Food Systems Research

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UNIVERSITY & RESEARCH

Preface

All over the world, ideally, food systems provide us with sufficient, nutritious and safe food; produced in a environmentally friendly way and against fair prices and wages. It is us, that shape these food systems. We're part of them and rely on them for our daily bread and well-being. This innovation passport of Wageningen University & Research highlights some of our projects through which we research and develop an evidence base for underpinning future pathways, all part of the food system approach. People, public sector and private organisations have to work together to shape successful transitions in our food systems, facing many challenges. We invite you to join us in finding answers that lead to successful food system transitions to reach the Sustainable Development Goals in 2030.

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Nourishing the city in a healthy manner

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City dwellers in Africa and Southeast Asia depend heavily on the countryside for their food. Fast-growing cities, such as Dhaka in Bangladesh, Kampala in Uganda and Nairobi in Kenya, suffer from both malnutrition and obesity. Solutions are needed to provide enough healthy food for the population. The *Feeding Cities and Migration Settlements* project uses the food system approach in the search for this. People who arrive in these cities often end up in "informal settlements" and struggle with a lack of work, opportunities and money. Their living environment is often heavily polluted. And the food they eat often has little nutritional value. Together with local governments, companies, aid organizations and residents, the researchers are exploring which interventions are technically and socio-economically promising.

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Food from the sea

pradeep_kmpk14 / Shutterstock.com

Fresh water is needed for the production of food. That is becoming increasingly scarce. Although saltwater can be a threat to food production in delta and coastal areas, it also offers opportunities. In the *Aquatic food systems* project, Wageningen scientists are investigating the possibilities of sustainable food production at sea. Seaweed is an interesting crop: no scarce agricultural land is needed for its cultivation and it is healthy for humans and animals. The research focuses on Indonesia, where economic and ecological conditions vary greatly, as do local customs. As a result, the effects of local factors on seaweed production can be properly measured. Seaweed is already grown in many locations in Indonesia. The researchers want to know, among other things, whether seaweed production in combination with shrimp catch and fishing has a positive impact on ecosystems.

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Finding solutions for healthy and sustainable food course

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Millions of people in the world are underfed. Even more people eat too much and too unhealthy. In the meantime, the world population will continue to grow to 9.7 billion around 2050. How can we assure in the future be assured of nutrient-rich food as the basis for a healthy life? In the *Food systems for healthier and sustainable diets* course, participants devise solutions for more sustainable production and consumption of food. So that generation after generation of people all over the world will remain assured of high-quality food. The fourth year of the course will start on February 2021. Starting from the latest insights, this course will also reflect on the COVID-19 pandemic and the consequences for the world food system. The course is specifically intended for professionals from low- and middle-income countries and for Wageningen master and PhD students in *Human Nutrition and Health*.

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Healthy future
for the banana

Worldwide banana production is at risk from two devastating fungal diseases: Fusarium wilt (or Panama disease) and Black Sigatoka. This puts food security and the income of millions of people at risk. Wageningen University & Research is working on a healthy future for the banana in various research programs. Wageningen experts follow the banana, the fourth crop in the world, from the soil on which the plant is grown to the processing of the discarded peel. The researchers are not only looking at the availability and threats from pests and diseases, but also at alternative cultivation systems, soil fertility, the impact of pesticides, the effects of climate change and the conditions of farmers and plantation workers. Studying effects in their context provides insight into the main bottlenecks and opportunities.

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Food systems benefit from biodiversity

Wild nature directly contributes to the food supply in many tropical countries. A lot of biodiversity strengthens a food system and makes it less vulnerable to climate change and pests. In the *Food and biodiversity* research program, Wageningen scientists are looking for solutions that are beneficial to biodiversity and at the same time make food systems more resilient. The knowledge generated by the program will enable policymakers to better assess the short- and long-term effects of possible measures. What if a region switches to an organic food system? What will happen to biodiversity in the surrounding nature? What effect does this have on crop resilience, land use and productivity? More insight into the impact of measures makes informed decisions possible.

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Deltas under
pressure

Freshwater availability is rapidly declining in the world, partly due to climate change. Delta areas are particularly vulnerable to this. For example, Bangladesh and the Mekong Delta in Vietnam are struggling with rising sea levels, salinization and subsidence. In addition, both areas often have to deal with floods, alternating with periods of drought. Due to all these factors, agriculture in these areas is no longer self-evident. In the *Deltas under Pressure* project, Wageningen researchers are mapping bottlenecks in both deltas. The challenges vary widely; rice farmers in southern Bangladesh, for example, suffer a lot from salinization, while shrimp fishermen in the same area benefit from it. There is no single super solution for all problems, which is why the researchers are connecting all links in the chain. Objective: to make agriculture in both deltas more resilient to climate change.

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Missing Middle

Sunshine Seeds / Shutterstock.com

In many low- and middle-income countries, there is a gap between agricultural production and responsible food consumption. This *Missing Middle* affects vulnerable groups, such as small farmers and poor consumers in the city, and makes it more difficult to combat hunger (SDG $_2$). Wageningen researchers are studying the causes of this gap with funds from NWO-WOTRO and are developing routes in pilot projects to arrive at effective solutions. In Tanzania they are investigating how improved industrial processing can better integrate maize, soy and chicken chains. Objective: sustainable production and a healthy diet. Vietnam is investigating how supermarkets can promote the sustainable production of safe food by tackling excessive use of fertilizers and pesticides. Various actors are involved in the approach and both policy and business take their responsibility to close the gap.

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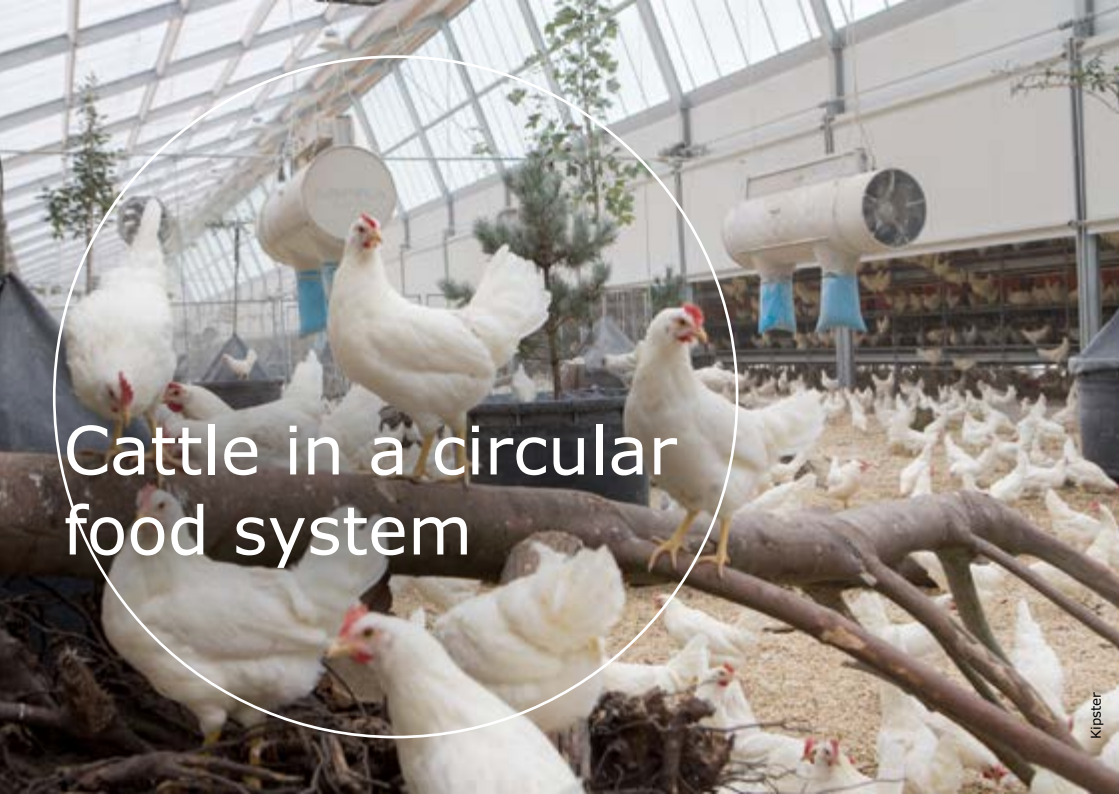
Cattle in a circular food system
Kipster

In order to feed the growing world population in a sustainable manner, we must switch to a circular food system. In such a system, cattle no longer eat grains and other crops that we also eat directly. Instead of grasses, ruminants also convert residual flows from agricultural crops and waste from the food system into valuable food, such as milk, meat and eggs. This concept is already being applied at Kipster. The chickens in these innovative stables are fed 'leftovers', such as rejected rusk or bread dough. How many animals we can feed in the world with only grass and residual flows depends on the quality and availability of residual flows. And this is determined by what we eat. Wageningen scientists are researching this and are thus laying the foundation for the circular food system of the future. A system in which the animal no longer eats whatever humans can eat.

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Zoom in,
zoom out

A food system includes the farmyard, the world food market and all links among these. To control such a system, you need to know the weakest link, especially in extreme events. In addition, ‘adapter plugs’ are required to translate scientific data from one level to another. In the *Multiple scales and extreme events* research program, researchers are working on models to link the individual blocks of knowledge. They are also developing a stress test to predict the response of food systems to extreme events. The researchers hope that this will enable them to look ahead. For example: what additional income will Ethiopia generate if farmers invest in irrigation? What is the effect on the availability of water? And how does this extra production affect the world market? In the event of a trade war, a hurricane or - very recently - a pandemic, this makes it easier to predict the bottleneck in the food system and how it affects the rest of the system.

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Comeback of traditional fermented food

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Just like we have sauerkraut and yogurt, African countries have traditional fermented products. Compared to non-fermented products, they are healthier, tastier and have a longer shelf life. It is almost only women who make these products and sell them on the market for their own use. This way, they make money for their families. Wageningen scientists encourage the development of fermented food. They selected three African countries: Benin, Zambia and Zimbabwe. In each country, they chose one traditional fermented food product: a dairy-based product in Zambia, and a fermented grain product in each of the other two countries. By further developing and making these products more available, they contribute to less hunger and malnutrition. In addition, they strengthen female entrepreneurship - and thus the income position of families. Where possible, the researchers use the results as inspiration for further dissemination in Africa and beyond.

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Routes towards a world without hunger

T.W. van Urk / Shutterstock.com

A sustainable, robust food system is only created if all parties that play a role in the system act together. To support these parties in the transition, a group of Wageningen researchers is developing an approach for so-called transition pathways. These pathways show how the change could be achieved. Joint answers to questions like: “What do they (stakeholders) want to achieve together? How do they want to do that? And who should be involved?” The researchers use expertise, models and tools to map out the effects of these routes. Questions that then arise are: How many people are sure of sufficient and healthy food? How much food is available and is food affordability also changing? What are the socio-economic consequences? And what role does behaviour play? With this expertise within reach, it is easier for stakeholders to identify the choices and actions that should be part of the route ahead.

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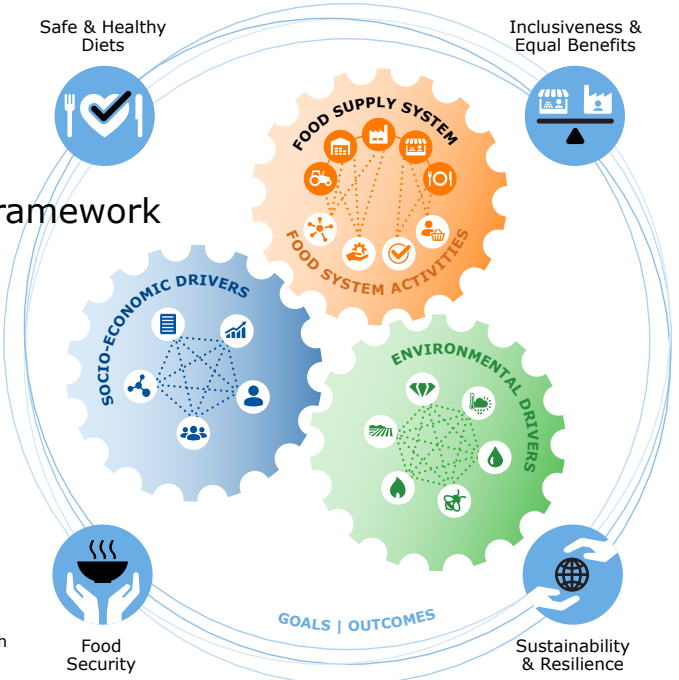
Food systems framework



Van Berkum et al. 2018,
Wageningen University & Research

A food system approach towards a world without hunger

The *food system approach* maps the various elements in a food system and the relationships between them as part of a coherent system of producing, processing, transporting, selling, consuming and disposing of food. To companies, researchers, policy makers, farmers, technology developers, investors and others, it shows the consequences of actions in one part of the system on other aspects in the system. On the one hand, it looks at all activities associated with the production, processing, distribution and use of food. On the other hand, the results of all these activities are studied: what are the consequences for food security and the nutritional value of the daily meal? What do the activities mean for farmers' incomes and for employment? And what is the impact of increased food production on the natural environment and on the emission of greenhouse gases?

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A better future for African smallholders

Pecold / Shutterstock.com

Higher yields, better access to good quality seed material and a healthier diet. These are the results of N_2Africa, a large-scale scientific project to improve food production and soil fertility in eleven sub-Saharan countries. Led by Wageningen University & Research and supported by the Bill & Melinda Gates Foundation, N_2Africa transferred essential knowledge to 660,000 small farmers. They learned how to increase yields and quality of beans, groundnuts, soy and other legumes by stimulating the crop's ability to capture nitrogen from the air in symbiosis with soil bacteria. They discovered which bacteria and seed varieties result in the highest yield and quality in their situation. Lead farmers were trained to transfer knowledge to farmers in remote rural areas. Women learned how to improve their household nutrition through diversified diets. And how to lighten their task in food production with crop protection agents and mechanisation. Through its local partnerships, N_2Africa has strengthened the position of hundreds of thousands of African smallholders and their families.

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Thanks
to nature

How can nature-based solutions help us make food systems more circular and climate-proof? And how exactly do these solutions work? These questions are central to the *Nature-based solutions for climate-resilient and circular food systems* research project. Two types of solutions are being investigated. One type is inspired by nature. For example, microorganisms are used in the Dutch province of Zeeland to make wastewater from agrifood companies suitable for agricultural use. The second type of solutions uses natural processes. In Ghana, water storage is being investigated as a solution to limit the decrease in food production due to drought or floods. The researchers are also looking at underlying principles of nature-based solutions and how they contribute to climate-proof food production. For example, they are studying the principle of "diversity" in the Netherlands through a study on mixed cultivation and in India a study is being conducted into a herb-rich diet for cows. The project also provides tools that enable stakeholders to consider different solutions.

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The Dutch food system in 2050: from more to better

A healthy and circular Dutch food system in 2050. A system which guarantees long-term food security, but within the limits set by our planet. And with an emphasis on natural production of healthy food. Wageningen scientists have developed a vision for this food system of the future, together with representatives of farms, nature and environmental organizations and knowledge institutes. If this vision comes true, we will eat more vegetable and less animal products by 2050. We will hardly waste food anymore. And healthy and sustainable food will be normal, attractive and widely available. Cows then will graze on herb-rich pastures, while pigs, chickens, fish and insects will only eat biomass which humans cannot eat.

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Future scenarios
for rural East Africa

Strong population growth and low agricultural yields. This is briefly the case in rural East Africa. The Arua region is a striking example. In this poor area of Uganda, agriculture is still largely self-sufficient and farmers hardly use improved seeds, fertilizers and plant protection products. Mechanization is also rare. At the same time, there is a strong influx of refugees from South Sudan. In the *Rural Areas in East Africa* project, Wageningen researchers use the food system approach to better understand the system in Arua and two Ethiopian regions. Given the population growth and climate change in the future, can these regions themselves provide a healthy daily meal for all residents? And what are the expected effects of extra or more intensive land use on nature and the environment? The aim of the project is to improve food security in these and other rural areas.

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A third of all food produced will end up as an energy source, as compost or on the landfill. So somewhere in the global food system, we lose and waste huge amounts of usable food. Producing more is not the solution; the prevention of food waste offers opportunities all over the world. This requires a better feedback loop between surpluses and shortages. Food losses and waste are increasing because the current system cannot absorb the surpluses. How can we deal with oversupply and side streams and how do we ensure that unsold products will find their way to local markets? Research by Wageningen experts shows that this is possible, provided that national governments, local authorities, cooperatives of farmers, customers and other chain parties are able to find each other and start cooperating. The key to less food waste is in their hands.

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A healthier diet
for everyone

Hundreds of millions in low- and middle-income countries are underfed as a result of faltering food systems. Together with CGIAR, the worldwide network for agricultural innovation, Wageningen scientists are mapping the largest bottlenecks. This is done in the research program *Food Systems 4 Healthier Diets*. The researchers dived deeply into the food systems of Ethiopia, Nigeria, Vietnam and Bangladesh and identified barriers. Robust experiments are carried out to make healthy food available, accessible and affordable for everyone. A trial with veggie bikes to deliver vegetables chilled to people's homes `was a great success in the metropolis of Lagos and is being followed elsewhere. Street food vendors are encouraged to sell larger portions of vegetables or salads as a side dish. And in Ethiopia an experiment with video interventions is underway to boost the intake of fruit and vegetables. Many master students from these countries and from the Netherlands work together on their theses in this project.

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A system approach to tackle poverty among farmers

Roger Reuver

A reasonable income for all farmers in developing countries. If we continue with 'business as usual' this will remain a utopia. Instead, we should approach poverty at the system level, say Wageningen researchers. Together with Mars Incorporated, they are investigating opportunities to improve the income position of small farmers. They rule out one-sided interventions: multiple solutions and a fundamentally different way of distributing both yields and risks in the food system are needed. Farmers should also have easier access to resources such as fertilizers, permitted plant protection products and funding. And it makes sense if farmers are helped to diversify, so that they are less vulnerable if the harvest of a crop is disappointing. The research serves as a springboard to permanently improve the position of farmers.

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Working together with Ugandan citizens on ideas for healthier food

Thipwan / Shutterstock.com

Selling vegetables by bicycle, which would allow vendors to move around the city a lot more quickly. Growing more fruit and vegetables in the city. These are just two of the ideas the residents of the Kanyanya area suggested for improving their access to healthy food. These ideas emerged during workshops that were organised by researchers from Wageningen Economic Research. The research study highlights Kampala's food system as seen through the eyes of the consumer, which offers a broader view of the problem and provides innovative solutions. These are accepted solutions that have such a good chance of succeeding that it is clearly worth taking the time to try them out in practice.

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Bridging gaps

In the EU and South East Asia, the differences between potential and actual farmers' yields are small. In sub-Saharan Africa and Eastern Europe, this yield gap is still wide. Wageningen research groups, together with international partners, are estimating the yield gaps for all key food crops in all food producing countries. What is the growth potential of maize in Ethiopia en Iran? What are actual farmers' yields in the same locations? Why is the yield lower than possible - and what is the role of water and crop nutrients? And how can the anticipated future food demand be met in an area while respecting ecological boundaries? The researchers map out all this information in a Global Yield Gap Atlas. This forms the basis for well-considered solutions, taking into account technological possibilities, ecological and socio-economic factors. In Africa, for example, there are opportunities for sustainable intensification, adapted to local conditions. While in the Netherlands, careful and circular use of inputs such as crop nutrients is paramount. The widely consulted Atlas is including 65 countries and is continuously adding new countries and crops.

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The Himalayas
are melting

900 million people live in the Ganges, Indus and Brahmaputra basin. The ice supply that flows into the river basins from the Himalayas in the summer as melt water will normally increase in the winter season. This balance is disrupted by climate change. At least a third of all Himalayan glaciers are likely to have disappeared by the end of this century. Wageningen experts have calculated how much melt water farmers use and what the effects will be on the harvest if this water is no longer available. The study makes clear that rice and cotton farmers in particular should start using other water sources, such as groundwater. But the availability of those other sources is also changing. For example, the monsoon rains will show a different pattern and the groundwater level will soon drop. At the same time, population growth will continue. Farmers will have to adapt to these changing circumstances. The experts help them by converting scientific knowledge into promising innovations in the field.

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Dashboard for a forward-looking European food system

Europeans eat too much and too unhealthily, and food isn't produced in a sustainable manner, according to the comprehensive EU research project SUSFANS. The research project resulted in a dashboard for a forward-looking food system. The dashboard is based on an innovative analytical model that for the first time has brought together EU-wide data related to health, the environment, equity and economics. This data has revealed possible future scenarios, which policymakers can use to steer their food policy. The expertise generated by SUSFANS is informing policies within the EU's 'Farm to fork' food strategy. Follow-up research will see SUSFANS being put into practice to support municipal food policies and innovation strategies for food processing companies.

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Keeping food systems robust: tackling COVID-19 implications

Michele Cattani

Wageningen researchers coordinate a Knowledge Community of Practice that runs a unique series of rapid COVID 19 assessments. These assessments show the national and local impacts of the COVID-19 crisis on food systems in low and middle income countries. Key impacts are identified and prioritised in extensive collaboration with governments, NGOs, SMEs and other relevant actors. They formulate interventions to limit the devastating effects on food security and actions that can be readily taken up. COVID-19 measures, for instance, hinder the mobility of seasonal laborers, have brought the income of women to a standstill. Furthermore, they hamper agricultural trade and critical input supplies such as seed and fertilisers. This has an enormous effect on current crop productivity and can threaten future production seasons. The assessments increase our understanding of vulnerabilities. Moreover, they help develop insights to build food systems that are more resilient to shocks such as pandemics, climate change and locust plagues.

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More information

www.wur.eu/foodsystemsapproach

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