Report: Green ERA-Hub Strategic Roadmapping Workshop

14 November 2023

Deliverable 2.2

Green ERA-Hub

The Green ERA-Hub (GEH) brings together networks in the Agri-food and biotechnology sector including all relevant ERA-Nets (Cofunds), and their predecessors, self-sustained networks and EJP. By this the GEH represents most of the relevant national funders in Europe in the Agri-food and biotechnology sectors. The goal of the GEH is to maintain the momentum and experience gained over the last 18 years of trans-national research programming and to use the experience to:

i.) continue to build on previous achievements and further enhance cross-sector collaborations between Agri-Food and Biotechnology ERA-Nets, through implementation of new joint calls resulting in the funding of transnational collaborative projects;

ii.) continue valorisation and implementation of other joint activities supporting the market, regulatory or societal uptake of results after the end of individual ERA-Nets;

iii.) identify common research and innovation priorities, agreed upon by the participating national programmes, and address them via new joint calls;

iv.) preserve best practice and managerial competences;

v.) contribute to the planning and complement the implementation of the new HEU Partnerships and Missions;

vi.) broaden the actions and impact of initiatives towards stakeholders and in terms of geographical coverage;

vii.) contribute to achieve the strategic goals of the SDGs, in particular zero hunger, industry innovation and infrastructure, responsible consumption and production, life on land, partnership for the goals, the farm2fork strategy and EU's Green Deal;

Contacts

Project coordination: Research Centre Juelich (FZJ), Germany

Communication: Institute for Agriculture, Fisheries and Food Research (EV ILVO), Belgium, email@email.com

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Authors:	Heather Alford (BBSRC-UKRI), Temiloluwa Daike (BBSRC-UKRI), Martine Vernooij (WUR)
Date:	24-02-2024

Email: greenerahubilvo@ilvo.vlaanderen.be
Website: https://greenerahub.eu
🔗 https://www.linkedin.com/in/green-era-hub/
🐦 @GEH_era

Table of contents

Summary

The Strategic Roadmapping Workshop aimed to bring together Green ERA-Hub (GEH) partners and select stakeholders, to support the development of the strategic roadmap and to foster collaboration and shared learning. The main objective of the workshop was to identify thematic research areas across the various initiatives as well as opportunities and priorities for the GEH going forward.

The workshop unfolded through structured sessions commencing with a creative brainstorming session where participants identified synergies as well as unique ideas between the GEH initiatives. It was followed by a gap analysis session during which representatives from several of the Horizon Europe (HEU) Partnerships provided brief overviews of their strategic research direction. Workshop participants used this information to identify which ideas may be gaps that the GEH can fill. The opportunity session identified ideas that were impactful for societal changes as well as being unique to the GEH. To prioritise ideas, participants voted on ideas they believe were unique, novel and could make a difference.

Some of the ideas were comparable and were clustered together. Some of the ideas/clusters of ideas that received the most votes are:

(i)   plant biology for nutrition and health, resilience to pests and diseases and for bioeconomy purposes/benefits

(ii)   an integrated approach and systems towards a food system that supports planetary health through redesigned livestock systems, changes in awareness and diet, animal breeding to meet climate goals and maintain climate resilience and animal/herd management (including animal feed) to support climate mitigation

(iii)   a systems approach to understand interactions between soil, plant, environment and crop management systems in context,

(iv)   knowledge generation in relation to nutritional value and health benefits/claims for plants and niche crops (including proteins) and the benefits of organic agriculture for human nutrition and health

(v)   improved measurement methods (that are cheap and accurate) for intake of grazing animals & methane emissions from animals at a range of scales and measurement of soil carbon

The ideas and topics that emerged from this strategic roadmapping session will be used to inform the GEH strategic roadmap, as well as provide input for the research call Work Package (WP3).

Background and Context

The Green ERA-Hub (GEH) is a Coordination and support action (CSA) funded under the WIDERA program of Horizon Europe. The consortium launched in September 2022 and will run for four years is a collaboration of twelve partners who have been involved in former or ongoing European Research Area – Networks (ERA-Nets). Together these partners represent some of the most relevant national funders in Europe in the Agri-food and Biotechnology sectors. The purpose of GEH is to maintain the momentum gained over the last seventeen years across the ERA-Nets and preserve the knowledge gained from these international collaborative activities.

The GEH involves collaboration between 15 different networks that cover 15 different scopes. One of the aims of the GEH is to have 3 calls for proposals (the first launched in May 2023) and ensure that all the networks are represented in at least one of those calls. Combining the scope of these 15 networks provides an opportunity for new relevant topics that are in line with, but not covered by, existing EU policies, strategies, and Partnerships. To identify and prioritise these new relevant topics, the GEH planned a series of roadmapping activities.

BBSRC led the development and delivery of the Strategic Roadmapping Workshop on 14th November 2023 in Brussels, in collaboration with Wageningen University and Research – Strategic Roadmapping (Work Package 2) Leads.

This workshop follows a kick-off roadmapping workshop that took place 16 September 2022 and scoping activities by the individual networks and funders, which helped to generate topics for the first research call.

Workshop Information

Purpose:
- To bring together GEH partners and select stakeholders for a hybrid workshop supporting the development of the GEH Strategic Roadmap and foster collaboration and learning.

Objectives:
- To identify thematic research areas and needs across initiatives, as well as gaps, opportunities and priorities for meeting the goals of the GEH.

Outputs:
- A workshop report with information on the research themes and research gaps between initiatives that helps inform a strategic synthesis report and strategic roadmap for the GEH.

Outcomes:
- Participants have a greater understanding of the synergies and opportunities across the agri-food and biotech sectors within the scope of the GEH.
- The workshop will help inform future research calls with greater potential to achieve enhanced outcomes through collaboration.

The workshop was held on 14th November 2023 in Brussels (with a virtual joining option) and attended by representatives from:

- 14 of the 15 GEH initiatives (BIOEAST were absent)
- The GEH External Expert Group (EEG)
- Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI)
- Horizon Europe Partnerships – the Partnership on Animal Health and Welfare (PAHW), Accelerating farming systems transition: agroecology living labs and research infrastructures (henceforth referred to as the 'Agroecology Partnership' and the Partnership for Sustainable Food Systems
- As well as colleagues involved in complementary research funding initiatives - the Wheat Initiative and the Global Research Alliance on Agricultural Greenhouse (GRA)

The workshop information, agenda and participants can be found in Annex 1.

Workshop Format and Overview

Introduction and background

Participants were provided with background on GEH work to date, including the landscape mapping document (available on the GEH SharePoint) as well as an overview of how the workshop will contribute to a synthesis report, integrated roadmap, and input into WP3 research calls. Participants have been provided with a copy of the slides.

Creative brainstorming session

Workshop participants were asked to identify ideas through a creative brainstorming game to understand:

- What are the synergies and added value across and between initiatives?
- What interesting or unique ideas can we identify through collaboration?

Participants were given playing cards with summaries of the initiatives in the GEH, key EU policies, strategies, and programmes, as well as a report detailing the aims, objectives and goals of the initiatives. In the form of a card game, they were asked to combine at least 3 initiatives to find unique ideas and synergies across research topics, cross-cutting or enabling approaches or ways of working together to help achieve goals or accelerate their progress. Since many of the virtual attendees were representatives from initiatives external to the GEH, they were asked to identify where there were areas of complementarity between their initiatives and the GEH.

Gap analysis session

Representatives of the Horizon Europe Partnerships – Animal Health and Welfare, Agroecology and Sustainable Food Systems gave brief overviews of their strategic research agenda and direction of travel for calls themes, where known. The session aimed to identify:

- How do the ideas align with Horizon Europe Partnerships?
- Which ideas aren't addressed by the Partnerships but are critical?
- To what degree are the ideas already covered by existing initiatives (or other initiatives/funding streams you're involved with)?
- Which ideas are emerging as complementary to the partnerships and/or gaps?

The gap analysis session focused on identifying the ideas generated in the creative brainstorming session that are covered, or will potentially be covered, by the Horizon Europe Partnerships and deprioritise them for the GEH. Ideas not covered by any existing initiatives were then carried forward to the opportunities session. The ideas that were identified as being relevant for the Partnerships and were not carried forwards for further discussion can be found in Annex 2. As the development of the Partnerships and their research calls evolves, the GEH will continue referring to these to evaluate whether the ideas warrant further consideration within the GEH.

Opportunities session

This session focused on identifying which ideas have a stronger case for consideration as an opportunity. The session aimed to identify:

- How impactful an idea is for solving societal challenges?
- Which ideas are unique to the GEH?

Participants considered each remaining idea and placed them at the appropriate point on a four-quadrant table based on impact versus uniqueness (see Figures 1-4 below and on subsequent pages). Where possible and useful, participants were asked to cluster ideas together (see next pages). Where identified, the report authors have left which GEH initiatives each idea was identified as being relevant to. Following the workshop, the report authors considered whether there were other ideas that could be clustered together within these themes, mainly reducing the repetition between the room and virtual setting. For clarity, the clusters below show which ideas have been clustered after the workshop by the report authors.
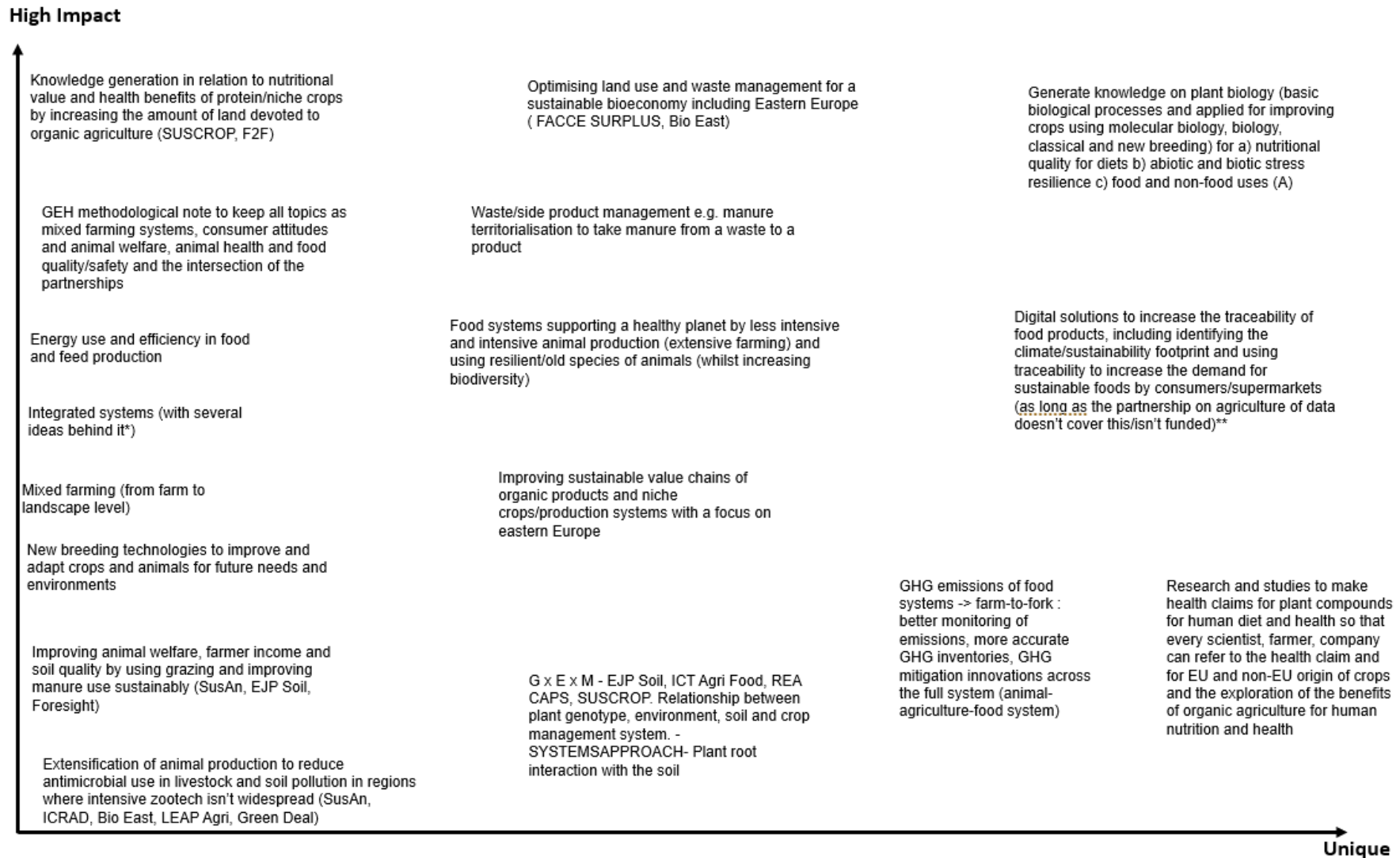
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High Impact

Knowledge generation in relation to nutritional value and health benefits of protein/niche crops by increasing the amount of land devoted to organic agriculture (SUSCROP, F2F)

Optimising land use and waste management for a sustainable bioeconomy including Eastern Europe (FACCE SURPLUS, Bio East)

Generate knowledge on plant biology (basic biological processes and applied for improving crops using molecular biology, biology, classical and new breeding) for a) nutritional quality for diets b) abiotic and biotic stress resilience c) food and non-food uses (A)

GEH methodological note to keep all topics as mixed farming systems, consumer attitudes and animal welfare, animal health and food quality/safety and the intersection of the partnerships

Waste/side product management e.g. manure territorialisation to take manure from a waste to a product

Energy use and efficiency in food and feed production

Food systems supporting a healthy planet by less intensive and intensive animal production (extensive farming) and using resilient/old species of animals (whilst increasing biodiversity)

Digital solutions to increase the traceability of food products, including identifying the climate/sustainability footprint and using traceability to increase the demand for sustainable foods by consumers/supermarkets (as long as the partnership on agriculture of data doesn't cover this/isn't funded)**

Integrated systems (with several ideas behind it*)

Mixed farming (from farm to landscape level)

Improving sustainable value chains of organic products and niche crops/production systems with a focus on eastern Europe

New breeding technologies to improve and adapt crops and animals for future needs and environments

GHG emissions of food systems -> farm-to-fork : better monitoring of emissions, more accurate GHG inventories, GHG mitigation innovations across the full system (animal-agriculture-food system)

Research and studies to make health claims for plant compounds for human diet and health so that every scientist, farmer, company can refer to the health claim and for EU and non-EU origin of crops and the exploration of the benefits of organic agriculture for human nutrition and health

Improving animal welfare, farmer income and soil quality by using grazing and improving manure use sustainably (SusAn, EJP Soil, Foresight)

G x E x M - EJP Soil, ICT Agri Food, REA CAPS, SUSCROP. Relationship between plant genotype, environment, soil and crop management system. - SYSTEMSAPPROACH- Plant root interaction with the soil

Extensification of animal production to reduce antimicrobial use in livestock and soil pollution in regions where intensive zootech isn't widespread (SusAn, ICRAD, Bio East, LEAP Agri, Green Deal)
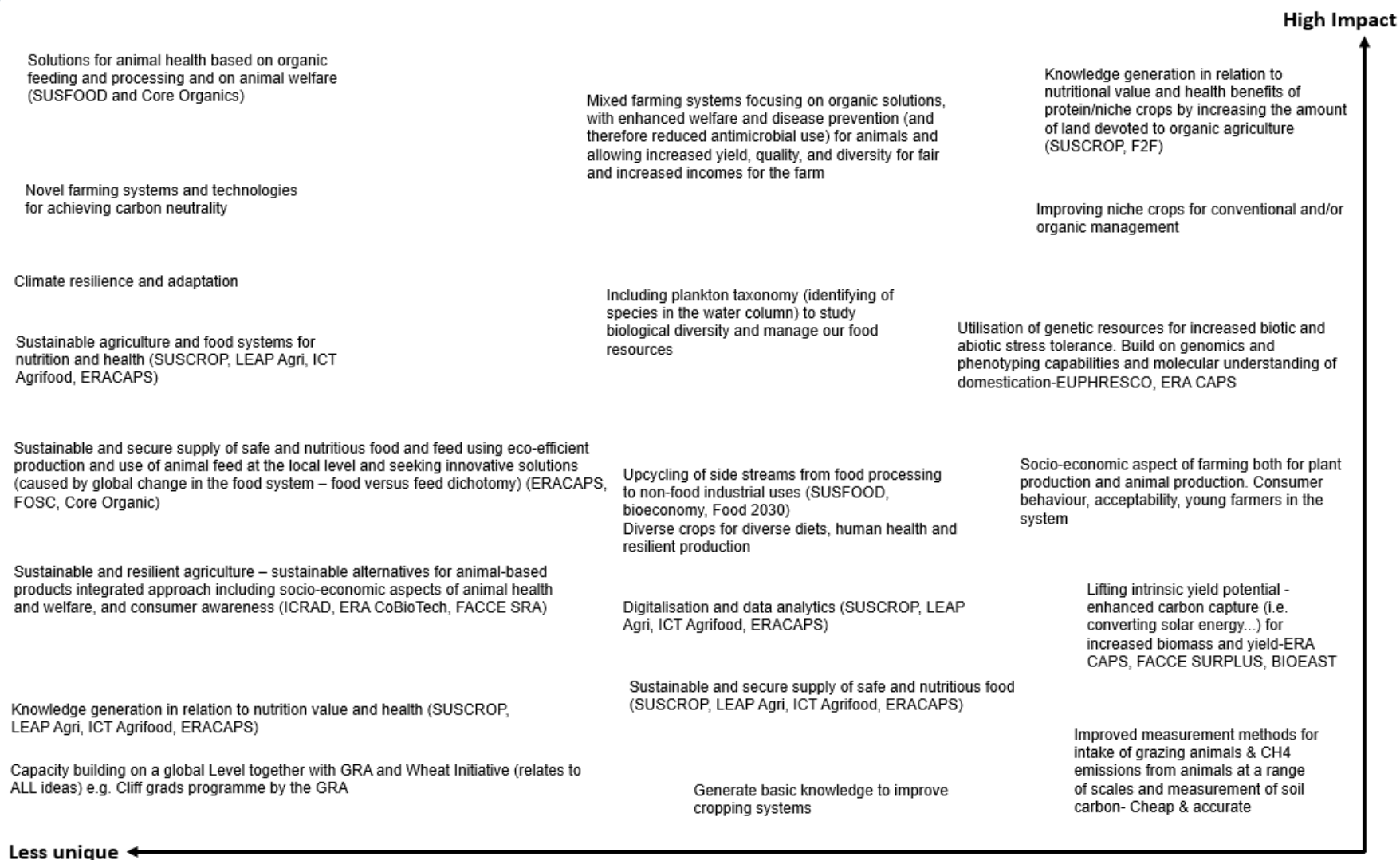
Unique

Figure 1: Ideas identified in the prioritisation session as **high impact** and **unique** to the Green ERA-Hub

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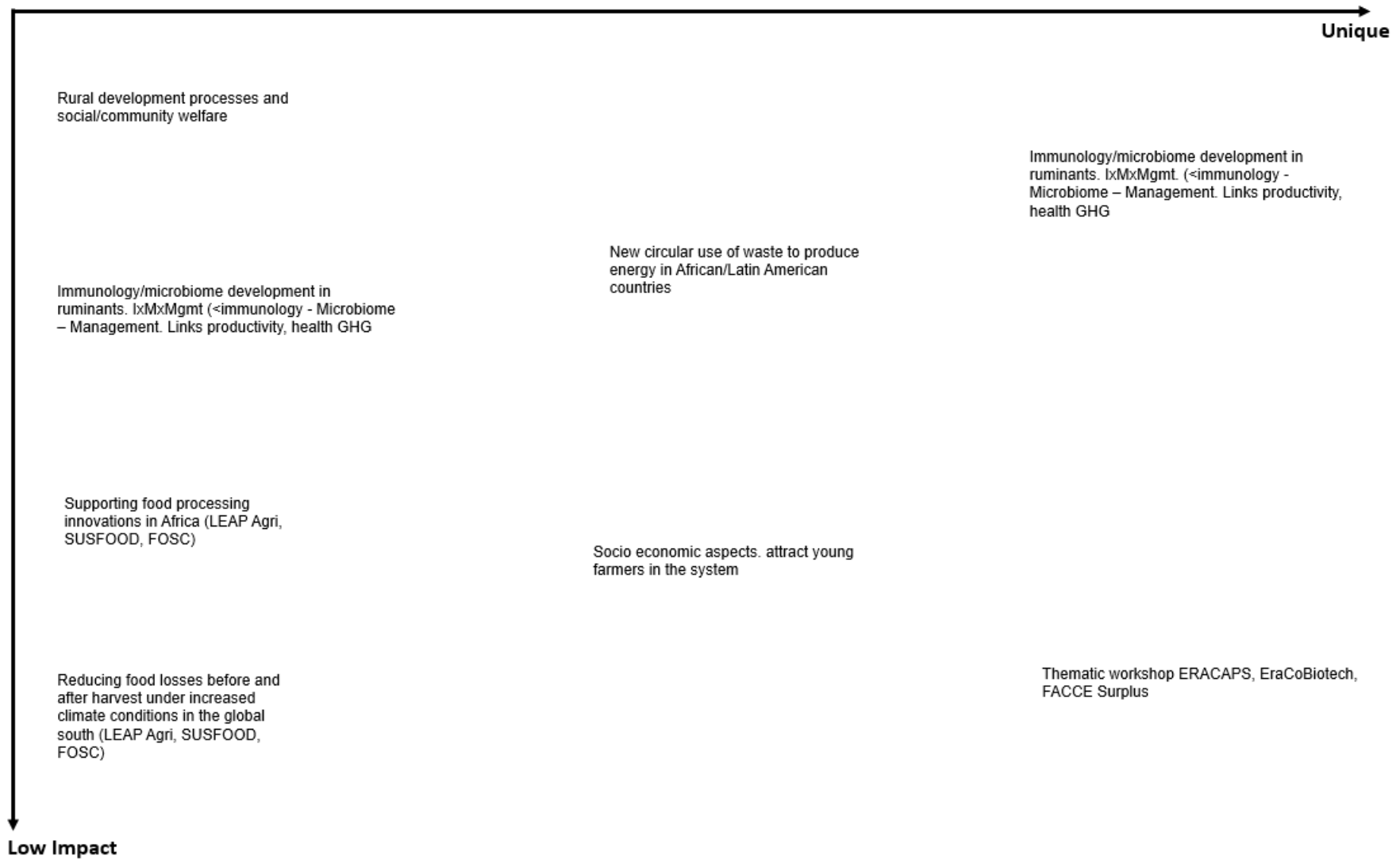on Agri-Food and Biotechnology

High Impact

Solutions for animal health based on organic feeding and processing and on animal welfare (SUSFOOD and Core Organics)

Mixed farming systems focusing on organic solutions, with enhanced welfare and disease prevention (and therefore reduced antimicrobial use) for animals and allowing increased yield, quality, and diversity for fair and increased incomes for the farm

Knowledge generation in relation to nutritional value and health benefits of protein/niche crops by increasing the amount of land devoted to organic agriculture (SUSCROP, F2F)

Novel farming systems and technologies for achieving carbon neutrality

Improving niche crops for conventional and/or organic management

Climate resilience and adaptation

Including plankton taxonomy (identifying of species in the water column) to study biological diversity and manage our food resources

Sustainable agriculture and food systems for nutrition and health (SUSCROP, LEAP Agri, ICT Agrifood, ERACAPS)

Utilisation of genetic resources for increased biotic and abiotic stress tolerance. Build on genomics and phenotyping capabilities and molecular understanding of domestication-EUPHRESCO, ERA CAPS

Sustainable and secure supply of safe and nutritious food and feed using eco-efficient production and use of animal feed at the local level and seeking innovative solutions (caused by global change in the food system – food versus feed dichotomy) (ERACAPS, FOSC, Core Organic)

Upcycling of side streams from food processing to non-food industrial uses (SUSFOOD, bioeconomy, Food 2030)
Diverse crops for diverse diets, human health and resilient production

Socio-economic aspect of farming both for plant production and animal production. Consumer behaviour, acceptability, young farmers in the system

Sustainable and resilient agriculture – sustainable alternatives for animal-based products integrated approach including socio-economic aspects of animal health and welfare, and consumer awareness (ICRAD, ERA CoBioTech, FACCE SRA)

Digitalisation and data analytics (SUSCROP, LEAP Agri, ICT Agrifood, ERACAPS)

Lifting intrinsic yield potential - enhanced carbon capture (i.e. converting solar energy...) for increased biomass and yield-ERA CAPS, FACCE SURPLUS, BIOEAST

Sustainable and secure supply of safe and nutritious food (SUSCROP, LEAP Agri, ICT Agrifood, ERACAPS)

Knowledge generation in relation to nutrition value and health (SUSCROP, LEAP Agri, ICT Agrifood, ERACAPS)

Improved measurement methods for intake of grazing animals & CH4 emissions from animals at a range of scales and measurement of soil carbon- Cheap & accurate

Capacity building on a global Level together with GRA and Wheat Initiative (relates to ALL ideas) e.g. Cliff grads programme by the GRA

Generate basic knowledge to improve cropping systems

Less unique ◄

Figure 2: Ideas identified in the prioritisation session as **high impact** and **less unique** to the Green ERA-Hub

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Unique

Rural development processes and
social/community welfare

Immunology/microbiome development in
ruminants. IxMxMgmt. (<immunology -
Microbiome – Management. Links productivity,
health GHG

New circular use of waste to produce
energy in African/Latin American
countries

Immunology/microbiome development in
ruminants. IxMxMgmt (<immunology - Microbiome
– Management. Links productivity, health GHG

Supporting food processing
innovations in Africa (LEAP Agri,
SUSFOOD, FOSC)

Socio economic aspects. attract young
farmers in the system

Reducing food losses before and
after harvest under increased
climate conditions in the global
south (LEAP Agri, SUSFOOD,
FOSC)

Thematic workshop ERACAPS, EraCoBiotech,
FACCE Surplus

Low Impact

Figure 3: Ideas identified in the prioritisation session as **low impact** and **unique** to the Green ERA-Hub

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Less Unique

Farming practices for climate change
mitigation

Preserving natural resources and greening farming to counter
climate change and improve social resilience

Developing digital tools for mapping adapted land for different
cropping systems including livestock and assessing GHG
emissions (ICT Agri food, FACCE SURPLUS, FACCE
ERAGAS, ICRAD)

Development of niche protein crops

Animal Health - GHG
What is the role of animal health in relation to GHG

Improving nutritional value chains by increasing diversity of
plant-based foods replacing animal-based products

Lack of organic aquaculture production data. Link to the
Form-to-Fork organic target of a "significant increase in
organic aquaculture"

Enhanced understanding of the effects of
climate change on global food systems

A data driven reward system for biodiversity
and biosecurity

Freshwater aquaculture (ICRAD; SUSAN, BIOEAST, EUP
AH&W)

Low Impact

Figure 4: Ideas identified in the prioritisation session as **low impact** and **less unique** to the Green ERA-Hub

Further information on the different clusters of ideas below (A, B, C, D, E and F).

Clustered Ideas A - fundamental and applied plant biology:

- Adapted varieties for climate change and agricultural practices that improve health (ERACAPS, EJP Soil)
- Basic research to increase plant/crop health by improving crops to use less chemical plant protection products for soil, plant and human health (FACCE Surplus, SUSFOOD, Euphresco, FOSC)
- Molecular plant science for sustainable, intensified agriculture (ERACAPS, LEAP Agri)
- Fundamental research on the interactions between plants and microorganisms
- Plant phenotyping and environment and monitoring plant and microorganisms/microbiome – fundamental plant science
- Development of resilient, high yielding and multipurpose crops for food and non-food biomass (Bio East, ERACAPS, FACCE Surplus)
- Improve crops for nutrient use efficiency and for beneficial compounds for human health (plant secondary metabolites) including eastern Europe (FOSC, EJP Soil, Bio East, soil strategy, F2F)
- How plants can adapt to climate change with a focus on capacity to adopt to changing environment and to be cultivated in diversified systems (Mediterranean and African regions) (ERACAPS, FOSC)
- Molecular plant science for crops that are suitable for new climate conditions (salinity, drought) whilst maintaining nutritional value
- *Plus these additional ideas added after the workshop upon reviewing outputs:*
- Utilisation of genetic resources for increased biotic and abiotic stress tolerance. Build on genomics and phenotyping capabilities and molecular understanding of domestication (EUPHRESCO, ERA CAPS)

Clustered Ideas B – integrated approach and integrated systems for a food system that supports the planet, nature and people:

- Food system supporting a healthy planet (GHG reduction) by a) redesigning livestock production (adapt species and breeds to climate change, increased biodiversity, old species) b) change of diet and awareness c) breeds, species for climate mitigation d) feed, management and herd management
- Changing diet and GHG reduction objectives: implications for animal breeding and redesign of the livestock system
- Eco-efficient animal breeding and livestock production to support sustainable intensification of integrated food and non-food systems (Core Organic, SusAn, SURPLUS)
- *Plus these additional ideas added after the workshop upon reviewing outputs:*
- Improving animal welfare, farmer income and soil quality by using grazing and improving manure use sustainably
- Mixed farming (from farm to landscape level)

Clustered Ideas C: Exploring the links between organic agriculture, food, nutrition and human health

- *Plus these additional ideas added after the workshop upon reviewing outputs :*
- Research and studies to make health claims for plant compounds for human diet and health so that every scientist, farmer, company can refer to the health claim and for EU and non-EU origin of crops and the exploration of the benefits of organic agriculture for human nutrition and health
- Knowledge generation in relation to nutritional value and health benefits of protein/niche crops by increasing the amount of land devoted to organic agriculture (SUSCROP, F2F)

Clustered Ideas D – improved crops (and cropping systems) with and for developing countries to support nutrition and health in Africa:

- Sustainable intensification/diversity of agriculture in the global south (developing sustainable markets and supporting innovation)
- Sustainable and carbon neutral pest management practices and phytosanitary measures (current practices are chemically based, not sustainable, impact biodiversity, contribute to climate change). The idea is to develop new methods that allow a green transition. The methods should be relevant for EU and Africa as harmonisation will open Europe to African products. Integrated pest management, biotechnology, agriculture, policy
- Development of technologies and crop varieties for pests and disease management in African ecosystems (LEAP Agri, Euphresco)
- Adaptation to climate change and upcoming droughts in Europe by using African agricultural techniques/methods/crops and at the same time-sharing knowledge on sustainable intensification (more focus on molecular plant science)
- Breeding and management for sustainable, resilient crops adapted to climate change (SUSCROP, ICT Agri, ERACAPS, FACCE SRA)

Clustered Ideas E – data, models and on farm digital solutions to increase the sustainability and resilience of agricultural systems:

- Value chains (including production) for low emissions agriculture, animal, and plant breeding management practices (FOSC, SUSFOOD, ERACAPS, ERAGAS)
- How plants can adapt or be adapted to a changing environment, information technology to support plant health activities, optimising carbon neutrality through digital technologies. In summary: understanding how plants adapt to the environment to produce digital solutions for carbon neutrality (ERACAPS, Euphresco, FACCE ERAGAS)
- Connectivity and digital tools for small-scale farming for development of sustainable business models (ICT Agri, EU rural areas)
- Digital farm management systems towards sustainable agriculture (reduce fertilisers, reduce pesticides) towards restoring biodiversity (ICT Agrifood, SCAR foresight)
- Sustainable crop production by using digital solutions and ensuring resource efficiency by a circular approach

- Digital farm management systems and robotics, sensors, automation to 'find your enemy' for improved inspection of emerging plant pests (Euphresco, ICT Agrifood)
- Establishing early detection and alarm systems for pests and disease identification and management, combining meteorological data (Euphresco, ERACAPS, biodiversity)
- Models for sustainable intensification of agriculture i.e., identify eco-physiological data, field tests, models linking data and test results, tools to support farming (plant physiology, plant metabolomics, ecology, breeding, modelling, IT, innovation)

Clustered Ideas F – digital solutions to increase the traceability and sustainability of food products and retail/consumer choices:

- Digital solution to develop traceability tools for new products/food chain based on carbon footprint and nutritional values (if the partnership on agriculture of data doesn't cover this/isn't funded) (SUSCROP, ICT Agri Food, FACCE ERA-GAS)
- Digital solutions to identify the climate/sustainability footprint of food products in supermarkets (if the partnership on agriculture of data doesn't cover this/isn't funded)
- Creation of digital "passport" for food products to increase the demand for sustainable and resilient food production (SUSFOOD, FACCE SRA) (if the partnership on agriculture of data doesn't cover this/isn't funded)

Prioritisation Session

This session aimed to identify which ideas are the priorities by asking participants to vote on which ideas they thought are:

- unique to the GEH
- exciting and feel novel
- able to make a difference

The number of votes each idea received is shown in Table 1 below. The clusters are presented here but reference should be made back to the original ideas that form these groupings for further detail. NB. Clusters A, B, C, D and E are represented but F did not receive any votes and so is not present in Table 1. The votes that were received for ideas that were subsequently clustered after the workshop have been re-allocated to their respective clusters (the original table showing votes can be seen in Annex 3). Each individual idea can be explored in the clusters as well as in the image of the quadrants to understand where participants placed it on the impact and uniqueness scale.

Table 1. Voting of Priority Ideas

Idea	Votes
Cluster A: Generate knowledge on plant biology (basic biological processes and applied for improving crops using molecular biology, biology, classical and new breeding) for a) nutritional quality for diets b) abiotic and biotic stress resilience c) food and non-food uses	17
Cluster B: Integrated systems	15
Relationship between plant genotype, environment, soil and crop management system in a systems approach e.g. plant root interaction with the soil (EJP Soil, ICT Agri Food, ERA CAPS, SUSCROP)	11
Cluster C: Knowledge generation in relation to nutritional value and health benefits/claims for plants and niche crops (including proteins) and the benefits of organic agriculture for human nutrition and health	8
Improved measurement methods for intake of grazing animals & methane emissions from animals at a range of scales and measurement of soil carbon - Cheap & accurate	7
Sustainable and resilient agriculture – sustainable alternatives for animal-based products integrated approach including socio-economic aspects of animal health and welfare, and consumer awareness (ICRAD, ERA CoBioTech, FACCE SRA)	4
Waste/side product management e.g manure territorialisation to take manure from a waste to a product	4
Digital solutions to increase the traceability of food products, including identifying the climate/sustainability footprint and using traceability to increase the demand for sustainable foods by consumers/supermarkets (as long as the partnership on agriculture of data doesn't cover this/isn't funded)	3
One health: soil, plants, animals, humans	3
Cluster D: Improve crops (and cropping systems) with and for developing countries (nutrition and human health in Africa)	3
Novel farming systems and technologies for achieving carbon neutrality	3
New breeding technologies to improve/adapt crops and animals for future needs and environments	3
Climate adaptation and resilience	2
Cluster E: Digital tools for agriculture and modelling	2
Improving sustainable value chains of organic products and niche crops/production systems with a focus on eastern Europe	2

Improving nutritional value chains by increasing diversity of plant-based foods replacing animal-based products	1
GEH methodological note to keep all topics as mixed farming systems, consumer attitudes and animal welfare, animal health and food quality/safety and the intersection of the Partnerships	1
Socio economic aspects of farming both for plant production and animal production. Consumer behaviour, acceptability	1
Lifting intrinsic yield potential - enhanced carbon capture (i.e. converting solar energy...) for increased biomass and yield. (ERA CAPS, FACCE SURPLUS, BIOEAST)	1
GHG emissions of food systems -> farm-to-fork: better monitoring of emissions, more accurate GHG inventories, GHG mitigation innovations across the full system (animal-agriculture-food system)	1
Immunology/microbiome development in ruminants IxMxMgmt (<immunology - Microbiome – Management) Links productivity, health GHG	1

Discussion

There appears to be between three to five top ideas or clustered ideas (depending on the voting cut off used). In summary, the top five ideas are focused on the areas of:

- Plant biology for nutrition and health, resilience to pests and diseases and for bioeconomy purposes/benefits
- An integrated and systems approach towards a food system that supports planetary health through redesigned livestock systems, changes in awareness and diet, animal breeding to meet climate goals and maintain climate resilience and animal/herd management (including animal feed) to support climate mitigation
- A systems approach to understand interactions between soil, plant, environment and crop management system in context
- Knowledge generation in relation to nutritional value and health benefits/claims for plants and niche crops (including proteins) and the benefits of organic agriculture for human nutrition and health
- Improved measurement methods (that are cheap and accurate) for intake of grazing animals & methane emissions from animals at a range of scales and measurement of soil carbon

Some ideas were more focused on approaches and principles that are important for the GEH, as opposed to research topics. For example, it was emphasised in the discussion that all topics should be

considered with respect to mixed farming systems, consumer attitudes and animal welfare, animal health and food quality/safety and how these intersect with the Partnerships. Furthermore, integration and a systems approach were frequently mentioned within individual ideas. Consideration of how these more methodological approaches and principles are integrated into the strategic roadmap and future calls will be important.

The area of climate change doesn't appear to have been identified and prioritised explicitly as much as the workshop organisers expected. However, climate change can be viewed as cross cutting all of the top ideas generated. Furthermore, areas related to the bioeconomy and central and eastern European countries were less well represented at the workshop. GEH should consider how this is likely to influence the generation of the strategic roadmap and call scoping and if any additional engagement could help consider where there may be important missing or under-represented areas e.g. through further engagement with the External Expert Group or individual initiatives. Furthermore, it will be important to consider how the ideas interact with the Partnerships when there has been further development in their work programmes and call scoping.

The evaluation survey from the workshop can be found in Annex 4.

Next Steps

The ideas and topics that emerged from this strategic roadmapping session will be used to inform the GEH strategic roadmap, as well as provide input for the research call Work Package (WP3).

Annex 1: Workshop Information, Agenda and Participants

Table 1: Agenda for the Strategic Roadmapping Workshop

Agenda Time (duration)	Item
From 08:30	*Registration and refreshments*
09:00 (20 mins)	Welcome, introduction and background
09:20 (10 mins)	Ice breaker
09:30 (90 mins)	**Thematic research areas and strategic ambitions** Session to identify: • What are the synergies and added value across and between initiatives? • What interesting or unique ideas can we identify through collaboration?
11:00 (20 mins)	Feedback to room
11:20 (20 mins)	*Break*
11:40 (60 mins)	Gap analysis exercise Session to identify: • How do the ideas align with Horizon Europe Partnerships or other initiatives? • Which ideas are emerging as gaps?
12:40 (20 mins)	Feedback to room
13:00 (60 mins)	*Lunch*
14:00 (5 mins)	Reflection on the morning and introduction to the afternoon
14:05 (45 mins)	**Opportunities discussion** Session to identify: • How impactful are the ideas? • Which ideas are unique to the GEH?
14:50 (20 mins)	Feedback to room
15:10 (20 mins)	*Break*
15:30 (45 mins)	**Prioritisation exercise** Session to: • Identify priorities for strategic roadmap development.
16:15 (15 mins)	Wrap up and next steps
16:30 – 17:00	*Close*

Workshop Information

Date: Tuesday 14th November 2023

Time: 9-5pm CET

Location: For in-person attendees: Representation of the State of North Rhine-Westphalia to the European Union, Rue Montoyer 47, 1000 Brussels, Belgium

Workshop Participants

- 14 GEH initiatives were represented at the workshop (BIOEAST was absent)

Last Name	First Name	Affiliation	Attendance
Alford	Heather	GEH WP2	In-person
Breuer	Christian	SusCrop	In-person
Clark	Harry	New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC)	Virtually
Daike	Temiloluwa	GEH WP2	In-person
De Ruyck	Hendrik	ILVO	In-person
De Simon	Ambra	IFOAM Organics Europe	Virtually
Freitag	Ruth	University of Bayreuth	Virtually
Giovani	Baldissera	Euphresco	In-person
Grando	Stefano	FOSC	In-person
Hippolyte	Isabelle	LEAP-Agri; FOSC	In-person
Hunninck	Marijke	SUSFOOD2 - ICTAGRIFOOD-Susan	In-person
Jacquet	Florence	ANR	In-person
Kollamparambil	Ancy	MASAF	In-person
Kotzia	Katerina	Federal Office for Agriculture and Food/ICT Agri	In-person
Langridge	Peter	wheatinitiative	Virtually
Lichtenberg	Anton	CORE Organic	In-person
Mackie	Nikki	ERA-CAPS;ICRAD	In-person
Margraf	Stefanie	FACCE SURPLUS	In-person
McKhann	Heather	FACCE-JPI	In-person
Metzlaff	Karin	European Plant Science Organisation, EPSO	In-person
Nanda	Amrit	Plants for the Future ETP	In-person
Ní Choncubhair	Órlaith	ERA-GAS	Virtually
Olesen	Jørgen E.	Aarhus University	In-person
Rafter	Megan	ERA-CAPS;ICRAD	In-person
Rojas Padilla	Eduardo	WAGENINGEN RESEARCH/GEH	Virtually
Rokka	Susanna	Natural Resources Institute Finland (Luke)	In-person
Sandmann	Philipp	Federal Office for Agriculture and Food	In-person
Schulte	Petra E.	Green ERA Hub and ERA CoBioTech	Virtually
Trkulja	Ivana	CORE Organic	In-person
Turan	Mahur	Animal Health and Welfare Partnership	Virtually
Vernooij	Martine	GEH WP2 leader	In-person
Ziegler	Ulrike	EJP SOIL	In-person
Zuniga	Evelyn	ERA-GAS	In-person

Annex 2: Ideas Aligned with the Partnerships

The following ideas were identified as being strongly relevant for the Partnerships and were therefore "parked" here so that the discussion could focus on areas which are more unique and impactful for the GEH. Where identified, the ideas include which GEH initiatives they relate to.

Animal Health and Welfare:

- Increasing yield of emerging protein/niche crops (for animal feed) by applying digital production in order to improve the health and welfare of animals by better disease protection (SUSCROP, ICT AgriFood, ICRAD)
- Organic animal production for reduced environmental impact e.g. less inputs including Bioeast countries (SusAn, Core Organic, Bioeast)
- Digital monitoring systems for animal welfare aimed at lower income farmers in rural areas – part of the (grant) focus should be directed towards the distribution of the technologies into farms, education of farmers for how to use the devices and servicing (ICRAD, SusAn, EU rural areas)
- ICT – enabled livestock surveillance/monitoring of animal health and welfare (ICT AgriFood, ICRAD)
- Developing markets under the conditions that will contribute to the reduction of antimicrobial and antiparasitic use in livestock (ICRAD, FACCE SRA)
- Digital solutions, using AI technologies for surveillance and improvement for sustainability and management (SUSAN, ICT, AGRI FOOD, EUP, AH&W)

Agroecology:

- Develop and propose cyclic farming systems including animals that allow circularity for reduced external inputs, GHG emissions, improved meat and crop quality (no networks provided)
- Masterclass and learning tools that can introduce and teach how plants can adapt, how they survive or respond to emerging and endemic livestock, and increase biomass, supporting innovation value creation (ERA-CAPS, ICRAD, Bio East, FACCE SRA)
- Trade and regulation (organic) production of crops with regard to the prevention of spread of plant pests (improved inspection, organic measures) (no networks provided)
- Low GHG emissions farming systems based on organic and other low-input methods and on circularity in the use of sidestreams (Core Organic, FOSC, Food 2030)
- Impact assessment and trade-offs of switching our current land use and production (SUSCROP)
- Include representation from rural areas that have been forced to change due to extreme weather conditions in a program with scientists doing molecular plant science in a network to figure out what can be done in those areas (ERACAPS, FOSC, EU rural areas)
- Interaction between soil management and organic production for sustainable agricultural production (Core Organic, EJP Soil, SCAR Foresight)

- Low emission agriculture and mitigation of GHG emissions through breeding and biotechnology (ERA CoBioTech, FACCE ERA-GAS, FOSC)
- Mixed farming systems, diverse food systems and biodiverse landscapes – under soil management and its influence on sustainable agricultural production
- Biodiversity recovery to help with enemy phytosanitary measures (Biodiversity, Euphresco)
- Knowledge and capacity building for sustainable intensification while ensuring plant health in regards to biotic stress (SUSCROP, Core Organics, Euphresco)
- Fostering the uptake of soil management practices which are conducive for climate change adaptation/mitigation end-users and policy (feed production, manure production/use) (no networks)
- Sustainable increase of biomass production, competitiveness while ensuring CO2 sequestration and preventing GHG emissions (no networks)
- Use of sensor systems in the soil for biomass efficiency and soil management (Bioeast, EJP Soil)
- Enhance carbon farming and soil carbon retaining through the further adoption of organic and other green farming methods (EJP soil, Core Organics, F2F strategy, soil strategy)
- Digital tools/solutions for soil quality monitoring (ICT AgriFood, EJP soil) (no name)
- Soil carbon sequestration while ensuring circular biomass production under climate change/various climatic conditions (no networks)
- Plant-microbiome interactions to manage soil to restore biodiversity in degraded ecosystems (ERACAPS, EJP Soil, Biodiversity)
- Sustainable increase of biomass (making production more resilient, supporting competitive food products) with a focus on widening participation e.g. Eastern Europe (Bio East)
- Increased plant-based biomass as a solution to reduce carbon footprint and to increase the bio-based value chains (FACCE ERA-GAS, Bio East, EUPHRESCO)

Sustainable Food Systems:

- Protein crop for food and material (crops selected for dual use) – the use as food/material will be linked to the quality/yield of the crop. This will help diversify the markets for farmers and secure use of all production (agronomy, breeding, biotechnology, physics, chemistry) (no networks provided)
- Workshop and focus group to better understanding consumer behaviour (SUSFOOD)
- Global food system sustainability – sustainable value chains taking into account climate change and shocks (LEAP Agri, SUSFOOD, SCAR)
- Eco-friendly food production systems to reduce GHG emissions (FACCE ERA-GAS, FOSC, Core Organic)
- Use living lab approaches to develop local based food systems/food chains connecting producers to consumers (SUSFOOD, LEAP Agri)
- Intensification of food and non-food systems of agriculture (SUSAN, Leap AGRI, FACCE Surplus, EUP AH&W)

Annex 3: Original Voting Priority of Ideas

Idea	Votes
Generate knowledge on plant biology (basic biological processes and applied for improving crops using molecular biology, biology, classical and new breeding) for a) nutritional quality for diets b) abiotic and biotic stress resilience c) food and non-food uses (A)	15
Integrated systems (with clustered ideas)	11
G x E x M EJP Soil, ICT Agri Food, REA CAPS, SUSCROP Relationship between plant genotype, environment, soil and crop management system. - SYSTEMSAPPROACH Plant root interaction with the soil	11
Improved measurement methods for intake of grazing animals & CH4 emissions from animals at a range of scales and measurement of soil carbon - Cheap & accurate	7
Research and studies to make health claims for plant compounds for human diet and health so that every scientist, farmer, company can refer to the health claim and for EU and non-EU origin of crops and the exploration of the benefits of organic agriculture for human nutrition and health	7
Sustainable and resilient agriculture – sustainable alternatives for animal based products integrated approach including socio-economic aspects of animal health and welfare, and consumer awareness (ICRAD, ERA CoBioTech, FACCE SRA)	4
Waste/side product management e.g manure territorialisation to take manure from a waste to a product	4
Digital solutions to increase the traceability of food products, including identifying the	3

climate/sustainability footprint and using traceability to increase the demand for sustainable foods by consumers/supermarkets (as long as the partnership on agriculture of data doesn't cover this/isn't funded)	
One health: soil, plants, animals, humans	3
Improve crops (and cropping systems) with and for developing countries (nutrition and human health in Africa) (D)	3
Novel farming systems and technologies for achieving carbon neutrality	3
Improving animal welfare, farmer income and soil quality by using grazing and improving manure use sustainably	3
New breeding technologies to improve/adapt crops and animals for future needs and environments	3
Utilisation of genetic resources for increased biotic and abiotic stress tolerance. Build on genomics and phenotyping capabilities and molecular understanding of domestication. EUPHRESCO, ERA CAPS	2
Climate adaptation and resilience	2
Digital tools for agriculture and modelling (E)	2
Improving sustainable value chains of organic products and niche crops/production systems with a focus on eastern Europe	2
Improving nutritional value chains by increasing diversity of plant based foods replacing animal based products	1
GEH methodological note to keep all topics as mixed farming systems, consumer attitudes and animal welfare, animal health and food quality/safety and the intersection of the partnerships	1

Knowledge generation in relation to nutritional value and health benefits of protein/niche crops by increasing the amount of land devoted to organic agriculture (SUSCROP, F2F)	1
Mixed farming (from farm to landscape level)	1
Socio economic aspects of farming both for plant production and animal production. Consumer behaviour, acceptability	1
Lifting intrinsic yield potential - enhanced carbon capture (i.e. converting solar energy...) for increased biomass and yield. ERA CAPS, FACCE SURPLUS, BIOEAST -high risk, basic research, low impact, due to the high risk	1
GHG emissions of food systems -> farm-to-fork: better monitoring of emissions, more accurate GHG inventories, GHG mitigation innovations across the full system (animal-agriculture-food system)	1
Immunology/microbiome development in ruminants IxMxMgmt (<immunology - Microbiome – Management) Links productivity, health GHG	1

Annex 4: Workshop Evaluation Survey

Questions

- Do you think the ideas generated at the workshop will usefully inform the strategic roadmap of the GEH? - Ideas
- Did you come away from the workshop with new connections? - Connections
- Did you come away from the workshop with new and/or exciting ideas for collaboration? - Ideas Collab
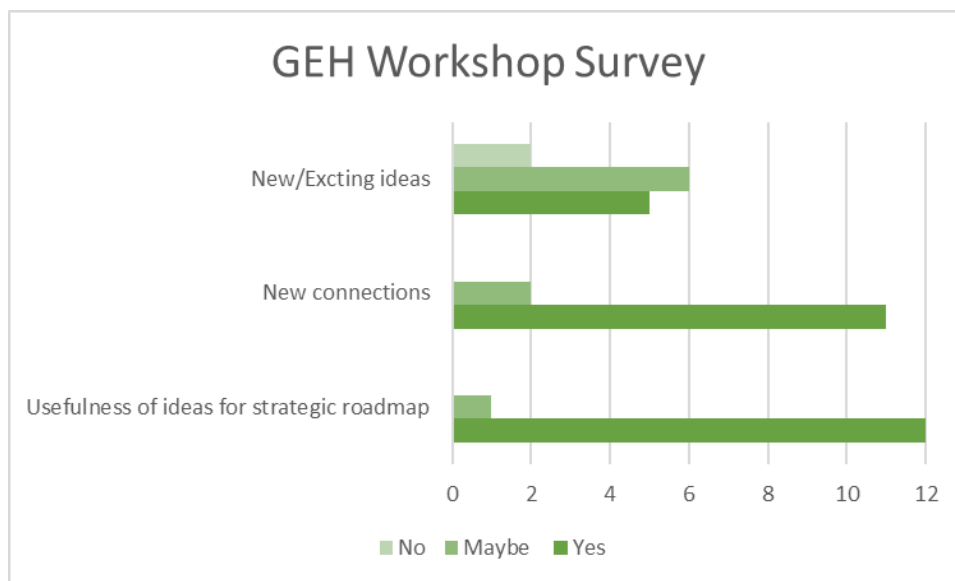

Figure 5: Bar graph of survey results for the GEH strategic roadmapping workshop

What one thing did you enjoy about the workshop

- That each step of the workshop built on what we discussed in the previous session. It gave us the chance to reflect on and move forward our ideas.
- The link between possible future topics and existing networks research agendas, and more generally the nice atmosphere triggered by the facilitators
- Good open discussion within the on-line group. Provided a good idea on how the system works.
- The creative way it was conceptualised.
- Very clear instruction
- To talk about the synergies that could occur in the future and hearing the gaps in the recent partnerships.
- The card game (6)
  - A great way to collect input from everyone
  - Wonderful kick off to get a bunch of ideas as basis for the entire workshop
  - A very interesting tool

What one thing would you change about the workshop? – Changes

- A slightly later start would have been nice. There isn't anything I'd have changed about the workshop itself.
- Make sure that everyone has a role. It's a way to keep everyone active throughout the event and to avoid that the pushy people are contained, and the shy people express themselves.
- The game (good idea!) Could have been made more free/flexible in the use of different cards to support the suggested topics. It was difficult to locate topic ideas to one area or another, but this is an issue common to all these exercises.
- Many ideas were crosscutting so sharing them under partnership themes (back to silos) was maybe not so fruitful. But for sure it was important to reflect the ideas towards partnerships anyways, even though it's not yet quite clear which topics partnerships will actually cover, or where the gaps will be.
- To talk about the synergies that could occur in the future and hearing the gaps in the recent partnerships.
- Don't know if it would have been possible to change it, but the workshop ended too late. Some of the participants had to leave before the end of the workshop, in order to travel home on the same day.
- Online session
- I felt that the on-line group didn't really get a good feel for the overall discussions. The feedback sessions were a bit too short and there was no opportunity to ask questions.   I realise that time was quite limited, but it would have been helpful if time were allocated for more discussion.
- Hybrid participation in a workshop seems rather difficult and I don't really see the added value. But very good, managed well
- For the prioritisation exercise and clustering of the ideas would dedicate more time. Maybe also think of additional tools and steps in the process.
- Split into two half days
- Nothing
- It was very enjoyable!