European Commission

Outcome Report
FOOD 2030 Pathways Workshop

4th March 2020

Future Research & Innovation Needs in view of the transition to sustainable, healthy, safe and inclusive food systems

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Research and Innovation

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OBJECTIVES OF THE FOOD 2030 PATHWAYS WORKSHOP

On **4 March 2020**, the European Commission's Directorate-General for Research and Innovation Unit on "Bioeconomy and Food Systems" held a workshop in Brussels, Belgium, entitled "**FOOD 2030 Pathways: Future Research & Innovation Needs in view of the transition to sustainable, healthy, safe and inclusive food systems**". This workshop was co-created with the support of the Directorates-General for Agriculture and Rural Development, for Maritime Affairs and Fisheries, and for Health and Food Safety. This document is the report of the workshop. The agenda can be found in annex 1.

The aim of this workshop, which gathered around 60 experts and EC policy makers, was to **identify and prioritise concrete future research and innovation needs** related to transforming food systems and nutrition, in view of future R&I policy and programming work, in particular in view of *Horizon Europe*.

Today's **EU policies and objectives**, including the **European Green Deal**[1], emphasize the importance of the transition to sustainable, healthy, safe and inclusive food systems from 'farm to fork', and the role of R&I as a key enabler. The European Commission's **FOOD 2030** initiative, provides a useful framework for providing direction to and boosting the impact of R&I related to food systems and nutrition. Together they provided the context for the discussions in the workshop.

This workshop provided input to translate general R&I impacts into more **concrete R&I needs**. The "**Pathways for Action**" that are being developed under the **Food 2030 initiative** were used in the survey and workshop to focus the discussion on those R&I needs that have the potential to deliver real impact. These pathways provide an **evidence-based logic** to future-proof food systems through R&I action and investment.

Prior to the workshop, an **online survey** was conducted to enable a larger group of stakeholders to provide input to the workshop. The survey questionnaire can be found in annex 2. A group of 301 people replied to the survey. Researchers were the biggest subgroup representing 56% of participants, while the private sector, the public sector and civil society represented respectively 14%, 13% and 11%. 88% of respondents were from EU Member States, 10% were from Africa.

[1] EC President Von Der Leyen announced a new "Farm to Fork Strategy" on sustainable food along the whole value chain (speech to European Parliament; 16 July 2019)

HOW TO READ THIS REPORT

The FOOD 2030 "Pathways for Action"

There are **ten Food 2030 "Pathways for Action", which** are used as the structuring element of this workshop report. These are:

- Governance and systems change
- Urban food system transformation
- Food from the oceans and fresh water resources
- Alternative proteins and dietary shift
- Halving food waste
- The microbiome world
- Healthy, sustainable and personalised and nutrition
- Food safety systems of the future
- Food systems Africa
- Food Systems and Data

Each chapter of this report summarises the outcomes of the discussions on one of the ten "Pathways for Action". They each start - under **PART A** - with a short description of the "Pathway for Action". Under "co-benefits" you will find an overview of the workshop attendants' view on which positive impacts could be delivered versus (multiple) policy targets. In **PART B** you will then see an overview of how survey participants and workshop attendants rated the importance of the proposed R&I actions for each pathway. Finally, in **PART C** you will see what workshop attendants thought would be priority R&I actions, which they further developed conceptually.

Lastly, it is important to say that this report summarises the outcomes of the workshop and the survey and that consequently, opinions expressed in this report are not those of the European Commission.. The purpose of this report is to have a summary record of what was discussed, as a basis for further reflection and work.

FOOD 2030 PATHWAYS WORKSHOP OUTCOMES

PATHWAY 1: Governance and Systems Change

PART A

Short description of pathway

This Pathway relates to improving the governance of R&I policy for food systems to deliver change. Resilience against global challenges such as climate change depends upon the successful implementation of policies, actions and development strategies. Those actions need to be facilitated by high quality and efficient governance. Well run institutions operating under good governance are thus key determinants of long-term stability and sustainable growth making relevant policy, addressing present-day challenges, and providing quality welfare and services. The many challenges related to food systems, as well as their key impact on climate, sustainability, health and livelihoods have made clear that we urgently need to improve our governance of food systems, beyond today's fragmented, siloed approach.

Co-benefits of this pathway

- A more integrated approach to food system decision-making.
- An effective food system approach adding value to health, environment and economy sectors through mutual co-benefits.
- Delivery of nutritious foods using environmentally sustainable production methods creating health and economic and environmental benefits for farmers, businesses, and consumers.
- A reorientation of the entire system where health, environmental and economic goals are met in synergy.
- A better connection between diets and related health, economic, and environmental goals - through improved approaches for public procurement, and within the Common Agricultural Policy.
- Cross-government and cross-sector collaboration supported through food systems policy audits, from governance mechanisms linking food systems work across national governments, and from EU and food system roundtables identifying specific steps for adaptation or change.

PART B

R&I actions that were presented to the survey and workshop

Per pathway, a number of R&I actions were presented to the survey participants and the workshop attendants. Survey participants were asked to provide their feedback on them (level of priority, missing actions, etc.). Workshop attendants were asked to select the R&I actions which they considered priority and subsequently comment on what exactly needs to be done for each of these priority R&I actions (see part C).

The R&I actions that were presented to the survey participants and the workshop attendants, are:

- R&I Action 1: Mapping and monitoring of food systems, markets and behaviour (actors across the food system, consumers)
- R&I Action 2: New knowledge, insights, data models and methods to support policy development and support decision making, especially to enhance climate resilience.
- R&I Action 3: Engaging society for the future of food systems
- R&I Action 4: Boosting demonstration and testing of solutions to systemic problems
- R&I Action 5: Supporting and investing in innovation deployment
- R&I Action 6: Improve education and training to support transition
- R&I Action 7: Developing R&I strategies and aligning R&I policies

Feedback from the survey on the R&I actions

- No statistical significant difference across both populations of experts and all participants to the responses to the seven R&I actions provided.
- All seven were deemed to be of high importance with respect to governance scoring more or less the same mark of 2.6.
- There were 126 additional comments made on the governance research actions, and 27 extra R&I items suggested for consideration.

R&I actions withheld by workshop experts, in order of priority

Experts felt that the subject is best approached by grouping all the R&I actions under one research action which could be seen as an "EU Governance and Systems Change Observatory/Platform to accelerate Food System Innovation". This Observatory/ Platform would apply R&I to improve Governance in three areas with a view to better support food system change:

1. UNDERSTANDING
2. ENGAGEMENT
3. DEPLOYMENT

<u>PART C</u>: What needs to be done for each R&I action?

OVERARCHING TITLE: EU Governance and Systems Change Observatory/Platform to accelerate Food System Innovation

Four-year effort needed to set up an EU Governance and Systems Change Observatory/Platform based on the three principles of understanding, engagement and deployment. The basis of this observatory/platform would be as a forerunning infrastructure feeding into the eventual launching of a Food System Partnership in 2023. It also needs to involve and engage with similar ongoing governance proposals such as in agroecology sector, the EIP, a possible Food System

Infrastructure proposal. Political support and engagement from the Member States and from EU departments (Sante, AGRI, and EFSA etc.) will be crucial from the onset.

UNDERSTANDING

- Understand incentives for food system approach
- Integrate health social environmental and economic data tools at all levels
- Carry out Food System mapping and policy audits, create data repository, working framework, check redundancy possibilities
- Respect all goals and targets (climate, biodiversity, public health, farm to fork, CAP, marine)
- Foster new/improved accelerators and living laboratories/physical spaces
- Devise best-case methodologies for monitoring and alignment, performance assessment and indicators of change
- High-level food expert group - academia, all science disciplines, policy, private, and public sectors
- Branded and visible EU Food System network to be established by 2025 (in line with food system Partnership)
- Major Global annual event at the level of the IPCC food systems to be launched
- Standards through links to international networks and initiatives to be established
- Source out new funding and investment routes
- Align with any Food System Infrastructure proposal under ESFRI
- Case studies and inter-institutional networks (such as EIP-AGRI)
- Measurement of Food System Transition progress

ENGAGEMENT

- Launch a Fit4food2030 2.0 pan-European engagement mechanism delivering a sustainable, multi-actor network mobilising all relevant Food System stakeholders via an interlinked structure at the level of cities, regions, countries and Europe supportive to the Farm to Fork strategy and beyond.
- Activities will include capacity building, mobilisation of all European institute departments and their Member State representatives.
- Setting up strategic policy laboratories in each Member State that engage with other actors and citizens, and facilitate meetings, communications, and campaigns at local regional and National levels.
- Provide fair and just national (regional and local) strategies and action plans for Food System transformation, awareness and design a process to achieve co-benefits, and policy support facilities for transition management.
- Mutual learning between countries and regions. Exchanges on best practices, expertise and mapping.
- Better food awareness campaigns, How to change diets, Open science, Better interlinking of EU projects, Knowledge sharing across silos, Role of the scientist, Food culture, Engage Citizens in R&I
- Erasmus+ for food systems curricula development in formal education at all levels.

- European knowledge area initiative through an EU wide academic/university network to help fight local and global hunger and foster sustainable food systems

POLICY DEPLOYMENT

- Ways to develop and better integrate R&I into evidence based policy strategies (demonstrate and monitor best practices) what works best?
- What happens at end of a project? Better measurement of R&I impact, continuation, and further funding/investment.
- Establish the trade-offs for the introduction of new technologies.
- Showcase success by demonstrating and bringing results of successful projects before policy makers.

PATHWAY 2: Urban Food System Transformation

PART A

Short description of pathway

Driving food system transformation in cities and towns, where people live and work, and empowering cities as agents of change for sustainable, healthy, inclusive and resilient food systems.

Co-benefits of this pathway

- Environmental benefits
  - Protection of biodiversity through short-circuit value chains
- Health benefits
  - Thanks to the re-shaping of the urban food environments that would ensure availability of, access to and desirability of healthy food, obesity and diet-related non-communicable diseases would decrease Increased urban food security (i.e. access, availability and quality of food)
- Economic benefits
  - More efficient use of resources
  - Reduction of food waste and of the associated costs
- Community and Innovation benefits
  - Increased social inclusion and decreased urban food poverty
  - Increased community resilience to food systems shocks
  - Better cooperation among different sectors at city level (i.e. horizontal governance) and among different government level (i.e. Horizontal governance)
  - Increased engagement of a wide diversity of stakeholders
  - Better education on food systems issues
  - Boosting the whole food-system transformation starting from the urban level

PART B

R&I actions that were presented to the survey and workshop

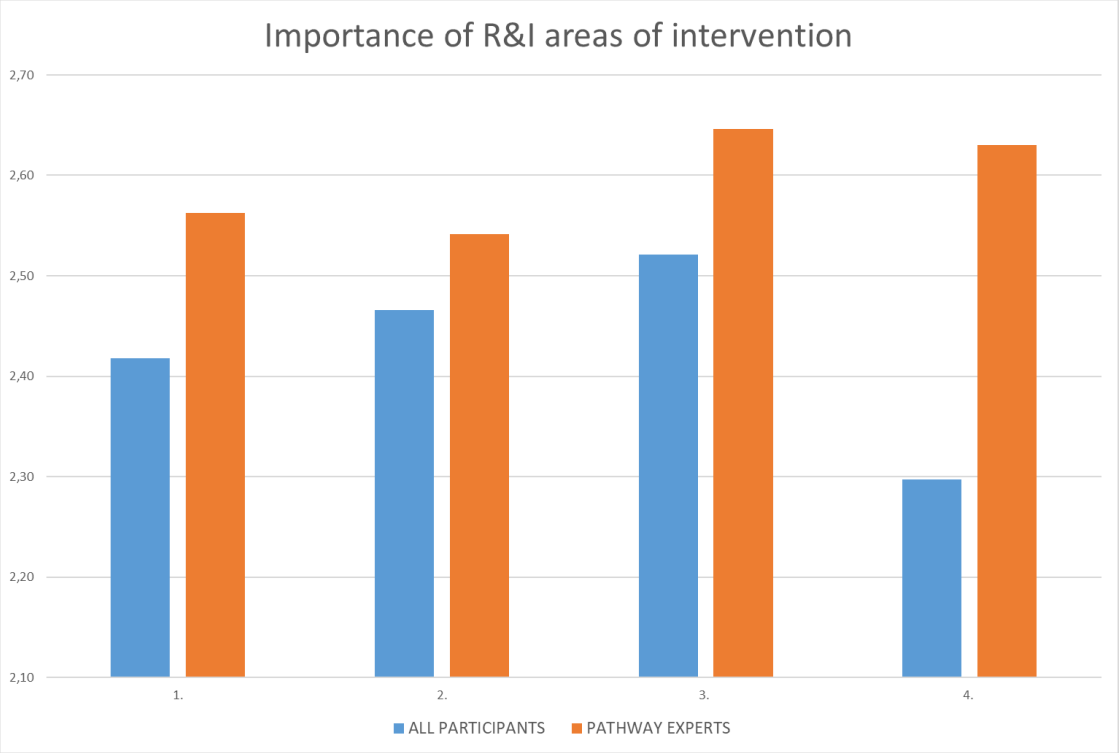
Per pathway, a number of R&I actions were presented to the survey participants and the workshop attendants. Survey participants were asked to provide their feedback on them (level of priority, missing actions, etc). Workshop attendants were asked to select the R&I actions which they considered priority and subsequently comment on what exactly needs to be done for each of these priority R&I actions (see part C).

The R&I actions that were presented to the survey participants and the workshop attendants, are:

1. Improve food production (e.g. Short food supply chains);
2. Innovate food supply and distribution (e.g. Green public procurement for healthy and sustainable meals; gastronomy and food service);

3. Ensure social and economic equity (e.g. Healthy food environments, enhancing urban social resilience to ensure urban food and nutrition security);
4. Improve governance (e.g. mapping of local food systems, analyses of governance models, study impact of urban food policies).

Feedback from the survey on the R&I actions



All R&I actions are considered to be of medium to high importance. Opinions on R&I Action 4 differ most. In general, survey participants assign only medium priority to this R&I action (maybe as a consequence of a poor description of the area itself); survey participants that indicated themselves as "pathway-experts" on the other hand assigned high priority to this R&I action. The latter group considered that investing in food supply chain at urban level should have a slightly lower priority.

Furthermore, participants to the survey were asked: "Which other R&I action has high importance and is missing in the above list?". Some of the replies are listed below:

- *"Relation of Urban Food Systems to their peri-urban and rural areas to have an integrated city-region food system and avoid stand-alone local plans"*
- *"Improving resilience to climate shocks and stresses"*

- *"Accessibility to poor consumers is a huge challenge that could be treated with a specific focus"*
- *"Governmental policies to entrench by law healthy & sustainable dishes mainly on plant-based diets at public caterings and canteens"*
- *"Improve knowledge and skills on providing nutritious food for all"*

Finally, participants were asked to specify "important and urgent R&I needs that you want to highlight and detail". Some of the replies are listed below:

- *"To put short supply chains and urban food production into practice"*
- *"Food self-sufficiency, nutrition security and sustainable agriculture"*
- *"Transformative socio-ecological innovations, grassroots social innovations and social movements for food system transformation from local to global levels"*
- *"Showcasing of alternative food systems (e.g. CSA, permaculture, Slow Food, agroecology living labs) and development of strategies for spreading/scaling such initiatives"*

R&I actions withheld by workshop experts, in order of priority

1. **Re-shaping the urban food environment[3]**
2. **More data and measurement mechanisms on urban food systems and policies**
3. **Improving the governance for integrated urban food policies**

<u>PART C</u>: What needs to be done for each R&I action?

1. **Re-shaping the urban food environment**
    - Re-shaping the food environment
        - *"With which instruments?"/ "By which actors?" / "How to do that?" / "For which objective?"*
        - *"Which are the existing food environments? Could those be clustered by geography and /or culture?"*
    - *Supporting Public-Private Partnerships and new business models*
2. **Data and measurement**
    - Developing a monitoring framework and indicators to:
        - Assess local food systems:
            - Food flows / Actors behaviour / Market characteristics / The reciprocal influence of different sectors
        - Assess the impact (social, environmental and economic) of local food policies
        - Investigate about the role of Business and its impact of local food systems

[3] A person's **food environment** is the combination of availability/accessibility, affordability, convenience and desirability of different foods (Herforth and Ahmed, 2015; Taylor et al., 2018, in MUFPP, RUAF, Gain, "A menu of actions to shape urban food environments for improved nutrition", 2019. These dimensions determine respectively people's physical access to food, their purchasing power, their knowledge about food and their preferences, which in turn determine the nutritional quality of the diets they consume (FAO, 2016; GLOPAN, 2016, in MUFPP, RUAF, Gain, "A menu of actions to shape urban food environments for improved nutrition", 2019)

3. **Urban governance**
    - Assessing the existing forms of governance and their specific needs
    - Experimenting (e.g. at different scale, budget, methodology and participants) new forms of governance to identify the most suitable to:
        - ensure policy coherence, both an vertical and horizontal level
        - increase urban resilience to food crisis scenario

PATHWAY 3: Food from the Oceans and Freshwater Resources

PART A

Short description of pathway

Food coming from the sea, lakes and rivers currently constitutes a relatively small percentage of the food consumed globally but can be key to ensure food and nutrition security globally and decrease pressure on terrestrial resources. R&I related to sustainable fisheries, aquaculture and seafood processing will ensure that enough, safe and nutritious seafood is provided to the world population while aquatic ecosystems where seafood production takes place are healthy and host a thriving biodiversity. For fisheries, increase in harvesting is in most cases out of question but a truly ecosystem-based approach with a meaningful incorporation of the maximum sustainable yield approach can result in a more predictable and less fluctuating harvest in the long term. For aquaculture, innovation in science, engineering, economics and behavioural studies can unlock the hibernating potential and contribute to higher seafood self-sufficiency in the EU.

Co-benefits of this pathway

- Environment:
  - Less impact of fishing gears on marine habitats
  - Less impact of fishing on non-target species including on endangered and/or charismatic ones
  - Less impact of aquaculture on surrounding water quality and integrity of aquatic ecosystems
  - Carbon sequestration by farmed algae
  - Bio-remediation of water by filter-feeding farmed molluscs
  - Less feed consumption through higher conversion rates of ectothermic aquatic animals and farming of low tropic species resulting in less greenhouse emissions
  - Better use and valorisation of marine biomass, including fish and shellfish rest raw materials, resulting in less waste
- Health:
  - Provision of high-quality seafood protein, poly-unsaturated fatty acids, minerals and trace elements
  - Provision of safe seafood by farming low trophic species that do not accumulate contaminants
- Communities:
  - Trigger blue growth and job creation in coastal areas and around likes and rivers
  - Increase resilience of communities around lakes, rivers and coasts by diversification and integration of economic activities, including agriculture, livestock, fisheries, aquaculture and tourism.
- Circularity:
  - Radical reduction in discarded aquatic biomass
  - Optimal utilisation and valorisation of aquatic biomass

PART B

R&I actions that were presented to the survey and workshop

Per pathway, a number of R&I actions were presented to the survey participants and the workshop attendants. Survey participants were asked to provide their feedback on them (level of priority, missing actions, etc). Workshop attendants were asked to select the R&I actions which they considered priority and subsequently comment on what exactly needs to be done for each of these priority R&I actions (see part C).

The R&I actions that were presented to the survey participants and the workshop attendants, are:

1. R&I Action 1 Increase availability of aquatic biomass, within planetary boundaries
2. R&I Action 2. Boost sustainable aquaculture innovation (including building climate resilience)
3. R&I Action 3 Improve biological knowledge and management tools for fisheries and aquaculture
4. R&I Action 4 Implement monitoring programs for risk assessment (animal health, emerging risks, pollutants…)
5. R&I Action 5 Improve consumer knowledge and perception on seafood. Develop labellingg strategies for awareness and fraud control
6. R&I Action 6 Diversify species, products and processes to reduce the environmental impact
7. R&I Action 7 Reinforce R&I capacity to support this pathway

Feedback from the survey on the R&I actions

- Top actions – all participants:
  - Diversify species, products and processes to reduce the environmental impact
  - Boost sustainable aquaculture innovation (including building climate resilience)
  - Implement monitoring programs for risk assessment (animal health, emerging risks, pollutants…)
  - Improve biological knowledge and management tools for fisheries and aquaculture

- Top actions – experts only:
  - Boost sustainable aquaculture innovation (including building climate resilience)
  - Reinforce R&I capacity to support this pathway
  - Improve biological knowledge and management tools for fisheries and aquaculture
  - Implement monitoring programs for risk assessment (animal health, emerging risks, pollutants…)
  - Diversify species, products and processes to reduce the environmental impact

Responses to the questionnaire circulated before the workshop revealed slight differences between experts and non- experts. R&I Actions 2, 7, 3, 4 and 6 scored the highest by experts while 6, 2, 4, 3 and 7 by all participants. In addition, it was highlighted that:

- Aquatic production scores low at ecological footprint, yet there is a lot of room for improvement and to factor in the contribution of the seas and oceans as buffers to climate change. However, there is a lack of data and insight that hinders reliable calculations.
- Aquatic biodiversity as source of compounds holds a huge potential that is currently underexplored.
- Climate change affects aquatic production already and there is a big need for biological information to feed into models and ensure realistic estimation.
- The effect of microplastics on the aquatic production and safety of products is a potentila priority area
- Informed spatial planning is crucial for aquaculture development
- There is need to monitor environmental interactions and to develop and validate forecast models to map these interactions
- Introduction of feed ingredients of low ecological footprint is key for the sustainable growth of the aquaculture sector
- There is need to map the geographical and social diversity in food from the ocean, based on use patterns and consumer interests

A considerable content overlap between some R&I Actions was observed and the experts worked to formulate R&I Actions with distinct objectives. Other experts in the room supported environment-friendly strategies as multi-trophic farming systems and aquaponics and stressed the need to reduce environmental impact as much as possible. However, a certain degree of unawareness towards aquaculture was revealed. Fisheries issues were not the focus of the discussion.

R&I actions withheld by workshop experts, in order of priority

1. Boost innovation for sustainable aquaculture
    - Open science and innovation
    - Multi-actor approach
2. Improve quantity and quality of aquatic food within planetary boundaries
    - Transdisciplinarity, including marine social sciences and ocean and freshwater education and literacy
    - Multi-actor approach
    - Open science and innovation
3. Strengthening R&I capacity to support the food from the ocean pathway
    - Interoperability

PART C: What needs to be done for each R&I action?

1. Boost innovation for sustainable aquaculture
    - Climate adaptation of aquatic food production systems
    - Novel, sustainable and scalable feeds that do not compromise farmed fish welfare or nutritional quality and that meet consumer needs
2. Improve quantity and quality of aquatic food within planetary boundaries

- Devise equitable, fair, trustworthy traceability and certification systems that meet the needs of European producers and consumers
- Valorisation of the 100% of fish and shellfish biomass
- Co-develop with producers, feed companies, retailers and consumers nutrient standards for farmed aquatic products
- Identify opportunities for tailor-made bio-fortified aquatic products to meet the health needs of the global population

3. Strengthening R&I capacity to support the food from the ocean pathway
    - Foster innovative collaborative partnership models to address bottlenecks and barriers that hinder technology development and uptake
    - Support ongoing novel research and innovation with infrastructure that build capacity to conduct high quality and fit for purpose research in priority areas
    - Harness citizen science to support and improve the development of sustainable aquatic food production systems

PATHWAY 4: Alternative Proteins and Dietary Shift

PART A

Short description of pathway

Changing our dietary habits can provide sufficient, nutritious, safe, healthy, accessible and affordable food to a fast growing world population taking into account the increasing pressures from climate change and natural resource scarcity (land use). R&I related to increasing the availability and sources of alternative proteins, while ensuring food safety, would help reducing the impact of food systems on health, environment and climate. R&I is also needed to help transition to new farm, processing, distribution, and food service models relying less on the supply of animal meat. R&I outputs should increase knowledge and influence consumption behaviours, through education and a better regulatory environment (what triggers dietary shift, social acceptance of alternative proteins products, consumer trust, etc).

Co-benefits of this pathway

- Environment:
  - Lower water use → better consumption footprint
  - Lower GHG
  - Lower energy and land-use (depending on the shift)
  - Crop rotation
  - Improvement state of biodiversity
  - Improvement of soil health
- Health:
  - Diversification of offer (wide range needed, new varieties)
  - Promotion of healthy diet (depending on the shift and the quality of the substitute, although some products might cause allergies)
- Communities:
  - Trigger innovation (new products/markets/business models)
  - Increase farmers' resilience and image, focus on quality, improve animal welfare
- Circularity:
  - Decrease food waste (longer shelf life/valorisation by-products)
  - Less dependency on imports → decrease risk of deforestation

PART B

R&I actions that were presented to the survey and workshop

Per pathway, a number of R&I actions were presented to the survey participants and the workshop attendants. Survey participants were asked to provide their feedback on them (level of priority, missing actions, etc). Workshop attendants were asked to select the R&I actions which they considered priority and subsequently comment on what exactly needs to be done for each of these priority R&I actions (see part C).

The R&I actions that were presented to the survey participants and the workshop attendants, are:

R&I Action 1. Fill knowledge gaps on health-related and environmental aspects of alternative proteins sources
R&I Action 2. Increasing market uptake of alternative proteins
R&I Action 3. New processing methods and technologies (e.g. for pulses, algae)
R&I Action 4. Stimulating and connecting actors of the food system for the production and provision of alternative proteins
R&I Action 5. Bioavailability of protein sources
R&I Action 6. The potential of controlled-environment farming in 2030
R&I Action 7. Regulatory science and right policy mix for alternative proteins
R&I Action 8. Developing healthier and sustainable food environment (access to healthy products)
R&I Action 9. Changing behaviour across the food system towards sustainability and health
R&I Action 10. Strengthen education on food systems

Feedback from the survey on the R&I actions

- Top 4 actions – all participants:
  - Changing behaviours
  - Education
  - Food environment
  - Filling knowledge gaps (health and environment)
- Top 4 actions – experts only:
  - Filling knowledge gaps (health and environment)
  - Changing behaviours
  - Food environment
  - Education

R&I actions withheld by workshop experts, in order of priority

The three topics below received the same number of votes:

1. Changing behaviours
   - This action should focus on all actors of the food system, not only consumers
   - We need to find the drivers that will transform behaviours
   - Demand pull needed
   - We need a "new normal"
2. Filling knowledge gaps on nutritional, safety, allergenicity and environmental aspects of alternative proteins
   - Several types of alternative proteins should be considered (crops, sea-based, algae, mussels (carbon sequestration function), etc)
   - A database that allows for calculating environmental footprint should be established
3. Food environment – improving and diversifying the offer in proteins

- Several elements to be taken into account: taste (new processing methods for plant proteins), prices, food/protein/nutrition quality, and genetics (need to close economic productivity gap of protein crops)

PART C: What needs to be done for each R&I action?

- Changing behaviours
  - Understand the drivers/barriers of production, processing, retailing, manufacturing, consuming (alternative) proteins and how to engage toward more sustainable choices
  - Potential of tools (e.g. policy measures, new business models) to realize this change
  - We need to shape the "new normal" that should be fair for the primary producers and maintain vibrant rural areas
  - Elements to be considered: cross-cultural, place-based differences (rather than cross-country), social inequalities, link with dietary guidelines, raising awareness
- Filling knowledge gaps on nutritional, safety, allergenicity and environmental aspects of alternative proteins
  - Comparative analysis of conventional/alternative proteins, using new PEF-based categories (Product Environmental Footprint)
  - Health/safety impact of alternative proteins (e.g. plant-based, insects, sea-based, etc), including on microbiome and NCDs (nano-plastics, contaminants, disqualifying nutrients, salt, statured fat)
  - Creation of a common/shared data space
  - Elements to be considered: global/international impact (environmental, economical, competition); impact of genomic engineering on health and the environment (production of alternative protein crops)
- Food environment – improving and diversifying the offer in proteins
  - Positive and negative impacts of (new) marketing approaches
  - Discover new and rediscover old varieties of proteins, processing methods, preserving taste, natural resources, affordability
  - Training of the "middle part" of the food system, including chefs and caterers
  - Elements to be considered: access to food and development of short supply chains, avoiding inequalities, food handling, pricing policies and incentives (monetisation of impacts on health and environment)

PATHWAY 5: Halving Food Waste

PART A

Short description of pathway

Halving food waste and reducing food losses throughout the food system

Co-benefits of this pathway, in order of importance, with main justification

- **Climate and Sustainability -** food is regarded as greatest source of GHGs emissions, so every reduction has significant impact
- **Circularity and Resource Efficiency –** valorisation of waste streams, production of animal feed
- **Innovation and Communities –** social value of foods and increase of community bonds
- **Nutrition and Health –** link to messages on healthy and sustainable nutrition

PART B

R&I actions that were presented to the survey and workshop

Per pathway, a number of R&I actions were presented to the survey participants and the workshop attendants. Survey participants were asked to provide their feedback on them (level of priority, missing actions, etc). Workshop attendants were asked to select the R&I actions which they considered priority and subsequently comment on what exactly needs to be done for each of these priority R&I actions (see part C).

The R&I actions that were presented to the survey participants and the workshop attendants, are:

1. New insights on the drivers of food losses and waste; on success factors and barriers to reducing and valorising food waste
2. Improving and harmonizing food losses and waste measurement and monitoring methodologies
3. Impact analysis of food losses and waste prevention actions
4. Developing sector-specific guidance
5. Improving the information flows and the coordination along the food supply chain
6. Better food processing and preservation facilities
7. Improving shelf-life & Better technology for date marking
8. New schemes for food surplus redistribution
9. New approaches to sustainable food packaging

Feedback from the survey on the R&I actions

Respondents ranked the R&I actions with the highest impact on food waste as follows: "new approaches to sustainable food packaging" (action 9) received the highest ranking, followed by "new insights on the drivers of food losses and waste,

drivers and barriers" (action 1), and "new schemes for food surplus redistribution" (action 8).

At the same time, respondents who defined themselves as 'pathway experts' ranked actions 1 and 9 as priorities, followed by action 3 ("impact analysis of food loss and waste prevention initiatives " and action 5 ("improving information flow and collaboration across the food supply chain").

Furthermore, participants to the survey were asked: "Which other R&I action has high importance and is missing in the above list?". Some of the replies are listed below:

- valorisation of by-products and side streams (e.g. development of new technologies, safety measures and traceability, feed from insects, assessment of the sustainability of existent solutions, market opportunities)
- functioning of the food supply chain (e. g. trade patterns and regulation, role of big data)
- storage, packaging and date marking (e.g. sustainable storage solutions, including electricity supply; alternative packaging materials and new recycling technologies; date marking innovation; active packaging)
- consumers and education (e. g. developing a new social norms, addressing over-consumption of food, ways to engage consumers)
- other (e. g. actions to improve the sustainability of food production)

Finally, participants were asked to specify "important and urgent R&I needs that you want to highlight and detail". Some of the replies are listed below:

- *"Plant research using new breeding techniques, genomics, gene editing, to decrease losses and increase shelf-life"*
- *"Identify barriers to and incentives for the uptake of packaging strategies and solutions;*
- *"Establishing new collaborative projects for circular food value chains"*
- *"Tax reductions and policy frameworks to facilitate food waste reduction"*

R&I actions withheld by workshop experts, in order of priority

1. Measurement
2. Public-private partnerships
3. Consumer and business behaviour change

<u>PART C</u>: What needs to be done for each R&I action?

1. **Measurement**
    - Fast digital tools for individuals to measure food waste at home and for businesses to measure food waste within their operations
    - Help countries outside the EU with cost-effective solutions to start measuring their own food waste

- Solutions to cover the whole food supply chain (e. g. big data)
- Innovative policy measures to enable food waste measurement (e. g. promote and encourage measurement habits as a social norm, which could also increase voluntary reporting)

2. Public-private partnerships

- How to streamline the transformation process (e. g: organisation of table discussions and development of roadmaps before sealing partnerships)
- Stakeholders involved and level of governance (e. g. research on who are the relevant stakeholders in each EU MS to be involved and their role)
- More efficient, effective and rapid partnerships
- Make the transition process to successful Public-Private Partnerships a business case both for private and public entities
- Engaging SMEs and start-ups in the whole process

3. Consumer and business behaviour change

- <u>For consumers:</u>
  - How to shift social norms (e. g. amount of food to consume, healthy diets, less sugar)
  - Innovative cost-effective mechanisms for audience segmentation
  - Food education for future consumers
  - Innovative behaviour change interventions
  - Packaging innovations
  - Product innovations
  - Out of home behaviour (e. g. order the amount of food you will consume and not more when in restaurant, understanding of product date marking)
  - How to link messages for social norm change with healthy eating
  - True cost accounting of food (including all external costs)
- <u>For businesses:</u>
  - How to shift social norms
    - Value of food
    - Portion sizes
    - Operationalise food loss and waste reduction across the whole food supply-chain (e. g. Target-Measure-Act approach)
  - Packaging innovations (among which, research on simplifying/guidance on date marking)
  - Product innovations
  - New technologies to achieve behaviour change
  - Focus on SMEs
  - True cost accounting of food (including all external costs)

PATHWAY 6: The Microbiome World

PART A

Short description of pathway

The Microbiome: leveraging our insights, understanding and use of the microbiome across all parts of the food system.

Co-benefits of this pathway (priority list)

- (1)Maintain a healthy lifestyle ++++
  - Healthier foods and diets linked to individual human gut microbiome
- (2)Prevent and reduce disease ++++
  - Better understanding of microbiome will lead to better treatment and preventions of human/animal and plant diseases
- (3)Healthier soil – climate impact ++++
  - A tea spoon of health soil contains more microorganism than humans in this planet-a better understanding of microbiome will lead to healthier soil and improvement of a soil functions
- (4)Catalysis, reducing enzymatic activity +++
  - Microbiome research will improve and enrich available toolbox for industrial enzymatic reaction
- (5)Energy reduction and production of pharmaceuticals +++
  - New microbiome cultivars has the potential to increase energy production through microorganism and increase the availability of active ingredients and adjuvants for pharmaceuticals
- Increase of food security through yield stability
- Pro and pre-biotics as tools to target prevention
- Cleaner energy production
- Agriculture with less chemicals or replacing chemicals
- Contribution to microbial resistance
- Improve quality of food
- Key role in circularity of food, action in food safety
- Role in degradation of waste (organic/anorganic), biorefinery of waste
- Nanosafety – toxicity of food packaging
- Diversification of food production systems

PART B

R&I actions that were presented to the survey and workshop (priority list)

Per pathway, a number of R&I actions were presented to the survey participants and the workshop attendants. Survey participants were asked to provide their feedback on them (level of priority, missing actions, etc). Workshop attendants were asked to select the R&I actions which they considered priority and subsequently comment on what exactly needs to be done for each of these priority R&I actions (see part C).

The R&I actions that were presented to the survey participants and the workshop attendants, are:

- Citizen engagement to better understand the benefits of microbiomes
- New generation of scientist on systemic microbiome research
- Microbiomes for human health
- Microbiome for more sustainable and climate resilient agriculture
- Microbiome for healthier soils
- Microbiome for tackling AMR
- Microbiome for heather and taster food
- Life Cycle Analysis and risk-benefit assessment of precision fermentation and farm free proteins

Additional actions identified during the workshop (priority list)

- New generation of scientists +
- Tackling AMR
- Life cycle analysis

Feedback from the survey on the R&I actions

- Microbiome for healthier soils
- Microbiome for more sustainable and climate resilient agriculture
- Microbiomes for human health

The above three actions were voted by the participants in the survey. Regardless the relevance to field of the microbiomes the participants always rank Microbiome for healthier soil as the first action followed by Microbiome for more sustainable and climate resilient agriculture and Microbiomes for human health.

R&I actions withheld by workshop experts, in order of priority

- Sustainable and climate-resilient agriculture ++++++
- Microbiome for human health ++++
- Healthier soils ++++
- Healthier and tastier food ++

REFINEMENT OF R&I ACTIONS, PRIORITIZATION – MISSING POINTS

- Industrial applications
- Climate resilience of food systems (aquaculture, agriculture)
- Data management
- Environment performance toolbox – Portfolio enablement
- Flagship programmes to enable portfolio and connect the actions
- Integrate microbiome in plant synthesis and health R&D

PART C: What needs to be done for each R&I action? MICROBIOME PATHWAY R&I NEEDS (Priority list)

Sustainable and climate-resilient agriculture

- Business models for innovations
- Increase understanding/exploit microbiomes to increase yield stability under different climate change scenarios using living labs
- Targeting animal microbiome to reduce animal emissions
- Farm-free protein through fermentation and animal feed complement
- Including microbiome systems in cropping systems do promote yield stability and sustainability
- AMR and live stock
- Bog data approaches
- Map microbiome fluctuations and factors
- Gain insight of microbiome dynamics

Healthier soils

- Reduce fertilizers, provide alternate fertilizers/pesticides through microbiome applications
- Water quality impact on soil fertility/water retention
- Restoration of land via soil transplantation
- Salinity tolerance of soil, reduce soil salinity
- Soil for urban agriculture
- Bioremediation of soil
- International cooperation
- Bioremediation of chemicals through microbiome
- Restoration of biodiversity of higher organisms through microbiome
- Big data approaches
- Engage with stakeholders (end users/policy makers) at an early stage to identify barriers and leverage points

Microbiomes for human health

- Food production targeting human microbiome
- Definition of healthy microbiome across different population ages
- Connection between food/diets microbiome and human genetics/health impacts and environment/location of communities
- Intake of food-associated microbiomes and human health: a. prescription for disease, b. recommendations for lifestyle and diets (microbiome-based recipes?)
- Citizen opinion on what is important for them to reach/develop these actions
- Big data approaches
- Probiotics/Prebiotics
- Relationship between NCD and IBD with microbiome
- Investigation of non-gut microbiome (skin, lung)

PATHWAY 7: Healthy, Sustainable and Personalised Nutrition

PART A:

Short description of pathway

This pathway aims at empowering individual and health care professionals to adapt their diet and advices to patients for better health and sustainability.

R&I will contribute to develop innovative, healthy, sustainable and personalised nutrition solutions for different targeted groups from smart products, services, digital innovation, new technologies/ processes, business tools and models to reduce risk factors for NCDs, reduce malnutrition and micronutrient deficiencies and empower consumers to adhere to a long-lasting, healthy, pleasurable, nutritional and sustainable diet tailored to individual parameters. R&I will contribute to better understand the factors influencing consumer/producer choice, motivation and behaviour such as food environment, policies, gender, information, education, marketing, incentives, lifestyles.

Co-benefits of this pathway

- Consumers:
  - Empowerment of consumers at the centre
- Health:
  - Promotion of good health and healthy lifestyle
  - Reduction of risk factors for NCDs
  - Development of quality and healthy food products
  - Focus on most vulnerable groups
- Environment
  - Responsible and sustainable consumption and production while ensuring economic sustainability
  - Climate change mitigation
- Food and nutrition security
  - Lack of food quantity and quality
  - Zero hunger
  - Eradication of micronutrient deficiencies

PART B

R&I actions that were presented to the survey and workshop

Per pathway, a number of R&I actions were presented to the survey participants and the workshop attendants. Survey participants were asked to provide their feedback on them (level of priority, missing actions, etc). Workshop attendants were asked to select the R&I actions which they considered priority and subsequently comment on what exactly needs to be done for each of these priority R&I actions (see part C).

The R&I actions that were presented to the survey participants and the workshop attendants, are:

- R&I Action 1. Combating non-communicable diseases through nutrition and diet
- R&I Action 2. Personalizing nutrition for groups and individuals
- R&I Action 3. Combating undernutrition and micronutrient deficiencies
- R&I Action 4. Unravelling neurological triggers
- R&I Action 5. Dietary assessment methods
- R&I Action 6. Develop sustainable and healthy dietary guidelines
- R&I Action 7. Understanding people's food & nutrition behaviour
- R&I Action 8. Improve food systems communication, education and engagement
- R&I Action 9. Digital tools and labelling for citizens and health care workers
- R&I Action 10. Human gut microbiome and its impacts on immune system, mental & non-communicable diseases
- R&I Action 11. New food products, services & processes

Feedback from the survey on the R&I actions

- Top 6 R & I actions according to importance and impact – all experts:
  - Combatting NCDs
  - Food and nutrition behaviour
  - FS communication, education and engagement
  - Malnutrition and micronutrient deficiencies
  - Human gut microbiome
  - Personalised nutrition

- Top 6 R&I actions according to importance and impact - pathway experts
  - Food and nutrition behaviour
  - Combatting NCDs
  - FS communication, education and engagement
  - Human gut microbiome
  - Malnutrition and micronutrient deficiencies
  - Personalised nutrition

There is a need for a deep behaviour transformation of food industry, retailers, consumers and policy makers towards food/ food systems to improve public health and reduce NCDs. The approach should be systemic involving all the main actors to identify, assess and develop healthy and sustainable diet respecting environment, economically fair and affordable for all.

R&I actions withheld by workshop experts, in order of priority

R&I action 1 - Change behaviour for a responsible and sustainable consumption and production

- Better understanding the drivers (e.g. culture, age, religion, food environment, advertisement for healthy and unhealthy products, meat campaign funded by the government) influencing decision making of food industry/retailers and consumers, in particular, for the most vulnerable groups
- Identify effective measures within a system of factors influencing food consumption

- Food based dietary guidelines at national/regional level integrating environment, cultural and sustainable aspects
- Improve FS communication and education and adapt it to different cultures, values and beliefs and in particular for the more vulnerable groups
- Improve information about the link between healthy and safe food consumption practices with other aspects such as sustainability, environment, biodiversity, climate change, food losses and waste
- Improve digital tools and labelling (health and nutrition claims) to help consumers to make an informed and responsible choice

R&I action 2 – Promote good health and healthy and sustainable lifestyle

- Combat NCDs
- Identify and assess healthy and sustainable diets that are protective and respectful of biodiversity and environment, culturally acceptable, accessible, economically fair and affordable for all
- Develop personalised nutrition for the most vulnerable groups
- Better understand the effects of diet on gut microbiome and health
- Eliminate unhealthy lifestyle such as unhealthy diet, physical inactivity, alcohol abuse

R&I action 3 – Combating, malnutrition and micronutrient deficiencies

- Focus on the most vulnerable groups such as elderly, infants, migrants and low income groups
- Importance of taste, convenience, nutrient, preference, price, health status, etc for the different targeted groups

PART C: What needs to be done for each R&I action?

- For R&I action 1: Empowering consumer self-health and planetary health
  - How to communicate efficiently to make effective behaviour change
  - Develop new techniques to assess food/health behaviour
  - New methods for cooking and food education to engage and empower consumers, in particular, adapted for the most vulnerable groups
  - Novel approaches for more engagement and empowerment of food industry, retailers, policy makers and consumers to improve public health and sustainable environment
  - Better understand the factors (marketing, food environment, fiscal policies, gender, etc) influencing choice and decision making
  - Simple and harmonised labelling for nutrition profiles, fibres, nutrients, trace of allergens, impact on environment
  - Study the impacts of fiscal policies such subsidies, taxes and national/regional intervention/policy to promote good health and healthy lifestyles
  - Development of food-based dietary guidelines at national/regional level based on dietary consumption, age, culture and gender data

  - Development of digital tools and data connectivity to combine data from different domains such consumer behaviour, dietary intake, food environment and the impact on public health and environmental sustainability

- For R&I action 2: Promote good health and healthy and sustainable lifestyles to reduce NCDs
  - Develop advanced biomarkers of risk/response for NCDs
  - Develop effective response (solutions, strategies and products) for different targeted groups and in particular the most vulnerable groups (including omics solutions)
  - Study the effects of factors (such as diet, physical activity, etc) on human gut microbiome and its impacts on immune system, mental and NCDs
  - Develop personalised nutrition for a better self management of health and disease prevention
  - Develop effective and long term intervention studies for food, physical activity, microbiome
  - Identify the determinants of success to improve health (biological, sociological, behavioural, economical..)
  - Development of digital tools and data connectivity to combine data from different domains such consumer behaviour, dietary intake, food environment and the impact on public health and environmental sustainabilityStudy the effects of processed food on health

- For R&I action 3: Undernutrition, micronutrient deficiencies and hunger
  - Identify the barriers of malnutrition, food and nutrition insecurity
  - Develop a PAN EU nutritional surveillance
  - Develop innovative food products, solutions and strategies to eradicate hunger and micronutrient deficiencies
  - Develop appropriate and adapted education and communication, in particular, for the most vulnerable
  - Role of gut microbiome (bioavailability, digestion mechanisms during critical periods of life)
  - Elements such as taste, convenience, nutrient requirements, social isolation, age, gender, socioeconomic and cultural determinants, price should be considered.

PATHWAY 8: Food Safety Systems of the Future

PART A

Short description of pathway

Food Safety Systems of the Future: setting a new world reference for food safety and food authenticity while tackling emerging challenges and creating new knowledge.

Co-benefits of this pathway

Experts listed the following co-benefits for this pathway. The impact of the pathway will be to:

- Define food safety in the balance of the food system
- Access to safe and healthy food – emphasis on provision of public health
- Regulatory framework facilitates and supports R&I
- Policy shift linked to food safety and healthy food
- Link to Green Deal, the chemical strategy
- Enabler of circularity
- Connection with responsible production and consumption

PART B

R&I actions that were presented to the survey and workshop

Per pathway, a number of R&I actions were presented to the survey participants and the workshop attendants. Survey participants were asked to provide their feedback on them (level of priority, missing actions, etc). Workshop attendants were asked to select the R&I actions which they considered priority and subsequently comment on what exactly needs to be done for each of these priority R&I actions (see part C).

The R&I actions that were presented to the survey participants and the workshop attendants, are:

1. R&I Action 1. Innovation in **risk assessment** methodologies
2. R&I Action 2. Control **biological and chemical hazards**, including emerging risks
3. R&I Action 3. **Traceability and authenticity** in the digital era
4. R&I Action 4. **Communicating on** and **engaging citizens** in risk assessment and risk perception science

Feedback from the survey on the R&I actions

- Participants stated that all 4 R&I Actions had "high importance".
- Experts ranked higher the importance of the R&I Actions than all participants.

- R&I Action 2 was judged to be the most important and R&I Action 4 as the least important.
- There were 56 additional comments made on the research actions and R&I items suggested for consideration.

R&I actions withheld by workshop experts

The workshop experts (re)formulated **3 priority R&I actions**

1. **R&I action 1. Food Safety regulatory science for the future**
2. **R&I action 2. Identification and management of existing and emerging food safety issues**
3. **R&I action 3. Improved systems for authenticity and traceability in the food/feed system**

Cross-cutting issues: health, digital, sustainability, climate, communication, citizens.

PART C: What needs to be done for each R&I action?

1. For R&I action 1: **Food Safety regulatory science for the future**
    - Re-evaluating food safety risk assessment and policy within the health and sustainability context;
    - Risk-benefit-sustainability;
    - Risk prioritisation in the political process: pesticides, antimicrobials and endocrine disrupting chemicals;
    - Development of preventive and anticipatory measures and systems to identify issues before they become problems;
    - Regulatory methodologies for emerging technologies;
    - Evaluating the efficiency of food systems at different scales: local, regional, national, etc.;
    - Exposome driven risk assessment, emerging chemicals;
    - Systems for tracking, tracing and characterise food-borne pathogens/hazards, e.g. foster whole genome sequencing, application of metagenomics technologies and uptake in regulatory science.

2. For R&I action 2: **Identification and management of existing and emerging food safety issues**
    - New models for crisis management: 'multi-component dimensional crisis modelling and simulation';
    - High-quality analytical methodologies for early warning of food safety issues;
    - Identification of new risks from new technologies/novel foods;
    - Microbiome and personalised-related food risks;
    - Detection methods for new hazards; predictive modelling of pathogens;
    - Emerging issues: micro-nano-plastics, toxins, antimicrobials; effects of biotransformation of chemicals and risks of resulting substances;
    - Understanding the epidemiological pathways of new biological hazards;

- Explore social media, citizen science for food safety issues: involvement of citizen's science as an early warning of food safety issues;
- Cross-sector collaboration to manage food safety issues: food, feed, livestock.

3. For R&I action 3: **Improved systems for authenticity and traceability in the food/feed system**
   - Standardised methodologies for authenticity testing;
   - Research on new methods for standardisation of methodologies for regulatory use;
   - New systems and technology for linking food content with labelling identification;
   - Development of smart analytical methodologies to identified emerging risks associated with circularity economy within a food systems context;
   - Developing early warning systems;
   - Development of analytical methods for real-time in-situ for authenticity and quality;
   - Re-examination of optimal food policies for food authentication.

PATHWAY 9: Food Systems Africa

PART A

Short description of pathway

Transforming African Food Systems: supporting the sustainable development of African Food Systems. The market for food in Africa is expanding rapidly, fuelled by a growing population, urbanisation, growing incomes and an increasing middle class. By 2030, food demand is projected to increase by 55%, bringing the size of Africa's food and agribusiness to $1 trillion and opening up employment opportunities all along the value chain.[4] African supply still dominates the domestic food markets with an estimated 90% of all consumed food supplied by local producers. Nevertheless, the African Development Bank projects that African food imports will triple from $35 billion in 2017 to about $110 billion in 2025[5].

Many of the challenges described in other pathways are also relevant such as those on governance, nutrition or food safety.

Food Systems Africa is implementing the jointly agreed roadmap between the EU and the African Union in the High Level Policy Dialogue on Science Technology and Innovation and its first priority on Food and Nutrition Security and Sustainable Agriculture[6]. Actions within the roadmap are linking to four pillars and kept complementary between the actors, in the European Commission these are DG RTD, DG AGRI and DG DEVCO (co-creating Horizon Europe implementation, the African Union Research Grants and DeSira). In addition to the workshop feed-back from the EU-AU FNSSA Working Group and the co-design process in the Commission will be important.

Co-benefits of this pathway

- Better nutrition for African cities
- Improved food safety in an African free trade zone
- Promotion of nutrition sensitive bio-diverse agriculture
- Reduction of food loss and waste
- Climate change adaptation and mitigation
- Zero Hunger

PART B

R&I actions that were presented to the survey and workshop

Per pathway, a number of R&I actions were presented to the survey participants and the workshop attendants. Survey participants were asked to provide their feedback on them (level of priority, missing actions, etc). Workshop attendants were asked to select the R&I actions which they considered priority and

[4] World Bank, (2013), (2015).
[5] African Development Bank Group (2017) Remarks delivered by Akinwumi A. Adesina, President of the African Development Bank at the Centre for Global Development, Washington DC, April 19.
[6] https://ec.europa.eu/research/iscp/pdf/policy/eu-africa_roadmap_2016.pdf

subsequently comment on what exactly needs to be done for each of these priority R&I actions (see part C).

The R&I actions that were presented to the survey participants and the workshop attendants, are:

- R&I Action 1: Mapping and monitoring of food systems, markets and behaviour (actors across the food system, consumers) …
- R&I Action 1: Research and Innovation for African Food Cities
- R&I Action 2: Improve food safety for an African Free Trade Zone
- R&I Action 3: Combating malnutrition
- R&I Action 4: Research and Innovation for African food entrepreneurs
- R&I Action 5: Nutrition sensitive bio-diverse agriculture
- R&I Action 6: Reduce food losses and waste
- R&I Action 7: Data based digital and mobile food solutions
- R&I Action 8: Human gut microbiome and its link to malnutrition and food safety in Africa

Feedback from the survey on the R&I actions

- Around 10% of the overall respondents came from Africa. Considering that ten FOOD 2030 transition pathways are proposed, 9 with a European focus, one with an African focus, this looks like a nice mobilisation of African survey participants.
- The survey ranked malnutrition, nutrition sensitive bio-diverse agriculture and reducing food losses highest, in the middle were food cities, food safety and innovation support for food entrepreneurs, with a higher ranking from pathway experts than other participants, lowest ranking received microbiome and data.
- There were 62 additional comments made or extra R&I items suggested for consideration.

R&I actions grouped according to discussion of workshop experts

The workshop experts (re)formulated **3 priority R&I actions:**

> **R&I action 1.** R&I for African Food Cities – From Farm to Fork – Rural-Urban Linkages
> **R&I action 2.** Safe, nutritious, affordable and available food for sustainable (African) diets
> **R&I action 3.** Resource efficiency and Circular Economy for Sustainable Value Chains

Building on the EU-AU R&I Partnership on Food and Nutrition Security and Sustainable Agriculture (FNSSA) and the progress on the FNSSA Roadmap, and other EU-Africa processes, the R&I actions seek to address the ongoing challenges:

strengthening the sustainable production of safe and nutritious food, targeting the linkages in the food supply chain, and ensuring resource efficiency. Experts deemed these as is particularly important in the light of the African Continental Free Trade Agreement which will bring to bear the world's largest free trade zone, by country, offering a great opportunity for agri-food systems in Africa.

1) R&I for African Food cities - FARM TO FORK – RURAL-URBAN LINKAGES
    a. Urban systems build upon initiatives like the Milan pact of Cities, and upon the recommendations of the Task Force Rural Africa report Urban systems
    b. Rural small cities and linkages to small-scale and subsistence farming
    c. Understanding the connectivity between European food systems and African food systems
    d. Building capacity in policy for food systems
    e. To identify the bottle-necks and "lock-in"
    f. Vulnerable population groups
    g. Local markets for organic produce
    h. Certification/traceability/ standards/controls
    i. Tradeification of sustainable food systems
    j. Improvement of market and trade for the benefit of pro-poor food accesibility
    k. Food Systems Infrastructure and Facilities
    l. Link to diversified and integrated farming (e.g. agro-silvo-pastoral)

2) R&I for SAFE, NUTRITIOUS, AFFORDABLE AND AVAILABLE FOOD FOR SUSTAINABLE (AFRICAN) DIETS
    a. Exposome (Contaminants/ mycotoxins and toxic residues)
    b. Link to soil quality
    c. Link to seed quality
    d. Gut Microbiome (Africa)
    e. Health claims
    f. Nutrient portfolio
    g. Diversified diets, link to diversified farming systems/ agro-ecology/organic farming
    h. Packaging and distribution
    i. Link to nutritious and under-utilised species
    j. Link to Animal/plant/fish health (ie AMR)

3) R&I for RESOURCE EFFICIENCY AND CIRCULAR ECONOMY FOR SUSTAINABLE VALUE CHAINS
    a. Avoidance of food losses and food waste
    b. Avoidance of waste/reuse
    c. Understanding the connectivity between European agrifood systems and African agri-food systems.
    d. Farm level action
    e. Post-harvest level action
    f. Innovation in Sustainable Storage and packaging
    g. Water resource efficiency
    h. Energy efficiency and Sustainable Energy Sources
    i. Consumer utilisation/awareness
    j. Producer responsibility
    k. GHG reduction

l. Biomass valorisation
m. Nutrient cycling
n. Integration of animal/fish/plant production

Transforming African food systems and supporting the sustainable development of African Food Systems is a complex agenda. Therefore, there are numerous cross-cutting issues to take into account. Workshop experts concluded that the following cross-cutting issues should be considered in the context of each of the R&I actions:

Combatting malnutrition and stunting; Nutrition and NCDs (longitudinal cohorts); Dietary diversity; Climate mitigation and adaptation; Digitalisation and new food solutions; Codex Alimentarius; Food safety enforcement; Gender equity; African Continental Free Trade Area, and Regional Economic Communities; Biodiversity and agro-ecology; Build advisory services (eg. Nutrition, agro-specialists, entrepreneurs, etc) ; Local capacity building; Data collection, Data analysis, Bio-informatics, Bio-statistics; Local production and reduced dependency on imports; Innovations in processing and value-addition (agri-food entrepreneurship); Education, communications, consumer awareness (NB cultural norms); EU-Africa co-benefits; Governance and socio-political frameworks.

PATHWAY 10: Food Systems and Data

PART A

Short description of pathway

This Pathway is about leveraging data and digital technologies to future-proof food systems.

Co-benefits of this pathway

Experts listed the following co-benefits for this pathway. The impact of the pathway will be to:

- Increase **transparency** as a basis for **better understanding & decision making**; to drive change, diet and behaviour (food footprint); to monitor; to anticipate; to improve access to markets and market intelligence
- At level of **actors**: Optimise results & make processes easier ; Improve decision making for every actor in the supply chain. Examples include: Optimisation of food safety, food quality, resource use, conversion of data into knowledge, usage of knowledge on the work floor; End-to-end food system optimisation (reduce waste; sustainable production); Enable circularity of resources (mass balances); Better ways to deal with obligatory reporting (e.g. compliance reporting, certification, labelling); Cope with labour shortage in production; Improve traceability
- At level of **markets:** Better matching of demand & supply; Increase market orientation for all; react better to volatility and reduce food waste; Ensure data access for everyone (platforms), mitigate power asymmetries; fair competition; easier market entry; consumer benefits; Increase fairness for the economy, for food system actors and for consumers; Better value distribution between farmers and retailers; Break isolation of local food system to improve supply; Improve traceability
- Improve monitoring of several **policies** (e.g. climate, food waste)
- Improve results for **science & technology**: the next level of science and technology development will be based on Big Data
- [Improve data practices:] Improve sharing of data - Improve data sovereignty

PART B

R&I actions that were presented to the survey and workshop

Per pathway, a number of R&I actions were presented to the survey participants and the workshop attendants. Survey participants were asked to provide their feedback on them (level of priority, missing actions, etc). Workshop attendants were asked to select the R&I actions which they considered priority and subsequently comment on what exactly needs to be done for each of these priority R&I actions (see part C).

The R&I actions that were presented to the survey participants and the workshop attendants, are:

1. R&I Action 1. Improving the **understanding** of the data economy and the free flow of data in food systems (functioning, issues, barriers, opportunities, future policy) with a view to inclusiveness, fairness, sustainability and climate
2. R&I Action 2. **Enabling platforms and technologies** that support data driven innovation in food systems by citizens (including citizen science) and food system actors
3. R&I Action 3. Boosting **the innovation ecosystem** for data-driven solutions that support food system transition
4. R&I Action 4. Addressing **the digital divide** among consumers, supply chain actors and researchers in the food system

Feedback from the survey on the R&I actions

- Participants stated that all 4 R&I actions had "high importance". R&I action 4 was judged to be least important.
- Other remarks
    - An additional R&I action was suggested related to **digital science infrastructure** and building the European Open Science Cloud for food system related research fields
    - Attention should go to improving the understanding of the **risks related to digitalization**, and to encouraging a responsible approach to innovation by developers

R&I actions withheld by workshop experts

The workshop experts (re)formulated **3 priority R&I actions**:

1. R&I action 1: Increasing the **understanding** of the data economy in food systems (to address the barriers/enablers for the free flow of data/ the uptake of digital solutions/ digitalisation); this with a view to improving effectiveness, inclusiveness (access to data and algorithms), transparency, fairness, sustainability (incl. climate action) of food systems for consumers, citizens, businesses, researchers and public policy.
    - Examples of barriers: quality of data (form of data, integrity), technical barriers to data collection (e.g. linked to machinery), ethics, trust, ownership issues, data monopolies, data graveyards, skills
2. R&I action 2: **Enabling platforms & technologies** that support data driven innovation in food systems by citizens & food system actors; create data markets (open and fair; also towards smaller players).
3. R&I action 3: Boosting **the innovation ecosystem** for data driven solutions that support food system transition. This includes: Raising awareness about potential digitalisation; platforms for dialogue; training & education; room for experimentation & demonstration.

<u>PART C</u>: What needs to be done for each R&I action? (feedback from workshop and survey)

- For R&I action 1:

  - A study of the data economy for food covering all aspects (economical, technical, legal, social, …); large scale engagement on the data economy with stakeholders to provide inputs for study; learning from developments outside of food; study should also look into issues like barriers and enablers, social determinants (how is data used and how does it impact behaviour of consumers and actors), risks and negative consequences of digitalisation, information asymmetries, portability, privacy, data graveyards (not-used public and private data);
  - Defining a basic framework for the data economy in food systems, as a basis for monitoring its development;
  - Formulating recommendations (economical, technical, legal, social, …) to help the development of the data economy for food systems; technical recommendation could also look into how machinery can improve data capture and use;
  - Conduct multiple case studies of end-to-end data flows in food systems, covering public and private, and identifying critical success factors (e.g regarding level of acceptance of data quality);
- For R&I action 2:
  - Make inventory of which platforms already exist; experiment with existing platforms (incentives for use – trust building); bring data science, business and government communities together to work on use cases & trials, using different platforms
  - Standardise among existing platforms; invest in interconnectivity and intermediate formats; Meta-data standardisation for food systems
  - Invest in transforming data into actionable information for consumers, researchers, businesses; benchmark the food on offer in supermarkets
  - Develop "platform of platforms" (cfr FAO GIFT platform on food consumption; http://www.fao.org/gift-individual-food-consumption/en/)
  - Pilot data sharing platforms for food (multisector; vertical integration around real challenges, standardisation/interoperability, data markets); Joining up food systems through shared big data systems
  - Applying data governance to food systems (ownership, compliance); case of personalised nutrition/ biomedical data
  - Common European Food Data Space; a public infrastructure for sharing data on food between citizens, policy makers and researchers
- For R&I action 3:
  - Make the innovation ecosystem a system -> Invest in cooperation programmes (cooperation between start-ups and established companies); shared business models in data value chains
  - Establish long term partnerships between public and private
  - Overcome the valley of death for new solutions and businesses by establishing a multi-layered network of agrifood Digital Innovation Hubs (multi-layered = EU/national/regional)
  - Boost incentives for researchers, public authorities and others to share data; provide cross-sectoral support for data sharing (on retail, logistics, water, energy; including large industry, SMEs, start-ups)

- Create awareness on potential of digital solutions and data sharing (dialogue, training, testing, demonstration)
- Address under-management of R&I data (despite data richness)