Abstracts of Keynote Speakers

In alphabetical order of the (first) author.

All names are given without academic titles.

Malnutrition and obesity: (related) global challenges

Rocco Barazzoni, University of Trieste, Department of Medical, Surgical and Health Sciences, Italy

Hunger- and poverty-related malnutrition remain unfortunately common throughout the world, but malnutrition prevalence is also largely increasing in affluent and developing countries due to increments in older-adult population and chronic non-communicable disease patients. Both aging and aging-associated chronic diseases, such as end-stage heart and kidney failure, pulmonary disease or cancers, indeed commonly lead to malnutrition through complex mechanisms including reduced appetite, metabolic derangements and altered skeletal muscle mass and function (sarcopenia). Conservative estimates indicate that several dozen million individuals are malnourished or at risk for disease-related malnutrition in Europe alone; substantial social and clinical costs are directly caused by disease-related malnutrition through disability, loss of autonomy, enhanced morbidity and utilization of healthcare resources. Importantly, the concomitant ongoing obesity epidemics has a direct although seemingly paradoxical negative impact on malnutrition, by directly favoring the onset of chronic non-communicable diseases. In addition, obesity and its metabolic complications may directly alter skeletal muscle mass and function, leading to sarcopenic obesity with enhanced disability and morbidity burden. Such complex nutritional and metabolic challenges may be notably attenuated and treated through appropriate nutritional therapy. It is however increasingly clear that effective preventive strategies in the aging population and in non-communicable disease patients will require higher awareness and further development of complex, multimodal epidemiological approaches.

FOOD 2030 - driving sustainable food system transformation though research and innovation

John Bell, European Commission, DG Research & Innovation, Belgium

Providing food and nutrition security is becoming more challenging and uncertain due to the compounded and interconnected global challenges of natural resource scarcity, climate change and demographic change. Our current-day food systems are broken – that is, they are unsustainable and contributing to malnutrition and non-communicable disease, in Europe and around the world. There is urgency now to transform our food systems: from how we produce, process and distribute our food, to what we eat or spill and how much. FOOD2030 is the EU policy framework for a systemic approach to transforming our food systems through more impactful and ambitious research and innovation (R&I). R&I has a key role to play in driving the transition towards sustainable healthy diets and climate-smart, sustainable and circular food systems that contribute to thriving and resilient rural, coastal and urban communities. To meet these goals simultaneously, future R&I will need to be multi-objective to maximise co-benefits, and inter and trans-disciplinary, involving a wide diversity of disciplines, sectors and actors across the food system. FOOD 2030 provides an actionable narrative and way forward for Horizon Europe to address the most important issues relevant to citizens.

Sustainable Food Systems – suggestions for the German and European Research Area

Hanns-Christoph Eiden, Federal Office for Agriculture and Food, Germany

The Federal Ministry of Food and Agriculture (BMEL) contributes to find solutions to the urgent challenges of the Agenda 2030 like to end hunger, achieve food and nutrition security and promote the sustainability of food systems through funding of research and development projects in different scientific fields.
In this regard, the Federal Office's for Agriculture and Food (BLE) capacities are put to use for new tasks and services for BMEL, among which the coordination of research and development projects and their funding is one of the most important ones.
We fund, for example, projects to reduce salt and sugar in our nutrition, a core topic when talking about a healthy nutrition. Another issue is safe foods and transparency; in this area, we explore for example ways to a safe proof of origin. The goal to produce safe, sustainable and resource-efficient food is reflected within all our projects, especially in those dealing with organic farming.
Besides the national research activities, a focus is set on the European level with the participation in numerous Committees and P2P partnerships, covering the whole value chain including fisheries and forestry. The European interests often cover national interests, and in addition offer a benefit. In this regard, Horizon Europe should be seen as a great opportunity to consolidate them and develop them further.
In order to arrive at the Food 2030 goals, further and more commitment of member states will be required. New initiatives addressing a Food Systems approach are upcoming, e.g. the follow-up of the ERA-NET ICT Agri, intending to cover the agrifood sector in the future, the ERA-NET on Climate Change and Food Systems. The upcoming Foresight study of SCAR will deal with the transition to Food Systems thinking. It is recommended to continue this way, to think in systems dimensions, to implement more often a multi-actor approach and to enforce the consumer's involvement in a discussion about the value of our foods. With a concerted engagement we will achieve the Food Systems we need, and which are useful for everybody.

Next generation food processing for better health and sustainability

Remko M. Boom, Wageningen University and Research, Department of Agrotechnology and Food Sciences, The Netherlands

With around 10 billion people to feed in a few decades, and an impending shortage of many of our resources, we need to re-think the way that we produce our foods and food ingredients.
Many food ingredients are currently isolated with molecular purity in mind as we are generally convinced that the best purity will also give us the best product properties, and will allow the easiest product formulation. However, in the purification, large amounts of water and energy are used, while a significant part of the raw material is lost. Of course, in formulating products from ingredients, we mix all these pure ingredients again. Is it then necessary to create pure ingredients in the first place? If the final products are mixtures, then we also might create enriched fractions, which can be combined into very similar products compared to the current ones.
Creating these enriched fractions can be done with radically less water and energy, and may lead to much better use of the raw materials, when we do not destroy, but make use of the internal structure of the raw material. In some cases, one can separate components with only very small amounts of water, while in other cases, ingredient fractionation can even be achieved without using any water. The enriched fractions obtained have quite interesting properties, comparable or in some respects even better than those of conventional ingredients, which is probably because the natural structure of the raw material is preserved in these enriched fractions.
The enriched fractions allow us to combine the best of three worlds: while the production process is radically more efficient in the use of water, energy and raw materials. Excellent foods may be formulated without requiring additives, while the relatively unrefined ingredients fit into diets that will allow us to live healthier lives. Making use of the complexity of nature, instead of using much

resources to reduce it, is clearly the way towards better using our resources in the best possible way, and generating the best possible value from our precious resources.

The "Food and Agricultural Approaches to Reducing Malnutrition" cluster-randomized trial in Bangladesh: Improving home garden soils and food diversity for better health

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Background
To address food insecurity and malnutrition among small-scale farmers, it is critical to enable them to produce more food on available land, ideally at low cost, without carbon emissions and while preserving soils – to contribute to climate change mitigation and adaptation.
We aim to evaluate the impact of a complex nutrition-sensitive agricultural intervention with biochar-based fertilizer on chronic undernutrition in rural Bangladesh.

Methods
The "Food and Agricultural Approaches to Reducing Malnutrition" (FAARM) cluster-randomized trial (NCT02505711) evaluates a Homestead Food Production program from 2015 to 2019. It includes approximately 2700 married women under age 30 and their children under age 3 in 96 villages of rural Habiganj District in Sylhet Division. The main objective is to reduce child stunting.
The intervention comprises dietary diversification through year-round home gardening and poultry rearing, nutrition and hygiene education, women empowerment and market linkages. To improve soil fertility in home gardens, farmers were introduced to conservation agricultural practices and to producing biochar-based fertilizer by converting crop residues into biochar in soil-pit kilns and mixing with cow urine and compost.

Findings
At baseline in 2015, 34% of women were chronically energy-deficient (BMI<18.5) and 41% of children under age 3 (n= 1534) were stunted (length-for-age Z-score<2). Only 30% of both women and children consumed adequately diverse diets. In the rainy season 2017, households in the 48 intervention villages had increased garden crop diversity and grew on average 6.9 vegetable species compared to only 2.4 in control ($p<0.001$). Dietary diversity also improved with 50% of women and 53% of children in the intervention arm eating an adequately diverse diet compared to only 33% and 38% in control ($p=0.002$, $p=0.005$).
The urine-biochar fertilization technology was readily accepted and scaled up. Farmer families (n=134) tested the new fertilizer against usual practice in field trials, and yields of two winter and three summer vegetables more than doubled on average (ranging from 67% to 151% increase). As of April 2018, 70% of farmers reported using the technology.

Interpretation
An integrated gardening and nutrition program including biochar-based fertilization can increase the production of micronutrient-rich fruit and vegetables and improve dietary diversity, while being carbon-negative and increasing resilience of small-scale farmers to climate change.

Contributions: SG had the idea for the study and is principal investigator; SG, JW and AW plan and oversee data collection with contribution from AM; AK ensures data quality in the field; SA supervises the implementation; TH oversees process evaluation; SS leads the food hygiene intervention and supports research activities; KK guided the home garden species inventory and analysis; HPS introduced biochar-based fertilizer and oversees farmer trials; IJ contributed expertise in nutrition; JW performs data management; SG and JW analyzed the data; all authors contributed to interpretation and writing.

Competing interests: none

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FAARM trial registration: https://www.clinicaltrials.gov/ct2/show/NCT02505711

The food security conundrum

Ken E. Giller, Wageningen University and Research, Department of Plant Science,
The Netherlands

There is consensus that food production must increase to meet global needs, that adjustments in diets are required to ensure efficient use of the food produced and avoid undernutrition and obesity, that the expansion of land under agriculture should be avoided and that food should be produced in a sustainable way. Global population growth continues apace with most recent estimates of 9.8 billion by 2050 and an extra billion people by 2030, half of which in Africa. The required increase in global food lies between 25-75%, depending on how well we learn to control food losses and changes in diets for example. But where will this food be produced? And who will produce it?
Estimates of food self-sufficiency at country level suggest that some regions will remain major bread-baskets – notably Australasia, North America and South America. Most countries of sub-Saharan Africa will be net consumers of food as the rate of population growth will outstrip increases in agricultural productivity. Major trends in farming can be identified. In land-abundant, mechanised agriculture we witness a continued expansion of large farms that employ relatively few people. Declining population growth in Asia together with high rates of urbanisation suggest that farm sizes are starting to increase. By contrast in sub-Saharan Africa rural populations are expanding rapidly despite rapid urbanisation. Sub-division of farms leads to fragmentation of land into small and uneconomic units increasing marginalisation of the rural population. In this talk I will explore and raise questions concerning our vision of what sustainable agriculture we want, and the economic, social and demographic obstacles that need to be surmounted. The food security conundrum that we face is how to provide cheap and nutritious food for the poor – and at the same time guarantee a living income for the farmers who must produce it in a sustainable manner?

Microbial surfactants - bioproduction and application perspectives

Rudolf Hausmann, University of Hohenheim, Institute of Food Science and Biotechnology,
Germany

Microorganisms produce manifold metabolites that do not seem to be necessary for their growth and survival. Specifically, amphiphilics, for example, phospholipids, form the basis of all biological membranes. Although many cell components, such as fatty acids and phospholipids, generally, lower interfacial tension, additional specific compounds that lower interfacial tension are known from many microorganisms. These microbial surfactants usually comprise unique structures. Such metabolites that lower interfacial tension are often secreted by microorganisms either into the culture medium or are integrated into the cell wall, thus permitting them to grow on or to take up hydrophobic substrates. They are often designated as “biosurfactants.” These surfactants are among the few known microbial metabolites with bio-physically useful properties.Owing to the lipid moiety, the extracellular compounds are assigned to the exolipids or “free” lipids. The majority of these exolipids is only formed under special, usually limiting growth conditions. A large number of type-specific, partially very unusual glycolipids, lipopolysaccharides, lipopeptides, and proteins are known. Despite the diversity in structures, all of these metabolites that lower surface tension are designated as biosurfactants. The designation of biosurfactants for amphiphilic substances of microbial origin is to differentiate them from conventional synthetic surfactants. All in all, about 2000 different amphoteric structures of biological origin have been described. These substances were mainly interesting due to their antibiotics properties. However, the term biosurfactant is sometimes synonymously used to refer to

any natural surfactant or those obtained by chemical bonding of polar head groups and the hydrophobic tails, obtained from a natural source. Well-known examples of biosurfactants in a broader sense are soybean and egg yolk lecithins obtained from plant and animal sources, respectively, and alkyl polyglucosides (APGs) for chemically obtained surfactants from renewable sources. The presentation will give an overview on the production and application perspectives of the commercially available microbial surfactants, rhamnolipids, sophorolipids and surfactin as well as overview on current research.

Health and environment futures under 'Business as Usual'

John Ingram, Environmental Change Institute, University of Oxford, United Kingdom

One of the great human achievements over the last half century is that advances in food production have largely kept pace with demand on a global basis. Today, around 6 billion people are not hungry, up from about 2 billion 50 years ago. But we should not be complacent. Despite these successes, nearly 1 billion people are still hungry, and at least 3 billion more lack sufficient nutrients. Paradoxically, there are also already more than 2.5 billion people overweight or obese; different, overlapping forms of malnutrition are the 'new normal'. We also know that current food system activities will continue to significantly impact natural resources. How then can food systems be developed to provide sufficient, nutritious food for a growing, increasingly wealthy population, while mitigating poor health and environmental outcomes but while also maintaining vibrant enterprise and livelihoods? Based on a brief introduction to food system challenges, the presentation will consider plausible future food demand and the actions necessary to limit further negative consequences for health, society and environment.

Food transitions 2030

Frans Kampers, Wageningen University and Research, The Netherlands

The world needs to transition from the current unsustainable food system to a healthy, circular and resource-efficient paradigm. A hugely complex process since the multiple aspects of food production and consumption are closely interconnected and changing one aspect can easily have major unintended consequences. Yet the transitions are urgent and must be driven by science as well as values and economics. Therefore an integrated vision is proposed characterised by four objectives, which are to be pursued through eight scientific approaches combined within a matrix, always aiming for societal acceptance and citizen appreciation. We believe that a joint effort of all stakeholders in a Joint Undertaking is the best way to pursue the strategy.

Transformation in food systems – a challenge for society and industry

Kerstin Lienemann, German Institute for Food Technology, Germany

Food systems have various target figures: Food produced within it should be good for us (e.g. healthy, nutritional, and available) and good for the planet (e.g. reduced CO2 emission, maintain biodiversity on land and in the water, sustain ecosystems). Hence, exploring trade-offs between conflicting objectives is in its nature. However, recent expected and unexpected changes in society, environment, policy and economy will inevitably require transformation processes in these food systems. For example, the food producing and sales sector will need to acquire the necessary knowledge, skills and capabilities in time to meet (changed) expectations of consumers and society. Major challenges for research and technology include winning back consumer trust, delivering food products for a healthy and responsible consumption and creating resilient food systems. Solutions to these areas are as

important as shaping and enabling the best possible framework to tackle these research and innovation challenges. The German Institute of Food Technologies (DIL) has a long tradition in food science and technology as well as a large network of and close cooperation with food industry in the area of pre-competitive research as well as commissioned research activities within food systems. Ideas and suggestions regarding the European and national research agenda will be presented as food for thought for a subsequent discussion.

Food systems approach: A pathway towards the SDGs

Huub Löffler, Wageningen University and Research, Center for Development Innovation,
The Netherlands

AGRINATURA is a grouping of 30 European universities and research organizations from 16 European countries with a common interest in supporting agricultural development in a sustainable manner in order to improve people's lives. It seeks to nurture scientific excellence through joint research, educational and training programmes and projects and advocates for greater support for agricultural research and educational programmes that contribute to the achievement of the Sustainable Development Goals. Typically, Agrinatura collaborates with DG-DEVCO to support the commission in developing and implementing their policies. For example, Agrinatura manages and delivers the 'Value Chain Analysis' (VCA) component of the Inclusive and Sustainable Value Chains and Food Fortification Programme (VC4AD) and, jointly with FAO, the Capacity Development for Agricultural Innovation Systems (CDAIS).
A pro-actively initiative developed by Agrinatura members, and presented to the commission in the DESIRA frame, concerns a 'Food System Support Facility'. The rationale of this initiative is that transformation of food systems all around the world is inevitable to make them future proof, and that any transformation must be fact-based. One element of this facility is the Global Food System Index (GFSI), as proposed by IFPRI. This index provides an evidence-based tool that enables to track progress in the key dimensions (production, access, consumption, environment, markets, policies) of food systems. The GFSI will aim to fill a gap among a crowded field of indexes and indicators; while many indexes exist, none distils the complexities of the entire food system into a single index or set of indexes. Once developed and implemented, the GFSI will guide national and international bodies and institutions to develop and monitor interventions, to the benefit of sustainable food systems, and ultimately to the benefit of us all: the consumers.

Agricultural emission reduction and climate change adaptation in the context of the Sustainable Development Goals

Hermann Lotze-Campen, Potsdam Institute for Climate Impact Research, Germany

In order to achieve the targets of the 2015 Paris Climate Accord, greenhouse gas emissions in the agricultural sector have to be strongly reduced by 2050 and beyond. At the same time, agricultural and food production need to be adapted to rising temperatures and more frequent weather extremes, even below 2 degrees of global warming. This talk will provide an overview of future global scenarios of agriculture, food, and land use change, based on quantitative simulation modelling of the Shared Socio-economic Pathways (SSP). Available scenarios in the literature show, how major trade-offs between climate protection and food security may be resolved. Options for improving cross-sectoral policy coherence in the context of the SDGs will be discussed.

The rise of medium-scale farms in Africa: Causes and consequences of changing farm size distributions

Milu Muyanga, Michigan State University, Department of Agricultural, Food and Resource Economics, USA

This presentation highlights the causes and consequences of changing farm size distributions in sub-Saharan Africa. Medium- and large-scale farms account for a rising share of total farmland, especially in the 5 to 100 hectare range where the number of these farms is growing especially rapidly. Medium-scale farms control roughly 20 percent of total farmland in Kenya, 32 percent in Ghana, 39 percent in Tanzania, and over 50 percent in Zambia. The rapid rise of medium-scale holdings in most cases reflects increased interest in land by urban-based professionals or influential rural people. The rise of medium-scale farms is affecting the region in diverse ways that are difficult to generalize. Many such farms are a source of dynamism, technical change and commercialization of African agriculture. Evidence shows that the rise of bigger farms is encouraging new entry and investment by large-scale traders and more concentrated marketing channels as well as greater use of mechanization even by small-scale farmers. However, medium-scale land acquisitions may exacerbate land scarcity in rural areas, bid up land prices and encourage outmigration of rural youth. Medium-scale farmers tend to dominate farm lobby groups and influence agricultural policies and public expenditures to agriculture in their favor. Nationally representative Demographic and Health Survey (DHS) data from six countries (Ghana, Kenya, Malawi, Rwanda, Tanzania and Zambia) show that urban households own five percent to 35 percent of total agricultural land and that this share is rising in all countries where two or more DHS surveys warrant comparisons over time. This suggests a new and hitherto unrecognized channel by which medium-scale farmers may be altering the strength and location of agricultural growth and employment multipliers between rural and urban areas. Given current trends, medium-scale farms will soon become the dominant scale of farming in many African countries.

Workshop "Key narratives on microalgae for food production"

Christine Rösch and Maximilian Roßmann, Karlsruhe Institute of Technology, Institute of Technology Assessment and System Analysis, Germany

Microalgae are considered a promising source for sustainable food production to feed a growing world population with changing food habits. This is due to their high nutritional and food technical potential and their positive effects on climate change, resource depletion, and land use. On the bio-technical side, improved upstream (cultivation and harvesting) and downstream (drying and extraction) processes aim to explore the diverse potential of microalgae. However, little is known about consumers' view on microalgae food, the expected sensory quality, prices, or other reasons for acceptance or rejection of microalgae food.
As part of the Bioeconomy Research Program Baden-Württemberg (www-bioeconomy-research-bw.de), the Institute for Technology Assessment and Systems Analysis (ITAS) at the Karlsruhe Institute of Technology (KIT) carried out a research project aimed at developing key narratives for the use of microalgae as food in order to close this gap. Key narratives are important tools for the assessment of microalgae food value chains since they mirror public perception and discussion. They form the background against which new technology, developments, and products are assessed and valued. To develop these narratives, a discourse analysis and a public Delphi survey were conducted. In the first round, the attitudes and expectations of consumers regarding microalgae food were investigated and statistically clustered. In the second round, the key narratives developed from the results of the first round were evaluated and rated.
The aim of the workshop is to share knowledge and expectations and to reflect on the current pathways for microalgae food production. We will therefore present and discuss the following four key narratives: (1) microalgae for health and wellness, (2) microalgae for cheap and simple products, (3) microalgae to sustainably feed the world, and (4) microalgae for decentralized, regional supply. Our results show that survey participants want microalgae to contribute to sustainability (3), but rather

expect the food industry to implement the key narratives (1) and (2). Since every narrative strives for specific socio-technological concepts (e.g., large-scale or small plants, integration of waste streams, open ponds or PBRs, mixotrophic cultivation, etc.), the workshop will identify criteria for the realization of these visions based on current knowledge. Beyond that, we want to explore critical research gaps and exaggerated public expectations to give orientation and support for decision makers in industry, science, and politics.

Addressing food as a system: from theory to (urban) practice

Roberta Sonnino, Cardiff University, Research Center for Urban and Regional Food, United Kingdom

In the context of a persistent and evolutionary food crisis, scholars are increasingly calling for a new research and policy agenda that accounts for the wide range of economic, social and environmental dynamics that interact with each other at various scales, making food part of a complex system. To date, however, the debate on food systems has not gone much beyond the abstract level, with very little effort made to test the perceived benefits of a systemic approach to food against the goals and objectives of actors who are attempting to apply it in practice. To begin to address this gap, this presentation will focus on urban food policies, highlighting opportunities for (and barriers to) the implementation of an approach that can really meet the challenges of systemic food change and stimulate sustainable food transformations.

Progress in land system modelling and climate adaptation research

Thilo Streck, University of Hohenheim, Institute of Soil Science and Land Evaluation, Germany

The ongoing anthropogenic emissions of CO2 and other greenhouse gases will provoke a significant change of climate in the next decades. It becomes more and more manifest that the international emission reduction commitments to mitigate global climate change will rather not be successful. Unchecked climate change will have substantial consequences for the structure and functions of agricultural landscapes.
Despite the vast body of literature about the manifold aspects of adaptation, current climate projections and recommendations for adaptation strategies deduced from them fall short in a number of aspects. Issues that are of utmost importance for agricultural systems include the accuracy of crop model simulations and the underlying climate projections as well as the feedbacks between atmosphere and the soil-crop system, between climate and land use and between adaptation and structural change. Yet, there are also very positive developments that can be expected to foster progress. The objective of this presentation is to discuss relevance and implications of the above issues, highlight new developments and outline research strategies which will ultimately lead to better climate projections and more realistic adaptation strategies.

Smart Farming is key to developing sustainable agriculture

Achim Walter, Eidgenössische Technische Hochschule Zürich, Institute for Agricultural Sciences, Switzerland

Agriculture is currently undergoing a fourth revolution triggered by the exponentially increasing use of information and communication technology (ICT) in agriculture. Autonomous, robotic vehicles have been developed for farming purposes such as mechanical weeding, application of fertilizer or harvesting fruits. The development of unmanned aerial vehicles with autonomous flight control, together with the development of lightweight and powerful multispectral cameras that can be used e.g. to calculate biomass development and fertilization status of crops, opens the field for sophisticated farm management advice. Improved, seasonal drought forecasts, index-based insurances and other

measures based on advanced ICT further contribute to a technical revolution that will generate disruptive changes in agricultural practices. This trend holds for farming not only in developed countries but also in developing countries, where deployments in ICT such as the use of mobile phones and access to the Internet are being adopted at a rapid pace. Overall, these improvements have the potential to lead the way into a more climate-smart agriculture. Yet, such profound changes in agricultural practice come not only with opportunities but also with big challenges. It is crucial to point them out at an early stage of this revolution to avoid 'lock-ins': Advocates and skeptics of technology need to engage in an open dialogue on the future development of farming in the digital era. Only if aspects of technology, diversity of crop and livestock systems, and networking and institutions (i.e. markets and policies), are considered jointly in the dialogue, should farming in the digital era be termed 'smart farming'.

Assessing food systems to enable a new dialogue on food system change: The case of the EU food system

Monika Zurek, University of Oxford, Environmental Change Institute, United Kingdom

Food system around the globe are not delivering the outcomes that decision makers as well as consumers expect from them, neither in food security, health, environmental, economic or social terms. The need for food systems' change is widely acknowledged in research and policy circles, but food systems encompass many different actors and activities, each with their own set of driving forces and goals. This needs to be taken into account when discussing and negotiating change in the system. This paper proposes an integrated approach for assessing sustainable food and nutrition security of the EU food system. It lays out the different steps, performance metrics and an visualization tool allowing an integrated perspective on and assessment of possible food system innovations. The approach has two distinct features: It has been designed through extensive stakeholder consultation, and it links the metrics to an advanced ex ante evaluation framework.