Multidisciplinary Program on Sustainable Food and Biomass Systems

1. Background

The world faces the enormous challenge of supplying food and biomass in a sustainable manner and under the escalating pressures of climate change, environmental degradation and population dynamics[1]. Ensuring an adequate and sustainable food supply and biomass production requires a transformative adaptation of production, distribution and consumption, involving unprecedented levels of innovation.

With this perspective in mind, there is a growing number of national, regional and global initiatives aimed at developing integrated strategies on sustainable food and biomass systems. On the EU-level these include strategies such as the "European Green Deal" and the "Farm to Fork Strategy"[2].

In addition, the Corona pandemic is a stern reminder that the world needs to be better prepared for next pandemics of human, animal and plant diseases as well as other disasters[3] that can disrupt food supplies. Part of that preparedness will be to strengthen local food security[4].

2. The VUB Multidisciplinary Program on Sustainable Food and Biomass Systems

What is of key importance in the effective implementation of these strategies for sustainable food and biomass systems is that the approaches are multidisciplinary and integrated, based on evidence and impact assessment, and developed in a transparent and inclusive manner.

In this context, the Vrije Universiteit Brussel (VUB) is establishing a support program for multi-disciplinary and integrative projects on sustainable food and biomass systems.

The program will support the development and implementation of collaborative, multi-disciplinary research and education projects on food and biomass systems that are aimed to contributing to Sustainable Development Goals (SDGs)[5]. Sustainability under this program is understood to have environmental, human health, economic, and social aspects.

While the projects supported by the program can very vary in nature, they are envisaged to have several common characteristics, such as:

a. *Multi-disciplinary, interdisciplinary, integrative and evidence based*, i.e. drawing upon all relevant disciplines such as life sciences, engineering and process-technology, law, economics, public policy, spatial planning, history, and ethics;
b. *Collaborative*, i.e. developed and conducted in collaboration with universities and institutes in the EU and beyond, where possible in communication with other relevant organisations;

[1] See for example the FAO Annual State of Food and Agriculture 2019, the 2019 report of the Intergovernmental Panel on Climate Change, the 2019 report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, the 2019 report of the World Meteorological Organisation, and the 2019 report of the Global Commission on Adaptation
[2] See also various earlier initiatives of the Science and Technology Options Assessment Panel (STOA) of the European Parliament, such as "Options for feeding 10 billion people" and "Precision Agriculture and the future of farming in Europe".
[3] See for example the Global Report on Food Crises 2020 and various FAO statements
[4] Food security is one of the EU Treaty's objectives. See also the Global Food Security Index.
[5] See also for example also the FAO Strategic Objectives.

c. *Results-oriented,* i.e. providing decisionmakers and other stakeholders with tools (e.g. sustainability indicators for biodiversity, energy use, greenhouse gas emissions) to make informed decisions, including decisions that involve 'trade offs' between various aspects of sustainability.
d. *Broadly applicable:* i.e. the projects serve a broad audience, including researchers, students, EU institutions, EU Member States, private sector actors such as farmers, and the general public.

The VUB Multidisciplinary Program on Sustainable Food and Biomass System will support the development and implementation of the described multi-disciplinary projects by, among other things:

1. Bringing together a consortium of research groups in universities and institutes interested in collaborating in multi-disciplinary, integrative research and education projects pertaining to sustainable food and biomass systems. (See Annex I).
2. Sharing with the consortium members suggested aspects and topics for inclusion in the projects. (See Annex II).
3. Sharing with the consortium members suggested multi-disciplinary projects. (See Annex III).
4. Conducting outreach activities such as debate events and sharing with the consortium members suggested topics for outreach events. (See Annex IV).
5. Establishing partnerships with relevant organisations on national-, EU- and international level, to facilitate exchange of information between those organisations and the projects.
6. Keeping the consortium members updated on relevant scientific and policy developments.
7. Assisting with the identification of and application for funding through specialised VUB offices.

3. Timeline and planning.

The VUB Multidisciplinary Program on Sustainable Food and Biomass System is intended to be operational on 1 January 2021.

In the period up to 31 December 2020, preparatory activities will be conducted under the auspices of the VUB Vice Rector for Research Policy, including:

- Updating and fine tuning of the program[6].
- Establishing collaboration with (research) groups in universities and research institutes.
- Establishing partnerships with other organisations.
- Establishing collaboration with VUB offices specialised in identifying and requesting funding.
- Conducting outreach activities, such as debate events
- Preparing at least two proposals for pilot projects for submission late 2020 or early 2021.

Feedback, indications of interest in participation and suggestions for topics to be included in multi-disciplinary projects and in outreach events can be sent to: Prof. Piet van der Meer, Office of the Vice-rector for Research Policy, Vrije Universiteit Brussel (VUB), Pleinlaan 2, B-1050 Brussels, Belgium, pieter.jan.van.der.meer@vub.be.

[6] Updates will be published on https://www.vub.be/en/research#excellence

Annex I: Research groups interested in collaborating in multi-disciplinary, integrative research and education projects pertaining to sustainable food and biomass systems

	Research group, faculty, university/research institute	Specific interests and expertise	Contact
	BELGIUM		
1.	**Laboratory of Plant Genetics** Faculty of Sciences and Bioengineering Sciences, VUB, Belgium.	Basic research on plant molecular genetics as well as applied research relevant to plant biotechnology and the agricultural sector.	Prof. Geert Angenon Geert.Angenon@vub.be
2.	**Brussels Human Robotics Research Center,** VUB, Belgium.	Interdisciplinary research to improve the quality of life and working conditions of people through Human Robotics.	Dr. Lennert.Vierendeels Lennert.Vierendeels@vub.be
3.	**Centre for Private and Economic Law,** Law Faculty, VUB, Belgium.	A teaching centre that focuses on economic and financial law from a comparative, European and international perspective.	Prof. Kim Van der Borght Kim.Van.der.Borght@vub.ac.be
4.	**Social and Cultural Food Studies** (FOST), Department of History VUB, Belgium.	FOST is an a multi-disciplinary, integrative research group with members from different research groups within and beyond the VUB, including agricultural historians, archaeo-botanists, ethnobotanists, food historians, archaeologists, bioengineers, and stable-isotope specialists.	Dr. ir. Frits Heinrich Friedrich.Heinrich@vub.be
5.	**MOBI research group,** VUB, Belgium	Circular food supply chains.	Dr. Philippe Lebeau Philippe.lebeau@vub.be
6.		Sustainability evaluation of bio-based products	Dr. Giuseppe Cardellini giuseppe.cardellini@vub.be
7.		Socio-economic impact assessment of sustainable distribution concepts for locally produced food	Dr. Sara Verlinde Sara.verlinde@vub.be

	Research group, faculty, university/research institute	Specific interests and expertise	Contact
8.	**Department of Hydrology and Hydraulic Engineering** (IR-HYDR), VUB, Belgium	Water for food, groundwater, surface water, water quality, climate and water, water management	Prof. Marijke Huysmans marijke.huysmans@vub.be
9.	**Department of Business – Marketing & Consumer Behavior**, Faculty of Social Sciences and Solvay Business School, VUB, Belgium.	Food consumption, marketing and retailing	Prof. dr. Malaika Brengman malaika.brengman@vub.be
10.	Research Group of Microbiology Faculty of Sciences and Bioengineering Sciences CUB, Belgium		
11.	**Laboratory of Applied Molecular Genetics** Department of Biotechnology, Faculty of Bioscience Engineering, Ghent University, Belgium	Basic and applied research in plant-pathogen interactions, including plant biotechnology, its applications and societal discussions.	Prof. Lieve Gheysen godelieve.gheysen@ugent.be
12.	**Department of European, Public and International Law**, Faculty of Law, Ghent University, Belgium	Nature conservation (species protection and protected areas), ecological restoration Link between climate change and biodiversity (nature based solutions), Protection of urban biodiversity, Human health and nature conservation and restoration	Prof. An Cliquet An.Cliquet@ugent.be
13.	**Laboratory of Biochemistry and Glycobiology,** Department of Biotechnology, Faculty of Bioscience Engineering, Ghent University, Belgium	Research on plant proteins and biological activities. Focus on protein-carbohydrate and protein-RNA interactions in plant signalling, development, stress responses.	Prof. Els Van Damme Elsjm.vandamme@ugent.be

	Research group, faculty, university/research institute	Specific interests and expertise	Contact
14.	Center for Microbial Ecology and Technology, Department of Biotechnology, Faculty of Bioscience Engineering, Ghent University, Belgium	Carbon capture and utilization, protein transition, new production pathways transcending ETS	Korneel Rabaey Korneel.rabaey@ugent.be
15.	**Centre for Synthetic Biology** Faculty of Bioscience Engineering, Ghent University, Belgium	Molecular optimization of microbes and enzymes for the conversion of plant biomass into new products (including alternative sugars for food).	Prof. Marjan De Mey (marjan.demey@ugent.be)
16.			

Updates of this concept-note and this annex will regularly be placed on:
https://www.vub.be/en/research#excellence

Annex II: Suggested topics for multi-disciplinary research and education projects

Interactions with universities, research institutes and other organisations have shown great interest in collaborative research and education projects on sustainable food and biomass systems, whereby many suggestions have been made for general aspects (section a.) and specific topics (section b.) to be addressed in such projects.

At this stage, this Annex II simply lists the suggestions made. This annex nor its groupings are intended to be exhaustive, but rather aim to be a source of inspiration.

a. Suggested general/cross cutting aspects for multi-disciplinary research and education projects:

- Sustainable Development Goals relevant to food and biomass systems;
- climate change adaptation;
- scientific and technological developments[7];
- traditional/ethnographic knowledge and practices;
- responsible innovation,
- governance and regulation;
- environmental impact assessment; food/feed safety assessment;
- socio-economic impact assessments;
- farmers' rights,
- Access and Benefit Sharing,
- plant breeding and pre-breeding
- plant gene editing
- plant genomics
- plant phenomics
- Rural development, young farmers, farm income development
- variety registration;
- waste reduction,
- circular economy
- foodborne anti-microbial resistance;
- Long term trends/historical developments in the production and consumption of food
- Long term trends in crop (micro)nutrient content
- Long term developments in crop and crop disease genetics
- Irrigation, sustainable/efficient water use and soil salinity
- Fertilization and biofortification strategies in areas with different problems (e.g. efficient N use/reducing N pollution / providing sustainable fertilization options to farmers in developing countries).
- Transport of food, logistics and food supply
- Circular economies and secondary products ('waste' does not exist)
- Trends in historical and modern malnutrition/overnutrition

[7] E.g.: FAO 2016: The role of agricultural biotechnologies in sustainable food systems and nutrition.

- Food and (unequal) trade relations / import/export restrictions
- Production quota, subsidies, and economic efficiency
- Soil erosion / deforestation and food production
- Desertification and food production
- (re)distribution of food; social justice/programs, political economy, international food aid
- Bad harvests, food shortages, food chain disruptions (war), famines.
- Urban-rural relationships
- long term trends in food prices
- long term trends in food production and population dynamics (cf. Malthusian vs Boserupian models).
- long term trends in crop improvements and animal breeding
- path dependent food preferences
- the study of historical texts incl. agricultural manuals and cooking books with the aim of looking at modern applications.
- food and taboo
- food and social status / luxury foodstuff consumption
- food processing techniques
- food preparation (cooking) techniques (incl. efficient fuel use)
- communication,
- public awareness and involvement,
- ethical considerations;
- developing country perspectives[8],
- multi-disciplinary study-design,
- World Population Prospects[9],
- UN resolutions[10],
- Labelling
- Global assessment on soil biodiversity,
- pollinators,
- multi-disciplinary PhD research design
- mobilizing knowledge
- avoid the externalisation and export of unsustainable practices (F2F)
- If European diets were in line with dietary recommendations, the environmental footprint of food systems would be significantly reduced (F2F)
- make the best use of nature-based, technological, digital, and space-based solutions (f2F)
- The circular bio-based economy is still a largely untapped potential for farmers (F2F)
- Sustainable food systems also rely on seed security and diversity (F2F)
- Research and innovation (R&I) are key drivers in accelerating the transition to sustainable, healthy and inclusive food systems from primary production to consumption. (2F)

[8] E.g.: FAIO 2010: "Agricultural biotechnologies in developing countries: Options and opportunities in crops, forestry, livestock, fisheries and agro-industry to face the challenges of food insecurity and climate change",
[9] World Population Prospects
[10] at https://www.un.org/en/ga/second/74/documentslist.shtml, https://www.un.org/en/ga/74/resolutions.shtml.

b. Suggested specific topics for multi-disciplinary research and education projects:

In the overview below the suggested specific topics have - for now - been grouped along the main components of food and biomass systems: 1) Production, 2) Distribution, 3) Consumption, 4) Post consumption.

Target	Topic	Related topics
1. Production		
a) Strengthening current systems		
	i) Strengthening farming practices	
	• Agro-ecology[11]	FAO: 10 elements of Agro-ecology: Diversity, Co-creation and sharing of knowledge, Synergies, Efficiency, Recycling, Resilience, Human and social values, Culture and food traditions, Responsible governance, Circular and solidarity economy
		Tool for agroecology performance evaluation
		Scaling Up Agroecology Initiative: transforming food and agricultural systems in support of the SDGs.
	• Digitalisation,	○ The International Digital Council for Food and Agriculture, ○ 'Big data',
	• Precision farming,	
	• Agro-forestry	
	• Aqua-culture	Global Plan of Action on Aquatic Genetic Resources
	• Robotics in food production	
	• Phototonics in food production	
	ii) Improving seed and planting material	
	• Enhancing agronomic characteristics	e.g. biotic resistances (pests, diseases), abiotic tolerances (drought-, flooding tolerance),

[11] Agroecology Knowledge Hub: http://www.fao.org/agroecology/home/en/, http://www.fao.org/3/i9037en/I9037EN.pdf

	• Enhancing food quality	e.g. enhancing nutritional value, removing unwanted characteristics such as allergens and gluten, prolonging shelf life, removing characteristics such as long cooking time
		HLPE Report 14: Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition
		EU Biodiversity Strategy for 2030
		HLPE Report 12: Nutrition and food systems
	○ Enhancing processing and biofuel characteristics	
	iii) Improving food-processing	
		Innovations in drying, salting and smoking of food
b) Alternatives for current systems		
	i) Agriculture on marginal soils	E.g. saline soils.
	ii) Urban and peri-urban agriculture	
		Facilitating local production and consumption of food in the Brussels-Capital Region, Belgium
		Strengthening city-region food systems during and beyond COVID-19
		City Region Food Systems: Building sustainable and resilient city regions
		Food beyond the City - Analysing Foodsheds and Self-sufficiency for Different Food System Scenarios in European Metropolitan Regions
		Urban agriculture in Europe / EPRS
		Urban food systems and COVID-19. FAO
		Indoor-Vertical farming E.g. growing plants and/or fish in facilities with residual heating
	iii) Aquaculture	F2F: Farmed fish and seafood generate a lower carbon footprint than animal production on land.

	iii) Fermentation processes	○ Precision fermentation ○ Protein production with bacteria ○ Farm to Fork: For example, advanced bio-refineries that produce bio-fertilisers, protein feed, bioenergy, and bio-chemicals offer opportunities for the transition to a climate-neutral European economy
2. Distribution		
a) Strengthening current systems		
	i) Short supply chains / improved distribution logistics	Measuring the Economic, environmental, and Social Sustainability of Short Food Supply Chains.
		Innovative Short Food Supply Chain management
		SKIN - Short supply chain knowledge and innovation network.
		SMARTCHAIN - Towards Innovation - driven and smart solutions in short food supply chains
		Practice abstract 15 - Foodhub.hu - Local ingredient directly from farm to fork
		Smart logistics to connect producers and consumers
b) Alternatives for current systems		
	• weekly markets, local retailers, web services	
	• reverse logistics – see below.	
3. Consumption		
	i) Reducing over-consumption	Growing trends of obesity
	ii) Reduce meat consumption; alternative sources of food	e.g. insects, weeds, and fish that are discarded during commercial fishing
	Iii) Change purchase behaviour of consumers	Origin of the goods, Transport modes used in the supply chain, purchase behaviour of consumers. How sustainable are the logistics and the purchase behaviour of consumers?

4. Post consumption		
	i) Reducing food waste	
		EU Platform on Food Losses and Food Waste
		e.g. initiatives as 'Too good to go'
	ii) Waste treatment	
	• Reverse logistics - Waste collection channels and valorization of food that does not reach the consumers. If these flows are well collected, we can better catch the remaining value of these flows, e.g. food banks and companies that can use specific food waste to produce other products (ex: http://www.flanderstoday.eu/innovation/brussels-entrepreneurs-grow-mushrooms-coffee-grounds	What are the different food sources of waste? What are the different existing waste food channels? What are possible alternative channels to valorise better waste food?

Annex III – Proposed multidisciplinary (pilot) projects

Title	Outline	Contributing Disciplines
1. Training network for the development of multidisciplinary, integrative PhD projects in Life Sciences	The proposed project aims at establishing a training program and network that assists prospective PhD students in Life Sciences by including a 'broader perspective' to the scientific topic, elaborating on questions of the future application of the result of their research, including aspects such as: contribution to the SDGs, safety/regulatory, economic/marketing, patenting/ABS, social acceptability, and communicating the research to stakeholders and society . The project aims to obtain for the period 2021-2025 funding for 10-20 PhD students.	- Life Sciences - Public Law/ Regulatory - Law/ IPR, ABS - Economics - Sociology - Communication, - Food and agricultural history -Archaeobotany
2. Crop improvement database	The proposed project aims to develop a database to assist national agricultural research strategies. Starting point is the identification of challenges in the agricultural production of crop plants, whereby per country the following information is collected: - Key crops in the country - Main challenges in the production of those crops (e.g.: diseases, pest, drought). - Current approaches to address these challenges (e.g. irrigation, crop rotation, pesticides) and their impacts - Ongoing and/or planned research on crop improvement, including conventional breeding, and modern biotechnological methods. (The approach is solution-oriented and does not focus on any particular technology). The information is collected with the participation of relevant stakeholders in the country, including farmers and farmer organisations, extension services, policy and decision-makers, non-governmental organisations, private sector actors. The aim is to share the collected information with the international agricultural research community through a web-based database	- Agronomy - Environmental toxicology - consumer preferences - plant breeding - Life Sciences - Archaeobotany and food and agricultural history
3. LCA based study on sustainable food.	Combine the impact of food production, distribution and recovery and compare that for various circular and local scenarios with more traditional food supply chains.	
4. Circular Hackathon	An education project to develop business cases that can capture value from food waste streams.	Teams should be as multi-disciplinary as possible.

Annex IV - Suggested topics for debate events.

The impact of food and biomass systems on the developments of pandemics	Many human infectious diseases are zoonotic (i.e. came from animals), and that practices such as 'wet markets', deforestation, irrigation dams, and intensive animal husbandry can result in an increase of such so called zoonotic diseases. As prevention is more effective and cheaper, As the Executive Secretary of the Convention on Biological Diversity stated at the occasion of World Health Day: "The lessons learned from COVID 19 and other epidemics tell us that we need to fundamentally transform our collective relationship with the natural world to prevent, insofar as possible, future pandemic outbreaks". The proposed debate event will discuss that this multifaceted challenge requires a multidisciplinary approach. For example, live animal markets are an important risk factor for disease spread. Measures taken by countries to reduce the number of live animals in food markets have the potential to significantly reduce the risk of future disease outbreaks. However, these markets also sustain the livelihoods of millions of people and many others rely on wild meat as a critical source of food security and nutrition, including in low-income rural areas.
The impacts of food processing on SDGs.	Food processing has been considered both as an important factor in contributing to sustainable food systems (e.g. by extending the 'shelf life' of products), and as a cause of health impacts. The proposed debate event will discuss the potential health, environmental, economic and food security impacts of various forms of food processing.
Protein deficiency	The EU has had a protein deficiency for decades, for which it needs to import large amounts of proteins (e.g. soy) from outside the EU. Over the years there have been attempts to find alternative protein sources (e.g. growing lupines, process technology using micro-organisms). The proposed debate will discuss the various proposed alternative from various perspectives, such as self-sufficiency, agronomic, environmental and political impacts.
Effect of changes in agricultural practices on nutritional profiles.	Changes in agricultural practices and alterations to our crops from the early 20th century onwards have also profoundly changed the nutritional profiles of our food (as analyses of herbarium and archaeological specimens in one of the FOST projects indicates) – this longer term trend should be included in the debate.
Business cases that can promote health through novel foods, food additives or food supplements.	