Bioeconomy, food and nutrition security

Chapter 1

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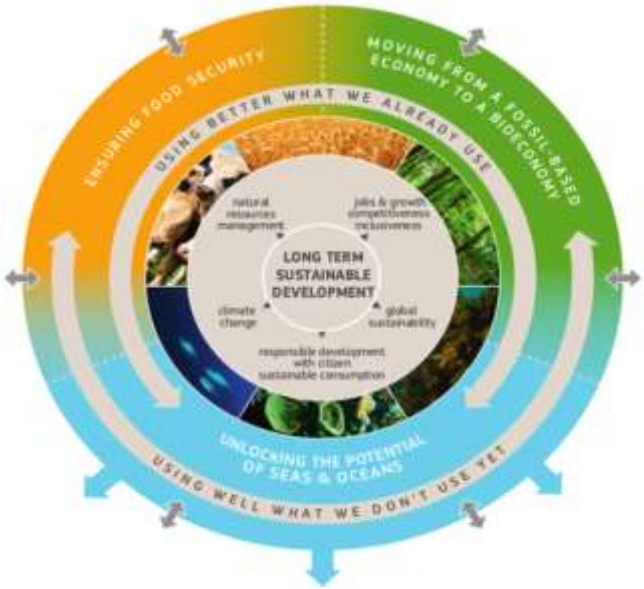
The title of the 30th EURAGRI conference in Tartu – "Bioeconomy challenges and implementation: the European research organisations' perspective" – refers to issues that are timely and important. We are surrounded by global challenges in a world where "volatility, uncertainty, complexity and ambiguity" (VUCA)[1] are the new normal. Developing a successful bioeconomy is now crucial for addressing many of these challenges, and research organisations have a critical role to play in this endeavour.

This text deals with the bioeconomy and research and innovation for food and nutrition security, two concepts that are very closely linked. Ensuring food and nutrition security is an important – perhaps the most important – pillar of the bioeconomy. The other two pillars are transitioning from a fossil fuel-based economy to a bioeconomy and unlocking the potential of the sea and oceans. Including marine-based ecosystems in the bioeconomy is fundamental for its lasting success. These three entry points are interlinked by circular uses, such as through waste streams. The bioeconomy cannot be driven by newly produced biomass and primary products alone.



EU context

In July 2014 Jean-Claude Juncker outlined ten priorities[2] in which he wanted the EU to make a difference and deliver concrete results for citizens. Since 2015, the Commission work programmes have been based on these guidelines and on putting these priorities into practice. Our activities concerning the agrifood sector and the bioeconomy at large relate directly to three out of these ten priorities:

- A new boost for jobs, growth and investment

[1] https://en.wikipedia.org/wiki/Volatility,_uncertainty,_complexity_and_ambiguity
[2] https://ec.europa.eu/priorities/index_en

- A resilient Energy Union with a forward-looking climate change policy
- A deeper and fairer internal market with a strengthened industrial base

In his 2016 speech on the state of the Union, Juncker very much emphasised solidarity as the glue that holds the Union together. Solidarity is also a vital prerequisite to transform our societies so that they become sustainable in the long-term.

Global context

The 17 Sustainable Development Goals (SDGs), adopted in 2015[3], are a call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. The SDGs provide a common vision and agenda to tackle some of the pressing challenges the world is facing such as poverty, climate change and conflict. Nine of them are directly linked and all of the remaining goals are at least indirectly relevant to food and the bioeconomy.

The planetary boundaries concept, first published in 2009 and updated in 2012[4], identifies nine global concerns relating to human-induced changes to the environment. These nine processes and systems regulate the stability and resilience of the earth system – the interactions of land, ocean, atmosphere and life that together provide conditions upon which our societies depend. The four boundaries which are currently crossed or close to being crossed soon – climate change, loss of biosphere integrity, land system change, altered biogeochemical cycles – all relate to the bioeconomy and food and nutrition security.

Marine pollution has increased exponentially over the last decades and is a major challenge, jeopardising the health and livelihoods of many across the global.

If left unchecked, climate change consequences will impact food security first, and time for action is diminishing every day. Decarbonisation of global activities is imperative to keep global warming within manageable limits.

Bioeconomy strategy

The deep decarbonisation foreseen in the Paris agreement following COP21[5] is impossible without the bioeconomy. Sustainably produced biomass and waste needs to replace fossil resources for a portion of energy and fuel needs, as well as chemicals and materials (plastics, construction, etc.). But this must be done within the planetary boundaries without compromising food security. Biomass production (agriculture) is a major source of greenhouse gas (GHG) emissions (to a large extent linked to meat and animal products, and also fertiliser production). But biomass is also a possible sink of CO_2 (forestry, soils, carbon capture and usage). Major innovations are needed to address deep decarbonisation in the bioeconomy.

The bioeconomy can help tackle the unprecedented societal challenges we face, in:

- Sustainably delivering and recycling an increasing amount of biomass to feed a growing world population and substituting chemicals, plastics and fuels for a post-petroleum, low-carbon economy
- Maintaining biodiversity and soil fertility and exploiting new biomass sources, especially

[3] https://sustainabledevelopment.un.org/post2015/transformingourworld
[4] "Planetary boundaries: Guiding human development on a changing planet", Science 13 Feb 2015, http://science.sciencemag.org/content/347/6223/1259855
[5] http://unfccc.int/paris_agreement/items/9485.php

aquatic sources and waste streams

- Producing foods that neither harm our health nor that of our planet
- Meeting the CO_2 emission reduction targets set by COP21
- Boosting industrial competitiveness and maintaining jobs in rural and coastal economies

The current EU Bioeconomy Strategy[6] was adopted by the European Commission in 2012. The strategy includes a bioeconomy action plan with three different pillars, and each of the pillars has a variety of actions linked to it.

Table 1.1.

Investment in research and innovation	Policy interaction and stakeholder engagement	Enhancement of markets and competitiveness
Horizon 2020, €3.8 bn research and innovation investment in Societal Challenge 2 (SC2) Increase multidisciplinary and cross-sectoral R&I Smart Specialisation European Fund for Strategic Investments (EFSI)	Bioeconomy Panel Bioeconomy observatory EU policy coherence Development of regional and national bioeconomy strategies International cooperation	Sustainable intensification of primary production Expansion of new markets Increase EU competitiveness Bio-Based Industries Joint Undertaking €3.5 bn investment through public-private partnership in biobased industries (of which €1 bn from Horizon 2020)

The EU Bioeconomy Strategy and action plan aim to "pave the way to a more innovative, resource efficient and competitive society that reconciles food security with the sustainable use of renewable resources for industrial purposes, while ensuring environmental protection."

The bioeconomy and the circular economy are closely linked, and in fact, some people refer to the bio-circular economy. At the conceptual level, much work still needs to be done to define, develop and optimise the many interfaces between the bioeconomy and the circular economy. The EU Bioeconomy Strategy is highly relevant to the development of the circular economy. The European Commission's Circular Economy Package[7] includes chapters on "biomass and biobased products" and on "food waste". It includes the "assessment of the contribution of the 2012 Bioeconomy Strategy to the circular economy" and updates to the strategy if so required. It mentions as one possible means the proposal to make the separate collection of biowaste mandatory under certain conditions, and to ban the landfilling of separately collected waste. Other bioeconomy-related aspects outlined as relevant to the circular economy are sustainable production, biodegradability, use of biowaste, and new circular value chains, among others.

In addition to the EU Bioeconomy Strategy, there are also a growing number of EU member states and regions with their own bioeconomy strategies and action plans adapted to their respective needs, skills and opportunities, thus supporting local businesses, resources and employment. These strategies share the vision of the bioeconomy as a non-fossil, post-petroleum economy based on sustainable development that will generate new growth and enhance the well-being of the respective societies. The necessary innovations underpinning this development depend on being located in, based on or adapted to particular places and conditions. They benefit the people who live and work

[6] "Innovating for Sustainable Growth: A Bioeconomy for Europe", Brussels, 13.2.2012 COM(2012) 60 final, http://ec.europa.eu/research/bioeconomy/pdf/official-strategy_en.pdf

[7] Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions. "Closing the loop - An EU action plan for the Circular Economy", COM/2015/0614 final, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52015DC0614

in the corresponding areas.

The aim of the 4th Bioeconomy Stakeholders' Conference[8] in Utrecht on 12–13 April 2016 was to foster stakeholder engagement and buy-in. It resulted in a concept for a Bioeconomy Stakeholders' Manifesto[9] that lists key challenges and opportunities, guiding principles and actions. The actions focus primarily on contributions stakeholders can make themselves. The renewed Bioeconomy Stakeholders' Panel has taken this into account. The new panel aims to support interactions between different policy areas, sectors and stakeholders in the bioeconomy, thereby leading to tangible policy actions.

This underlines that we need a holistic and systemic approach that brings together all these policy angles (agriculture and rural development, energy, environment, climate, competitiveness, health, etc.). This is why a bioeconomy strategy is so important. We need political mobilisation now to create a renewed, ambitious European bioeconomy strategy by 2018/19, following the review of the current strategy that we are carrying out in 2016/17.

Food and nutrition systems

Food and nutrition systems are at a turning point worldwide. With COP21 agreements and nine SDGs referring directly to food systems, food and nutrition security (FNS) is becoming a key concern for science, technology, policy and society. There is no security without food security, and no food security without nutrition security. Food and nutrition are not only at the heart of Europe's economy, they are also very much at the heart of the bioeconomy. Agriculture, food, fisheries and aquaculture represent 75% of Europe's bioeconomy turnover (2013). These sectors employ one-fifth of the EU workforce, and represent 6% of Europe's GDP.

Meanwhile, food and nutrition systems globally are facing a 'perfect storm':

- By 2050, nine to ten billion people will have to be fed, and it has been estimated that food production must increase by 60%.
- Today, there are more obese than undernourished people and yet 33% of food produced is wasted.
- Food systems in overall terms use 70% of freshwater resources, 30% of energy and produce 25% of GHG emissions worldwide.

It is therefore crucial that we design food and nutrition systems that can endure. Both are equally important and must be dealt with together in a holistic approach. Research and innovation (R&I) must play a more central role to develop sustainable systemic responses that transform and future-proof our food and nutrition systems.[10] For the EU, world class research matters. R&I stakeholders need to raise their ambitions, align their focus, connect across disciplines, restructure and scale up to have a stronger impact in tackling our global societal challenges. We need to work in new ways with public and private organisations, and engage new actors and citizens. Most importantly, given the nature, urgency and scale of the challenges for sustainable food and nutrition security, R&I stakeholders must adopt a 'food systems approach' that includes all the elements across our entire food system, from inputs to primary production (agriculture, aquaculture and fisheries), harvesting, storage, processing, packaging, distribution, waste streams and consumer intake. It must be an

[8] http://www.bioeconomyutrecht2016.eu/

[9] https://lumencms.blob.core.windows.net/site/30/Manifest.pdf

[10] See Nature, "A new global research agenda for food", suggesting shifting focus from feeding to nourishing the world, http://www.nature.com/news/a-new-global-research-agenda-for-food-1.21052

approach that connects land and sea, and incorporates the microbial economy.

Within the broad research field of nutrition and food systems there is a demand for a new level of ambition, focus and impact. With Food 2030[11] the European Commission wishes to:

- Promote a systems approach to research and innovation
- Better structure, connect and scale up European R&I in a global context
- Step up EU investment ambitions (public and private)
- Mobilise international stakeholders to tackle global societal challenges

The definition of food systems goes beyond the production and delivery of sufficient food for all (quantity). It must include the provision of safe and nutritious food for healthy and sustainable diets (quality) while fully considering the dimension of access. R&I will play a critical role in making our food systems future-proof so that they are more sustainable, resilient, responsible, diverse, competitive and inclusive:

- ***Sustainable****:* with respect to natural resource scarcity and in respect of planetary boundaries.
- ***Resilient****:* with respect to adapting to climate and global change, including extreme events and migration.
- ***Responsible*****:** with respect to being ethical, transparent and accountable.
- ***Diverse*****:** with respect to being open to a wide range of technologies, practices, approaches, cultures and business models.
- ***Competitive*****:** with respect to providing jobs and growth.
- ***Inclusive****:* with respect to engaging all food system actors, including civil society, fighting food poverty, and providing healthy food for all.

FOOD 2030 has four priorities: nutrition, climate, circularity and innovation.

- ***NUTRITION for sustainable and healthy diets***: Ensuring that nutritious food and water is available, accessible and affordable for all. It involves reducing hunger and malnutrition, ensuring high levels of food safety and traceability, reducing the incidence of non-communicable diet-related diseases, and helping all citizens and consumers adopt sustainable and healthy diets for good health and wellbeing.
- ***CLIMATE smart and environmentally sustainable food systems***: Building climate smart food systems adaptive to climate change, conserving natural resources and contributing to climate change mitigation. It seeks to support healthy, productive and biodiverse ecosystems. Ensuring diversity in food systems (including production, processing, distribution and logistics) including in terms of cultural and environmental diversity. Natural resources (water, soil, land and sea) are used sustainably within the planetary boundaries and available to future generations.
- ***CIRCULARITY and resource efficiency of food systems***: Implementing resource-efficient circular economy principles across the whole food system while reducing its environmental footprint. Circularity is applied for sustainable and resource-efficient food systems and food

[11] See FOOD 2030 High-level Conference background document, http://ec.europa.eu/research/conferences/2016/food2030/pdf/food2030_conference_background.pdf#view=fit&pagemode=none

losses and waste are minimised throughout.

- ***INNOVATION and empowerment of communities***: Boosting innovation and investment, while empowering communities. A broad innovation ecosystem leading to new business models and value-added products, goods and services, meeting the needs, values and expectations of society in a responsible and ethical way. More and better jobs across the EU, fostering thriving urban, rural and coastal economies and communities. Through closer partnerships with industry and food producers, markets that function in a responsible manner thereby fostering fair trade and pricing, inclusiveness and sustainability. Scientific evidence and knowledge from a wide diversity of actors underpinning the development and implementation of FNS relevant policies, at all geographical scales (Local to Global).

There is now a political opportunity with many initiatives and a renewed focus on food and nutrition. The overall framework for policy action includes:

- The Juncker Commission's ten priorities
- The 2030 Agenda and the Sustainable Development Goals (reduce hunger by 50% and stop food waste)
- The COP21 commitments to reduce GHG emissions to mitigate climate change. The IPCC's upcoming priorities will include oceans, cities and food security.

New opportunities for research and innovation are emerging. Breakthroughs and major advances are being achieved or may soon be within reach, such as on the microbiome, photosynthesis, precision farming, agroforestry, alternative protein sources, aquaponics, smart personalised nutrition, sustainable food cities, circular farms, multifunctional business models and many others. There is not only a need for agricultural research, but for life sciences in general and far beyond. Research breakthroughs often occur when researchers from different fields work together to find solutions.

FOOD 2030 can unleash investment opportunities:

- The EU Industrial R&D Investment gap persists according to data from JRC, FoodDrinkEurope and the European Commission. The overall corporate R&D intensity gap widened from 2005–2013. There is low investment in the EU R&D food industry compared to the US and Japan, and the uptake of EFSI by the EU agrifood sector was low.
- OECD and Purdue University have said greater investments in agricultural R&D would have been profitable.
- Not acting has high costs for society and business. There are now signs that venture capital investments in agrifood have increased sharply, according to the 2015 AgFunder AgTech Investing Report.

Several drivers can support FOOD 2030 and move it forward:

- Information and communication technologies (ICT) must be better leveraged in research. A food systems science needs to be developed and cross-disciplinary cooperation should be enhanced and mainstreamed, as is the case with smart personalised nutrition, consumer behaviour or the multi-actor approach.
- Regional and private sector collaboration are crucial to innovation and investment (such as the EU's Smart Specialisation Platform for Agri-Food, S3P Agri-Food).

- Open science will enable open access and data sharing, engagement, education and skills development. FoodCloud is a good example of an open science deliverable.
- International collaboration is important and can be empowered through Member State R&I alignment and support (e.g., International Bioeconomy Forum, ASEAN aquaculture).
- The European Commission's role in this endeavour is to facilitate multi-actor engagement to align, structure and boost.

Food and nutrition security is a key priority for EU Research & Innovation. In response to nutrition and food systems facing a 'perfect storm', a new level of ambition, impact and focus is needed. FOOD 2030 provides a response to these concerns.

Conclusion

As far as the perspective of research organisations is concerned, below are some check points for implementation:

- Use a systems approach (e.g., food system, connecting land and sea, etc.) to capture complexity, interconnectedness and a holistic perspective
- Encourage inter- and cross-disciplinary cooperation to break up silos
- Embed social sciences and humanities to ascertain societal relevance and consider socioeconomic and cultural dimensions
- Connect or converge with ICTs to unleash the potential of a digital revolution
- Link and integrate research with innovation (all types of innovation, including technological, social, business model, governance, institutional, etc.) to create solutions for products, processes, services, policies, etc.
- Adopt a multi-actor approach and beyond to embrace the perspectives of multiple stakeholders
- Achieve stronger engagement with and of citizens to enhance co-creation and societal acceptance
- Support public-private cooperation, possibly with involvement from new actors and young crowds, to unleash disruptive and market creating innovation
- Move results to market, policies or society to develop job and growth opportunities and enhance the impact on tackling global societal concerns

Some of these issues may be challenging, but they are essential for successful projects and activities. With regard to the overall context, a number of conditions and prerequisites are important to successfully drive a sustainable bioeconomy and future-proof our food and nutrition systems:

- Research breakthroughs
- Disruptive innovations that create new markets
- Market-creating regulation, standards for new products, use of procurement
- Future proof investments for a sustainable future
- Responsible business models, including fair working conditions

- Inclusive societies, addressing the challenge of growing inequalities
- Engaged citizens in science, innovation and society
- Security 'by design', addressing the root of causes of unrest, conflict and migration
- Resilience at all levels

Finally, a last point as food for thought: Is sustainability a sine qua non? In the nested model of sustainability[12], a "resilient and robust economy" is embedded within a "healthy society dependent on an intact and functional environment."

[12] See the United States Environmental Protection Agency, "EPA's Report on the Environment – What is Sustainability", https://cfpub.epa.gov/roe/sustainability.cfm, retrieved 19/01/2017