirulina* in dairy cows on ruminal fermentation, metabolic status of the cows and the nutritional quality of the milk. Special attention will be given to the effects on the organoleptic properties of milk and selected dairy products.

This project is part of the WFSC Flagship project Novel Proteins for Foods and Feed: <http://www.worldfoodsystem.ethz.ch/research/flagship-projects.html>.

Poster 17-0

Does maternal algae intake affect the metabolic health of the offspring? – Search for potential transgenerational effects of a superfood

Rosamaria Lugarà, Michael Kreuzer and Katrin Giller
Animal Nutrition, ETH Zurich

ABSTRACT

A high dietary intake of saturated fatty acids and sugar ('Western diet') is the leading cause of the alarming rate of obesity and metabolic syndrome, a major health issue of inhabitants of industrialized countries. Concomitantly, the consumption of foods with assumed particularly favourable properties (superfoods) such as the cyanobacterium *Arthrospira platensis* (Spirulina) is continuously increasing. The numerous bioactive compounds in Spirulina may indeed lead to beneficial metabolic effects. Evidence suggests links between the intrauterine environment and metabolic programming of the offspring with potential implications for its health. Therefore, maternal supplementation with bioactive compounds may have beneficial health effects in the offspring. By using pigs as a model for human nutrition, this doctoral project aims to investigate potential transgenerational metabolic effects of a maternal Spirulina intake. It is of particular interest if Spirulina can permanently ameliorate or even prevent the harmful metabolic consequences of a maternal Western Diet in the offspring.

This project is part of the WFSC Flagship project Novel Proteins for Foods and Feed: <http://www.worldfoodsystem.ethz.ch/research/flagship-projects.html>.

Poster 18-0

Value through functionality – characterizing short time high temperature stability of blue microalgae proteins: phycocyanin

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ABSTRACT

Microalgae are frequently considered as an emerging protein alternative for less resource intensive food production. However, production of microalgae as a food commodity is not yet economically feasible. Thus, interest focusses on functional high value algal extracts such as phycocyanin, which is the only natural blue food coloring. Subject to this study was the color fading of Spirulina-based phycocyanin upon heating. Frequently encountered high temperature short time food processing conditions were applied in batch and continuous mode to phosphate buffered phycocyanin solutions. Systems with high surface-to-volume ratios were used allowing isothermal conditions at residence times down to 5 s. Absorption scans suggest a biphasic degradation of the color activity to about 30% after 30 s at $T \geq 70^\circ\text{C}$. Previously assumed linear first order kinetics contradict with the results that are kinetically best described by a higher reaction order of $n=6$. The insights facilitate development activities and food research to optimize blue color shades in multiple food categories.

This project is part of the WFSC Flagship project Novel Proteins for Foods and Feed: <http://www.worldfoodsystem.ethz.ch/research/flagship-projects.html>.

Poster 19-0

How can high-quality beef be sustainably produced under Swiss production conditions?

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Animal Nutrition, ETH Zurich; School of Agricultural, Forest and Food Sciences (HAFL), Zollikofen

ABSTRACT

Intensive cattle fattening in Switzerland relies on high average daily gains, which are achieved with maize silage-concentrate based diets, i.e. feeds produced on arable land where also food crops could be produced. Currently about 1/3 of the diets consists of concentrate, commonly including soybean meal. Grass-based feeds are used only at limited proportions as poor animal performance is anticipated. Since Switzerland is a typical grassland area, larger shares of grass-based feeds should be used in the diet. However, this requires careful diet planning. Suitable energy-rich forages have to complement grass-based diets to minimize impairments of animal performance. Additionally, the use of protein sources alternative to soybean-based feeds is of interest because global soybean production is not sustainable. In the project, the current feeding practice of beef cattle farms is surveyed. This is followed by two extensive feeding experiments where alternatives in energy and protein sources are tested in fattening bulls.

Poster 20-0

Hazel leaves as environmentally friendly novel feed for ruminants

Melissa Terranova, Shaopu Wang, Lukas Eggerschwiler, Michael Kreuzer and Angela Schwarm

Animal Nutrition, ETH Zurich; Agroscope Posieux

ABSTRACT

Plant secondary compounds (PSC) play an important role in developing feeding strategies to reduce methane emissions from ruminants. In this context, alternative feeds that do not compete with the growing of human food are gaining increasing importance in milk and meat production. In the present project we quantified at first which shrub leaves may be effective in mitigating methane emissions from rumen fermentation (in vitro) and are palatable to cows as well. Hazel (*Corylus avellana*) leaves, being most promising, were then fed as pellets in mixture with lucerne in dosages of up to 50% of the diet. With this approach, methane emissions could be reduced by up to 33% and 27% per unit of intake in sheep and dairy cows, respectively. The underlying five experiments demonstrated the great potential of hazel leaves for sustainable ruminant nutrition. Hazel could also be well integrated in silvopastoral systems thus promoting biodiversity in agriculture.

Poster 21-0

Plants + Science = Meat

Eric P. Stirnemann and Erich J. Windhab
Laboratory of Food Process Engineering, ETH Zurich

ABSTRACT

Sixty percent of all vegetable protein produced is used as animal feed to still our tremendous appetite for meat. Meat production is associated with negative impact on the environment and is causing large greenhouse gas emissions. A more sustainable solution is therefore to forgo the animal and produce fibrous meat-like textures directly from plant proteins using extrusion cooking. These so called high moisture meat analogues provide a similar mouthfeel experience to meat. So far, soy bean and wheat gluten are used as raw materials, but these are not well suited for people suffering from soybean allergy or gluten intolerance. We have investigated the usage of proteins from pulses (pea, lentils, beans) and oilseeds (sunflower, pumpkin, rapeseed) and identified key aspects in raw material requirements, and recipe and process design rules. These novel texturized products will provide a more sustainable alternative to meat with only a fraction of the environmental impact.

Poster 22-0

Insights into the dehydration of soft cellular food using multiscale modeling

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ABSTRACT

As the basis for process and product optimizations, the knowledge on how to control the dehydration process of soft cellular food is of great interest of food scientists and the drying industry. In this context, continuum modeling is widely used to evaluate the dehydration of porous materials. The accuracy of such models depends strongly on the material's macroscopic properties that are used. For a soft cellular food, these properties vary significantly with water activity, due to the significant deformation of the microstructure during dehydration and the different cellular dehydration mechanisms. How these changes at the microscale affect the macroscopic moisture transport, and thus the drying kinetics, is yet to be determined. This study addresses this knowledge gap by using a multiscale approach. A coupled hygro-mechanical model at the microscale is developed to derive the macroscopic moisture permeability and sorption isotherm. Here, a realistic cellular structure from X-ray micro-CT is used. At the macroscale, heat and mass transport are solved together with the deformation and fruit quality evolution. We find that dehydration at low temperature and low relative humidity is preferable to produce high quality products within a reasonable drying time.

Poster 23-0

Mango quality evolution inside cold chains: a predictive multiphysics model

Giorgia Tagliavini, Thijs Defraeye and Jan Carmeliet

Building Physics, ETH Zurich; Laboratory for Biomimetic Membranes and Textiles, Empa St.Gallen; Laboratory for Multiscale Studies in Building Physics, Empa Dübendorf

ABSTRACT

Convective cooling is essential in many supply chain unit operations for refrigerated transport and cold storage of fresh products. Fruit must be kept at low temperatures to preserve quality and to slow down biochemically-driven food degradation. Along the cold chain, heterogeneities in temperatures are present amongst individual products, which influence the resulting quality and thus cause significant food losses. The objective of this work is to better understand the thermal behavior of a mango fruit under forced-convective cooling and to link it to multiple biochemical changes that are responsible for the product final quality. To achieve this, a multiphysics model of a complex-shaped fruit – a mango – composed of fruit flesh and a seed, is developed, which includes heat transfer, fluid flow around the fruit and the related biochemical reactions for predicting quality evolution. With this, we quantify and reduce quality losses throughout different unit operations of the cold chain.

Poster 24-0

Application of *Lactobacillus reuteri* and glycerol as a novel approach to control *Campylobacter* colonization in chicken gut

Paul Tetteh Asare, Anna Greppi, Clarissa Schwab, Annelies Geirnaert, Katharina Brenig and Christophe Lacroix

Food Biotechnology, ETH Zurich

ABSTRACT

Consumption of chicken meat is the main source for *Campylobacter* food-infection. Reuterin (3-HPA) is a potent antimicrobial compound naturally produced by *Lactobacillus reuteri*, from glycerol. We hypothesize that administration of chicken isolated *Lb. reuteri* and glycerol feeding results in in situ production of reuterin which can reduce *Campylobacter* infection. We isolated 25 reuterin-producing *Lb. reuteri* from Swiss broiler chicken and screen them for resistance against critical antibiotics to determine the Minimal Inhibitory Concentrations (MICs). *Lb. reuteri* PTA5-F13 was selected for its high reuterin yield (350 mM) by biotransformation of 600 mM glycerol and antibiotic resistance profile. The efficacy of reuterin was then tested against a broad panel of *C. jejuni* (n=14) and *C. coli* (n=3). The MICs of reuterin against *Campylobacter* spp. was 156 µM, indicating a high sensitivity compared to the sensitive indicator strain *E. coli*. We showed the presence of reuterin producing *Lb. reuteri* in chicken gut and a very high bactericidal effects of reuterin against *Campylobacter*.

This research is supported by the WFSC Coop Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/CRP/CampyChick.html>.

Poster 25-0

Wheat seed lipase heritability

Chunyue Wei, Andreas Hund and Laura Nyström

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ABSTRACT

Whole grain wheat flour is well known for the health benefits. However, they are facing the quality challenge of lipid rancidity, which leads to adverse nutritional, sensory and technological properties. One of the major cause of lipid rancidity is endogenous lipases. Traditional processes to deactivate the enzymes often involve thermal treatment, which not only are energy consuming but may also decrease the nutritional value of the products. Nevertheless, numerous wheat germplasm with broad genetic diversity are available. This study evaluated over 300 European wheat varieties and observed up to 2-fold variance on lipase activities. Moreover, broad-sense heritability of lipase was calculated based on samples from 3 years. The result will improve the use of wheat as raw material, benefit cultivation selection, and provide consumers with better quality and healthier products. A deeper understanding of different wheat genotypes will also contribute to the adaptability and resilience of our food system.

Poster 26-0

When evolution works against the future: disgust's contributions to the acceptance of new food technologies

Aisha Egolf, Christina Hartmann and Michael Siegrist

Consumer Behavior, ETH Zurich

ABSTRACT

From an evolutionary perspective, the avoidance of new food technologies might be maintained by a deeply-preserved risk avoidance system called disgust. In an online survey, participants (N=319) received information about a variety of new food technology applications (e.g., genetically modified meat, artificial meat, or a synthetic food additive). All technologies were rated according to respondent's willingness to eat them (i.e., acceptance) and disgust perception. People's trait food disgust sensitivity was also measured. In full mediation models, food disgust sensitivity predicted the disgust response towards each new food technology application, which in turn, influenced willingness to eat them. The results point to that new food technologies are likely perceived as harmful and a potential danger when consumed, because technology-specific cues might provoke, for example, contamination fear (e.g., a foreign gene inserted in another organism like in gene technology).

Poster 27-0

Real or not real? A virtual reality study on food disgust

Jeanine Ammann, Christina Hartmann and Michael Siegrist
Consumer Behavior, ETH Zurich

ABSTRACT

Disgust influences eating behaviour and is therefore an important research topic. However, investigation of food disgust can be challenging due to ethical concerns regarding exposure of participants to disgust elicitors that could pose a risk of contamination or infection. With virtual reality (VR), the disgust research can draw from a whole new range of possibilities since participants will always be safe in the virtual environment. With the present study, we investigated food disgust using a mixed reality design. First, we investigated whether it is possible to induce disgust in a virtual environment and second, whether there is an association between participants' disgust sensitivity and their willingness to eat a food that is offered to them in the virtual environment but would also be eaten in the real world. Our results provide supportive evidence for VR being a promising tool for the disgust research.

Poster 28-0

How to measure knowledge about food sustainability?

Christina Hartmann, Gianna Lazzarini and Michael Siegrist
Consumer Behavior, ETH Zurich; Sustainability assessment, Research Institute of Organic Agriculture (FiBL)

ABSTRACT

Our daily food choices have a huge impact on the environment and on climate change. However, most consumers are not aware of the environmental impact of food production and consumption. Knowledge about factors that influence food sustainability is an important determinant of food attitudes and behavior and part of many education strategies. To the author's knowledge, there is no valid and reliable measure of knowledge regarding food sustainability. Therefore, a 15-question knowledge scale was developed (FS-15 Scale). The FS-15 scale was administered to a sample of Swiss adults (N=612, 50% females). Pro-environmental value orientation and pro-environmental purchasing behavior were used as criteria for validity testing. Based on statistical analyses, the scale turned out to have good internal validity and criterion validity, thus meets standard psychometric criteria. Consumer's ability to select sustainable foods and the effectiveness of educational interventions could be tested with the scale.

Poster 29-0

Determinants of collective climate change mitigation in agriculture: a Swiss case study

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ABSTRACT

Effective climate change mitigation is of urgent need for sustainable agricultural systems. Collective action of farmers can help to facilitate reduction of greenhouse gas (GHG) emissions beyond the single farm level and reduce marginal mitigation costs. However, no research exists on the determinants of collective climate change mitigation in agriculture. Besides cost reduction and economic benefits of collaboration, behavioral economic aspects including social factors as well as individual preferences, values and attitudes play an important role in decision-making of farmers. We base our empirical research on a case study of the farmer-led initiative AgroCO2ncept Flaachtal in Switzerland, a unique example of collaborative climate change mitigation in agriculture. Based on interviews and surveys with farmers, we use social network analysis and agent-based modeling.

Poster 30-0

The effect of political institutions on agri-environmental outcomes

David Wuepper, Pasquale Borrelli and Robert Finger
Agricultural Economics and Policy, ETH Zurich

ABSTRACT

Despite considerable effort by a variety of stakeholders, we observe continuing forest loss, increasing soil erosion, as well as water and air pollution - to name just a few examples. According to economic theory, institutions define the 'rules of the game', which are especially important when economic incentives tempt individuals to environmentally unsustainable behaviors. Yet, we know little about the causal effects of different institutions on environmental outcomes. Here, we contribute to filling this gap in the literature, by starting with the issue of soil erosion. We employ high resolution, global datasets and a spatial regression discontinuity design to identify causal effects, and to explain them.

Poster 31-0

Optimizing cocoa agroforests

Wilma J. Blaser, James Oppong, Simon P. Hart, Jonas Landolt, Edward Yeboah and Johan Six

Sustainable Agroecosystems, ETH Zurich; Council for Scientific and Industrial Research – Soil Research Institute, Kwadaso, Ghana; Institute of Integrative Biology, ETH Zurich

ABSTRACT

Meeting demands for agricultural production while maintaining ecosystem services, mitigating and adapting to climate change and conserving biodiversity will be a defining challenge of this century. The deliberate inclusion of shade-trees in cropping systems (agroforestry) is one of few strategies believed to contribute to all these goals, but their ability to do so will depend on how they are implemented. By measuring the effectiveness of cocoa agroforests to meet these goals along a gradient of shade tree cover, we show that cocoa agroforests around 30% cover are far superior to monocultures because they do not strongly compromise production, while at the same time provide higher ecosystem-service benefits. As shade-tree cover increases above approximately 30%, agroforests become increasingly less likely to generate win-win scenarios. Careful management of shade levels are therefore more likely to optimize crop and ecosystem-service benefits than current ad hoc implementation practices used by smallholder farmers.

Poster 32-0

Evaluating models for the simulation of sustainable production systems

Kathrin Fuchs, Lutz Merbold, Nina Buchmann, Lorenzo Brilli, Nuala Fitton, Katja Klumpp, Mark Lieffering, Raphaël Martin, Paul C.D. Newton, Robert M. Rees, Pete Smith, Susanne Rolinski and Val Snow

Grassland Sciences, ETH Zurich; Mazingira Centre, International Livestock Research Institute, Kenya; University of Florence, Italy; IBIMET-CNR, Italy; University of Aberdeen, United Kingdom; INRA, VetAgro, France; AgResearch Grassland Research Center, New Zealand; Scotland's Rural College, United Kingdom; Potsdam Institute for Climate Impact Research, Germany; AgResearch – Lincoln Research Centre, New Zealand

ABSTRACT

Grassland management greatly affects the microbial production of nitrous oxide in soils. Process-based models are useful tools to assess the impact of changes in management practices and climate on yields and greenhouse gas (GHG) emissions of grasslands. However, accurate simulations of GHG-exchange, in particular N₂O fluxes, are still a challenge. They are limited by our understanding of soil-plant-microbe interactions and the uncertainty in measured model input parameters. In order to improve model performance, thorough evaluations against in-situ measurements are needed. Therefore, we conducted a multi-model validation with three commonly used biogeochemical models (DayCent, PaSim, APSIM) comparing four years of data from an intensively managed Swiss grassland. All models predicted annual N₂O emissions more accurately than the IPCC (Tier-1) estimate. The results further suggest that using multi-model ensembles could be a defensible approach for simulating the impact of management strategies on yields and N₂O emissions in order to evaluate their sustainability.

Poster 33-0

Soil moisture satellite data to reduce basis risk of weather index insurances

Willemijn Vroege, Tobias Dalhaus, Janic Bucheli and Robert Finger
Agricultural Economics and Policy, ETH Zurich

ABSTRACT

Insurance is an important risk management tool for the resilience of farms, principally when adapted agricultural practices reach their limit during extreme weather situations. Using satellite imagery is discussed as a promising possibility to improve agricultural insurances. For this, it is important that a reliable, third party product with extensive temporal coverage is available at low costs. The Climate Change Initiative (CCI) program of the European Space Agency (ESA) developed a long-term, global and harmonized satellite soil moisture product, which is freely available. Soil moisture is essential for plant growth, so including soil moisture in the insurance design could improve agricultural insurances. In this contribution, the usefulness of satellite retrieved soil moisture data is explored. We will do this in an Eastern German case study by comparing the relation of wheat yields with soil moisture data from the ESA CCI to gridded soil moisture data provided the Deutsche Wetterdienst (DWD).

Poster 34-0

Irrigation modernization - an integrated perspective across spatiotemporal scales

Sandra Pool, Hong Yang, Mario Schirmer and Joaquin Jimenez-Martinez
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ABSTRACT

Agriculture accounts for the majority of water consumption worldwide. In semi-arid regions, water consumption is often related to high irrigation demands which are met with surface and groundwater resources. Both, a growing population and climate change are expected to increase pressure on these resources in the future. In this study, we focus on the Jucar River Basin in Spain, which is one of the major citrus producers in Europe and leading regions in drip irrigation. Using hydrological modelling tools we seek to understand the effect of the already implemented irrigation modernization on different water balance components. Participatory approaches including farmers, experts, and stakeholders will allow to consider the social component of water resources management to ultimately estimate future water demands under changing climatic conditions. The integrated perspective across disciplines and spatiotemporal scales will provide new scientific knowledge that can serve for policy recommendations for sustainable water resources management.

This research is supported by the WFSC Coop Program. Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs/CRP/IRRIWAM.html>.

Poster 35-0

Developing a model to assess the viability of action measures to enhance resilience, a case study in Ethiopia and Ghana

Luzian Messmer, Braida Thom, Assefa Kebebew, Evans Dawoe, Johan Six, Jonas Joerin and Pius Kruetli

TdLab, ETH Zürich; Climate Policy, ETH Zürich; Sustainable Agroecosystems, ETH Zurich; Ethiopian Institute of Agricultural Research, Debre Zeit; Kwame Nkrumah University of Science and Technology in Kumasi, Ghana

ABSTRACT

The viability of action measures (AMs) to enhance resilience is usually assessed focusing on either (1) feasibility or the stakeholders' (2) motivation, and without considering the resilience related (3) shock exposure, experience, and perception. In this study we used a questionnaire-based survey covering all three dimensions (1-3) to assess the viability of five AMs to enhance resilience to drought of tef farmers in Ethiopia and cocoa farmers in Ghana. In both cases, motivation and feasibility were associated for some AMs with the share of implementation used as viability proxy but not with the same effect. No direct effect of drought exposure, experience, and perception on the implementation of AMs was found. The results indicate that the share of implementation is more a function of the AMs' nature than a function of the stakeholder and its livelihood. Further research should be conducted to get a better understanding of the interactions and effect strength of AM related motivation and feasibility.

This project is part of the WFSC Flagship Project Enhancing Resilience in Food Systems: <http://www.resilientfoodsystems.ethz.ch/>.

Poster 36-0

Assessing the resilience of vegetable growers in a country facing rapid environmental and socio-economic changes, the case of fresh tomato in Morocco

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Sustainable Agroecosystems, ETH Zurich; University of Bergen, Norway; Mohammed V University of Rabat, Morocco

ABSTRACT

Farmers are increasingly exposed to various types of stresses. For horticultural growers, this is all the more striking as vegetable production, such as tomato, is input and water demanding. In Morocco, tomato is a key food crop, and also a key cash crop for the producers and constitutes a main agri-food export commodity of the country. On the other hand, water demand for irrigation has led to an overexploitation of the groundwater table causing significant natural resource management challenges in many parts of Morocco. The combination of groundwater changes and increasing drought raises concerns about the ability of tomato producers, to be sustainable and resilient to unexpected changes. To describe the interaction of environmental and socio-economic processes that influence farmers' livelihoods, a system dynamics approach is used. The model allows studying the synergies and trade-offs between different goals such as productivity, resilience and sustainability under rapidly changing framework conditions.

This project is part of the WFSC Flagship Project Enhancing Resilience in Food Systems: <http://www.resilientfoodsystems.ethz.ch/>.

Poster 37-0

Building farm system resilience in Canton Vaud, Switzerland

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ABSTRACT

In the context of climate change, enhancing farms' resilience is becoming increasingly important to ensure rural development and food quality for all. Therefore, DGAV (Vaud Cantonal Public Service for Agriculture), ETH, FAO and FiBL launched a project to assess and build resilience in Canton Vaud. Firstly the diversity of farms in the Canton was characterized and a sample of 130 farms based on a k-means clustering was chosen. The SHARP tool developed by the FAO was previously adapted to the Swiss context and used to collect data. Results were discussed with the farmers during workshops and the main obstacles to improved sustainability and resilience were identified. Policies aiming for more resilience in the region should focus on fostering diversification and natural mitigation of pests. A better knowledge and experience exchange among farmers would help developing successful initiatives. The project is thus continuing through an exchange platform to diffuse knowledge and local experiences.

This project is part of the WFSC Flagship Project Enhancing Resilience in Food Systems: <http://www.resilientfoodsystems.ethz.ch/>.

Poster 38-0

Resilience of the Swiss food system

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ABSTRACT

The Swiss food system is increasingly exposed to shocks such as hot and dry summers in 2003, 2015 and 2018 and extended periods of cold weather in 2013 and 2017. The regulation of food imports allows ensuring food security, however, the economic vulnerability of agro-input suppliers, farmers and processors remains of a challenge. To address it, the project aims to assess the resilience of different activities of the milk, beef, wine, wheat and potato value chains to three shocks: summer dryness, biological diseases and introduction of a free trade on food products with the European Union. The preliminary results based on an online survey show that the economic vulnerability of farmers is higher than vulnerability of processors both to the summer dryness and the free trade, and potato farmers show higher vulnerability than their counterparts in the milk, beef and wheat value chains to the both scenarios.

This project is part of the WFSC Flagship Project Enhancing Resilience in Food Systems: <http://www.resilientfoodsystems.ethz.ch/>.

Poster 39-0

Facing rice challenge by As and Cd in southern China: from origin to soil based prediction

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ABSTRACT

In southern China, large areas used for rice production are contaminated with toxic elements such as arsenic and cadmium due to human activities including mining and smelting as well as irrigation with contaminated waters. Intake via rice consumption has been estimated to be a major contaminant source for humans in the affected regions. Total contaminant levels in paddy soils were reported to be poor predictors for contaminant concentrations in rice grains. To derive adequate, empirical soil-related predictors for rice quality, we took 35 paired soil-rice grain samples in five provinces in southern China. The statistical analysis of our data revealed that rice Cd was most strongly correlated to CaCl₂-extractable Cd using fresh soil ($R^2=0.54$) but clearly less strongly in dry soil extraction ($R^2=0.27$). For rice As, a statistically significant soil-related predictor was not identified.

Poster 40-0

Trace metal(loid) bioavailability and mapping of chemical gradients in the rhizosphere of rice (*Oryza sativa*)

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ABSTRACT

Rice is the most important staple food and feeds half of the world population, however a substantial fraction of paddy soils are contaminated by trace metal(loid)s (e.g. As, Cd, Hg) which can detrimentally affect rice growth, quality and food safety. The bioavailability of nutrients and trace metal(loid)s in paddy soils is highly variable, depending on small-scale dynamics at the soil-root interface (rhizosphere) such as changes in pH, redox potential and root exudation. Here, we investigate the efficacy of inorganic soil amendments for metal(loid) management in moderately contaminated Chinese paddy soils. In rhizobox experiments, multi-elemental patterns around rice roots are mapped using low-invasive sampling and sensing techniques at high spatial (sub-mm) and temporal (min-h) resolution to improve the understanding of trace metal(loid) dynamics in soil-rice systems. First results showed that soil amendments did not affect rice biomass, however metal(loid) bioavailability in the soil and accumulation and speciation of arsenic was altered.

Poster 41-0

Tree-to-maize nutrient transfer via mycorrhizae?

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ABSTRACT

Mycorrhizal networks (MN) may play a key role in low-input agricultural systems because they can facilitate interplant nutrient exchange, benefiting crops. Trees maintain MN across cropping-seasons but whether a tree-to-crop nutrient transfer occurs and enhances crops is unknown. We assessed whether maize connects into MN. Maize was grown in tree root-free compartments next to *Mangifera indica* and *Faidherbia albida*. In the greenhouse, we used ¹⁵N and ³³P tracing to assess i) tree-to-maize nutrient transfer and ii) nutrient uptake from soil by tree-facilitated MN. In the field, we analyzed ¹⁵N natural abundance to investigate whether trees facilitate N transfer to maize. In the greenhouse, we found no tree-to-maize nutrient transfer. Soil-to-maize nutrient transfer was not affected by trees. In the field, a tree-to-maize N transfer occurred but had no impact on maize yield. Consequently, the longer-term role of MN in improving sustainability of yields and thus, food security needs further investigation.

Poster 42-0

Magic beans – disease resistant common beans for smallholder farmers

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ABSTRACT

Common bean, frequently termed 'the meat of the poor', is an important food security crop because of its high protein level and affordable price. Bean yields are frequently reduced by plant diseases, with angular leaf spot (ALS) being one of the most devastating fungal diseases. Although pesticides offer means for disease control, they are expensive and not always available for smallholder farmers in the tropics, hence resistance breeding offers a more feasible and sustainable solution. This study aims at providing breeders with a toolbox to facilitate breeding for effective ALS resistance. The ALS breeding toolbox established consists of a collection of the most resistant bean germplasm, information about the resistance of the collection against different pathogen strains in glasshouse and field trials and molecular markers linked to resistance loci. Taken together, this information will help breeders selecting and transferring the most effective resistance loci to their varieties.

Poster 43-0

Improving southern anthracnose resistance in red clover

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ABSTRACT

Red clover (*Trifolium pratense* L.) is one of the most important forage legumes in temperate climates. It is an excellent feed for cattle due to its high protein content and digestibility, and its ability to fix atmospheric nitrogen improves and maintains soil fertility. In recent years, losses in red clover due to southern anthracnose, caused by *Colletotrichum trifolii* increased, rising the demand for resistant cultivars. The study will be conducted in the framework of the Horizon 2020 project EUCLEG (Breeding forage and grain legumes to increase EU's and China's protein self-sufficiency). It aims at elucidating the genetic control of anthracnose resistance through genome sequencing and genome wide association studies (GWAS). Therefore, 400 red clover accessions will be genotyped and phenotyped in the glasshouse and in the field at different locations. The insights gained and the tools developed will support genomics-assisted breeding strategies that accelerate breeding progress and result in superior red clover cultivars.

Poster 44-0

Sex reversal in papaya

Tiago L. Meier and Ueli Grossniklaus
Plant Developmental Genetics, University of Zurich

ABSTRACT

Papaya belongs to the five most produced tropical fruits worldwide. In many countries papaya production and export is an important economic factor. Therefore, yield loss may reduce food security but also influence export. In the past, pathogens endangered the papaya production, e.g. the papaya ringspot virus. In the future, additional factors have to be considered, such as the effects of global warming. Papaya plants can have one of three sexes: male, female, and hermaphrodite. Farmers prefer to plant hermaphrodites, as they self-pollinate and produces more uniform fruits than those born on females. However, environmental effects, e.g. elevated temperatures, can cause sex reversal in hermaphrodite papayas, leading to the development of male flowers that do not produce any fruits. In this project, we try to identify the molecular correlates of sex reversal and genetic markers linked to a higher robustness of sexual differentiation, which would allow breeding papaya against sex reversal.

WFSC Poster

World Food System Center Mercator Research Program

World Food System Center, ETH Zurich

ABSTRACT

The Mercator Program, operated by the World Food System Center (WFSC), aims to explore the role and potential of organic production systems (certified or non-certified) to contribute to global food security. The program supports activities in the areas of Research, Education, and Outreach & Dialogue. Since it start in 2012, the Mercator Research Program has supported 16 doctoral theses looking at topics ranging from biological pest control to greenhouse gas emissions from livestock, insects as feed, coffee and sweet potato production systems, resilience, and global models of organic agriculture. The main element of the Education area are the World Food System Summer School courses held in Switzerland or abroad and the Alumni activities. In the area of Outreach & Dialogue, the WFSC organizes public events like public lectures and the WFSC Annual Symposium and offers enabling grants for small projects and short-term educational or professional development activities through the WFSC Ambassador Program.

Further information is available at <http://www.worldfoodsystem.ethz.ch/research/research-programs.html>

WFSC Poster

Edible research: hands on learning for sustainability in agroecosystems and food value Chains

Anett Hofmann, Anna K. Gilgen, Manuel Stamm, Luna Urio, Martina Binder, Laura Schnegg, Eva Penz, Michelle Grant and Johan Six
Sustainable Agroecosystems, ETH Zurich; World Food System Center, ETH Zurich

ABSTRACT

Edible Research is a science communication project designed and implemented by the research group Sustainable Agroecosystems and the World Food System Center. Within the framework of this project, scientists, lecturers, and students collaborate with secondary school teachers and teacher trainers to develop learning materials and hands-on activities for teenagers, aged 12 to 15. The focus topic 'Sustainability in Agroecosystems and Food Value Chains' is explored with all senses through activities such as role playing on palm oil production; debate on food labels and reduction of meat consumption; visualizing the value chains of rice, potatoes, and maize; experiments on soil CO₂ emissions; and solar cooking of tropical staple crops like teff, yams, and cassava. So far, we have interacted with approximately 350 teenagers and 120 adults with our events.

Further information is available at <http://www.worldfoodsystem.ethz.ch/outreach-and-events/dissemination-and-participation/agera.html>.

WFSC Poster

A journey into food systems in Ivory Coast: WFSC Summer School 2018

World Food System Center Summer School Alumni

ABSTRACT

The cornerstone of the World Food System Center's educational activities is the 'World Food System Summer School' program that each time brings together around 25 students from ETH Zurich and universities from around the world for a two week intensive course on food systems. Between 2013 and 2018, this course took place seven times, four times at a pioneering organic farm in the Canton of Zurich (Gut Rheinau), once in India, once in South Africa, and once in Cote d'Ivoire. The 4-unit course incorporates a variety of innovative teaching formats, such as first-hand exchanges with stakeholders and practitioners, group work, concept mapping, policy impact analysis, business planning exercises, panels, and hands-on practical applications. Instructors include ETH Zurich faculty, international researchers, and practitioners from industry, public, and non-profit sectors. This approach ensures the courses balance academic content and rigor with an immersion and experiential learning context. Solution-approaches in multidisciplinary and multicultural teams are a key component.

Further information is available at <http://www.worldfoodsystem.ethz.ch/education>.

WFSC Poster

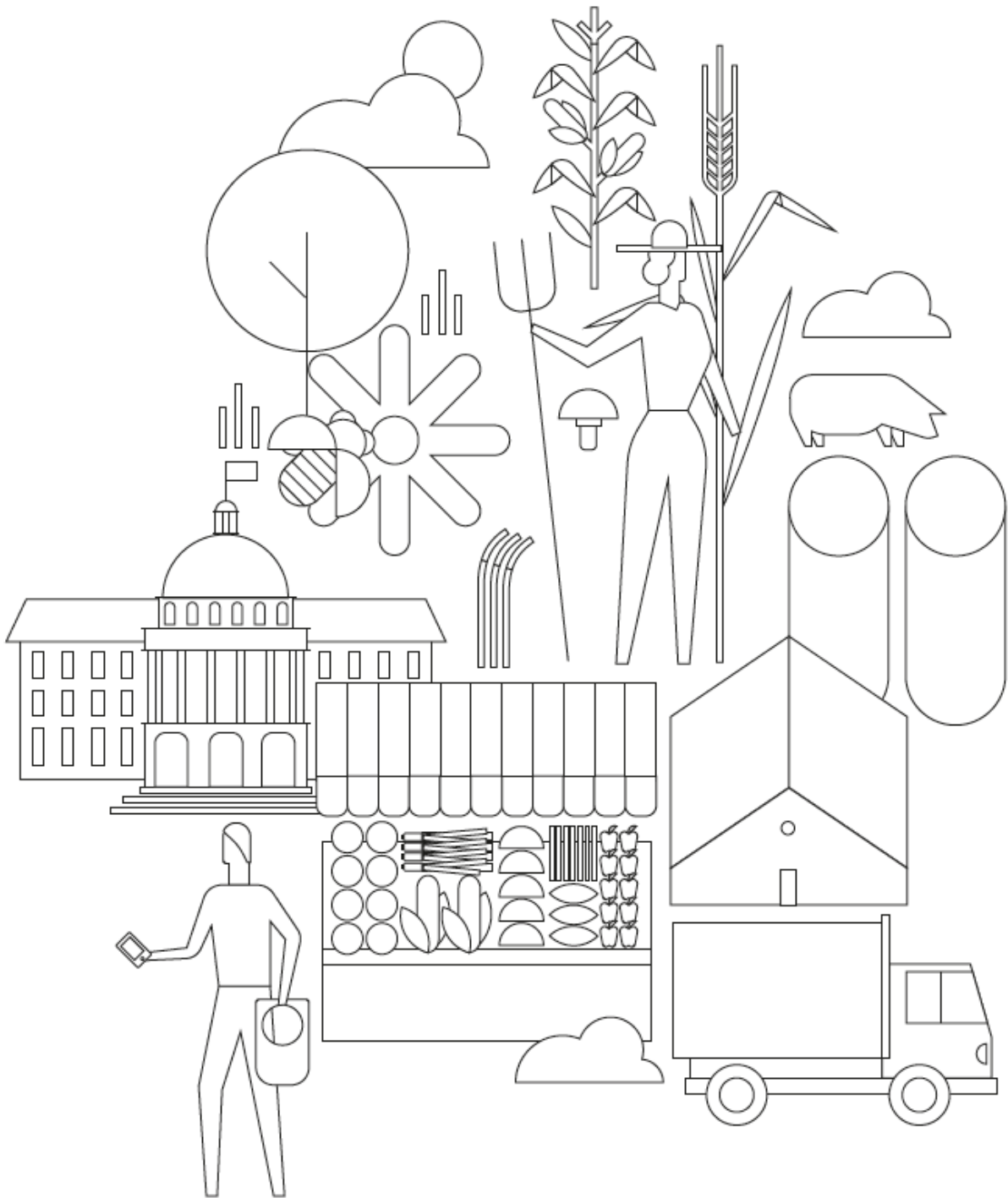
World Food System Summer School Alumni

Jonna Cohen, Annet Westhoek, Pienaar du Plessis and Rhea Cordeiro

ABSTRACT

The vibrant World Food System Summer School Alumni community includes 189 alumni from 53 different countries throughout the world, including participants from seven summer schools and one study tour. While a number of platforms currently exist for alumni to share resources and opportunities with one another, the World Food System Center conducted a survey, as well hosted its first ever Alumni Workshop to create a space for alumni to develop offerings that meet their evolving needs. The three-day workshop resulted in a working group that continues to advance the offerings that the alumni prioritized for 2019: creating an online platform, developing further food system related knowledge, and solidifying the structure of the alumni organization.

Color our food system



Notes

Notes

Food system facts

31% of all food is wasted.



4 million tons of pesticides are used annually in the global food system; if filled into trucks, the column would stretch over 1650 km.

In Switzerland, 7% of the household budget is spent on food, while for the very poor elsewhere, the share rises up to 75%.



Layout

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