PROJECT DISRUPT: GAME-CHANGING INNOVATIONS FOR HEALTHY DIETS ON A HEALTHY PLANET

INSIGHTS FROM A DELPHI STUDY

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Charlotte Pedersen, Roseline Remans, Heather Zornetzer, Maud De Hemptinne, Eric Brulé-Champagne, Sanne Jensen, Catia Pedro, Wendy Gonzalez, Abigail Falla, Marie-Angélique Laporte, Fabrice DeClerck

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ABOUT GAIN

The Global Alliance for Improved Nutrition (GAIN) is a Swiss-based foundation launched at the UN in 2002 to tackle the human suffering caused by malnutrition. Working with governments, businesses and civil society, we aim to transform food systems so that they deliver more nutritious food for all people, especially the most vulnerable.

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The Global Alliance for Improved Nutrition (GAIN)
Rue de Varembé 7
1202 Geneva
Switzerland
T: +41 22 749 18 50
E: info@gainhealth.org

gain Global Alliance for Improved Nutrition

PROJECT DISRUPT PANEL OF EXPERTS

The following individuals played a critical role in the development of this report as participants in the Delphi Panel.

Alem Hadera Abay, *Senior Nutritionist, Consultant*

Ermias Aynekulu, *Land Health Scientist, World Agroforestry (ICRAF)*

Nazmul Alam, *Programme Manager, International Food Policy Research Institute (IFPRI)*

Lukasz Aleksandrowicz, *Portfolio Manager, Wellcome Trust*

Fikadu Reta Alemayehu, *Assistant Professor, Hawassa University, Ethiopia*

Henrik Jørgen Andersen, *Senior Executive R&D Advisor, Arla Foods Ingredients*

Alex O. Awiti, *Senior Research Fellow, East Africa Institute, Aga Khan University, Kenya*

Christopher B. Barrett, *Stephen B. & Janice G. Ashley Professor of Applied Economics and Management, Cornell University*

Kaleab Baye, Associate Professor, Addis Ababa University

Tesfaye Hailu Bekele, *Researcher at Ethiopian Public Health Institute; Phd Candidate at Wageningen University and Research*

Inge D. Brouwer, *Associate Professor, leader A4NH-CGIAR Flagship Food Systems for Healthier Diets, Wageningen University*

Patrick Caron, *Chair of the Scientific Council of AgroParisTech, Vice President for International Affairs, University of Montpellier*

Julia Compton, *Head of Secretariat, Commission on Sustainable Agriculture Intensification (CoSAI), WLE/IWMI, Battaramulla, Sri Lanka*

Damien Conaré, *Secretary General UNESCO Chair in World Food Systems (Montpellier SupAgro)*

Tesfaye Haile Dargie, *Project Manager, UNDP Ethiopia*

Camilla De Nardi, *Associate FReSH, World Business Council for Sustainable Development (WBCSD)*

Ruth DeFries, *Denning Family University Professor of Sustainable Development, Columbia University*

David Edwards, *Director of Food Strategy, World Wildlife Fund-UK*

Jessica Fanzo, *Professor, Johns Hopkins University*

Giovanni V. Frajese, *WFO-OMA Scientific Advisor; Associate Professor of Advanced Medical Technical Science and Director of SMART Lab, University of Rome "Foro Italico"*

Greg S. Garrett, Director of Strategy & Design. ThinkWell

Douglas Gayeton, *Co-Founder at The Lexicon*

Chris Gordon, *Country Engagement Lead, Climate Development Knowledge Network (CDKN)*

Joseph Gridley, *Business Development, EIT Food*

Nicola Gryczka, *CEO of Gastromotiva and Co-founder of the Social Gastronomy Movement*

Afton Halloran, *Independent Consultant in Sustainable Food Systems Transitions*

PROJECT DISRUPT PANEL OF EXPERTS

The following individuals played a critical role in the development of this report as participants in the Delphi Panel.

Chavanne Hanson, *Food Choice Architecture and Nutrition Manager, Global Food Team @ Google*

Jody Harris, *Research Fellow, Institute of Development Studies (UK) and Lead Specialist - Food Systems at the World Vegetable Center (Thailand)*

Guy Hogge, *Global Head of Sustainability, Louis Dreyfus Company*

Nick Jacobs, *IPES-Food, Director*

Thomas Kähler, *Senior Vice President, ROCKWOOL*

Mark Kaplan, *Founder and Partner / Envisible - Wholechain*

Tarik Kassaye, *Independent Nutrition Consultant*

Bushra Ferdous Khan, Lecturer, North South University, Bangladesh

Carl Lachat, *Professor, Ghent University*

Ferew Lemma, *Senior Advisor, Ministry of Health, Ethiopia*

Agnes Martin, *Health & diet advocacy director, Danone*

Timothée Pasqualini, *Research analyst, World Benchmarking Alliance*

Sarah Rawson, *Senior Sustainability Strategist, Olam International*

Carson Roper, *Seafood Industry Liaison, Independent Consultant*

Ruerd Ruben, *Professor & Research Coordinator, Wageningen University & Research*

Petra Schmitter, *Research Group Leader, Sustainable and Resilient Food Production Systems, International Water Management Institute (IWMI)*

Dominic Schofield, *Partner & Managing Director, Peregrine Impact Associates*

Sergey Shabala, *Professor, University of Tasmania, Australia*

Dorothy Shaver, *Global Sustainability Lead, Knorr; Registered Dietitian, Unilever*

Laura Shulman, *Founder and President, Food Future Strategies, Inc*

Ethan Soloviev, *Chief Innovation Officer, HowGood.com*

Shakuntala Haraksingh Thilsted, *Research Program Leader, Value Chains and Nutrition, CGIAR-WorldFish*

Nazim Uddin, *Senior Scientific Officer, Horticulture Research Center, Bangladesh Agricultural Research Institute (BARI)*

Elke Vandamme, *Systems Agronomist, International Potato Center (CIP)*

Tom Verdonk, *Ph.D. student, University of Leuven*

Alain Vidal, Director, Science and Partnerships, World Business Council for Sustainable Development (WBCSD)

SUMMARY

The global food system is a major driver of environmental degradation, ill health, premature mortality and inequity. To enable resilient, affordable, safe and nutritious diets for the current and growing global population while restoring and safeguarding our environment, we need to urgently innovate food system solutions that work for both people and planet. GAIN, the Alliance of Bioversity International and CIAT (International Center for Tropical Agriculture), and EAT joined forces to conduct a three-stage Delphi study as part of 'Project Disrupt', from March through to June of 2020. Our objective was to surface and assess promising innovations that support both dietary and planetary from a diverse group of experts.

The Delphi study asked, "Which innovations can be game-changers in making affordable, safe and nutritious foods available in an environmentally sustainable way by 2030?" We focused on the distinct challenges and opportunities of three geographical and food system settings: semi-arid rural Ethiopia, tropical/coastal environments in Mozambique and urban Bangladesh. This paper discusses results and insights from this process, highlights selected focus innovations and projects pathways to achieve impact by 2030.

A Delphi methodology was applied to elicit expert opinions and use a consensus-based approach to identify game changing innovations. Data were gathered using online tools and virtual discussion sessions during the early months of the COVID19 global pandemic from a diverse panel of 52 experts. A subset of innovations spanning the food supply chain were selected and further prioritised based on expert scoring criteria -- including dietary health, environmental restoration, equity and leapfrogging potential. Initial pathways to impact were developed to outline key steps and to imagine possibilities, spillovers, barriers, trade-offs and related solutions.

Our findings reinforce that no single innovation will fix the food system but that 'game-changing' is really about businesses, governments and civil society to join forces and invest in portfolios of innovations to reach the scale necessary to truly transform our food systems – for better nutrition, better planetary health, and greater equity by 2030.

KEY MESSAGES

- This project uniquely addressed the challenges in identifying and assessing innovative solutions to improving both planetary and dietary health by 2030, grounded in three real world settings.
- Key technological, nature-based and societal innovations can help transform our food systems but we need to connect, enable and accelerate their transition pathways.
- Interest to apply the adapted Delphi process in other settings prompted the development of the Delphi Process Toolkit.
- We call for investors, businesses, governments and civil society to act out of the box and invest in portfolios of promising innovations that can help catalyse food system transformation by 2030.

BACKGROUND AND OBJECTIVE

The food system is a major driver of global environmental degradation and poor health and thus in dire need of change. To enable a growing population to access affordable, safe, and nutritious diets while restoring and safeguarding our environment, it will be important to think and act in new ways. There is an urgent need to reimagine food systems and devise transformative solutions that address these interlinked issues simultaneously, while equitably delivering better nutrition for all.

From an environmental perspective, the way we produce, prepare, and dispose of our food contributes to climate change, land and soil degradation, deforestation, biodiversity loss, freshwater use, and pollution, among others. Food is estimated to be responsible for 29% of global greenhouse gas emissions, of which as much as 80% are linked to livestock production (1). Food production is estimated to account for 80% of land use conversion and biodiversity loss, 75% of freshwater use, and significant soil degradation (2,3). It is also a major driver of disruption to global nitrogen and phosphorus cycles, with important impacts on water quality (4). Furthermore, one third of the world's marine fisheries stocks were classified as overfished and almost two thirds as fully fished in 2015 (5). Rising atmospheric carbon dioxide concentrations results in ocean acidification that, in turn, threatens marine ecosystems (6). Additionally, the expansion of aquaculture practices has the potential to negatively impact coastal habitats and freshwater and terrestrial systems (2). In short, following a 'business as usual' approach for feeding 9 billion people by 2050 is untenable (7,8,9).

Despite the massive environmental cost, the food system does not currently support the attainment of global nutritional requirements: almost a quarter of all children under five years of age are chronically undernourished, and one in every three people (adults and children above the age of 5) is overweight or obese (10). Prior to the onset of the global COVID-19 pandemic, the Global Burden of Disease Study estimated that, in 2017, 11 million deaths and 255 million disability adjusted life years (DALYs) had diet-related causes (11). The corresponding numbers for 2020 may be significantly higher due to COVID-19, for which mortality risk is associated with diet-related health conditions (10).

No country is on course to meet all ten of the 2025 global nutrition targets set by the World Health Organization, and just eight of 194 countries are on track to meet four targets (10). Immediate action is essential to achieve Sustainable Development Goal 2 and to end all forms of malnutrition by 2030. Progress on malnutrition is also deeply inequitable, with the most vulnerable groups being most affected (10).

To help address these issues, GAIN, the Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT), and EAT joined forces, as part of an initiative called 'Project Disrupt,' to conduct a three-stage Delphi study to identify and investigate game-changing innovations for improving diets and equitably restoring environments by 2030. The Delphi method refers to a set of questionnaire-based problem-solving and forecasting techniques that share three underlying characteristics: partial or complete anonymity, structured feedback to the participants, usually including a statistical summary, and iterative rounds to build consensus (12). Project Disrupt builds on several works published over the last few years by a number of research groups and institutions that have investigated potential innovations and interventions that separately or collectively address human and planetary health (8, 13-22). Most of this prior work emphasises that disruptive innovation is critical to accelerate the transition towards a sustainable food system.

In 2018, the World Economic Forum (WEF) published a report identifying "emerging technology innovations that have the potential to drive rapid progress in the sustainability, inclusivity, efficiency and health impacts of food systems" (20). The WEF report identified additional technology applications that illustrate this potential and evaluated these for their different potential global economic and environmental impacts. In 2019, GAIN and the Global Knowledge Initiative (GKI) conducted a study using the Delphi methodology to identify innovations that could improve malnutrition outcomes on a five-year basis. De Brauw et. al. (2019) investigated food system innovations that have the potential to transform food systems performance in providing healthier diets for people in low- and middle-income countries (LMICs). That study also set out a multidisciplinary framework for both identifying and analysing such innovations (19).

Also in 2019, the High-Level Panel of Experts on Food Security and Nutrition (organised by the United Nations Committee on World Food Security) published a report investigating agroecological and other innovative approaches that have the potential to support the transition towards sustainable food systems (22). The report stresses that there is no 'one-size-fits-all' solution to carry out the transformation of food systems needed to achieve food and nutrition security but that instead it will require a diversity of transitions adapted to local conditions and challenges.

Herrero et al. (2020) used a Delphi methodology among co-researchers to identify and assess the adoption-readiness of future technologies that could profoundly transform the food system, spanning the entire food system, from food production, processing, and consumption to waste-stream management (21). Their research defined eight actions to accelerate technological change and systemic innovation in food systems: 1) building trust, 2) developing transition pathways (i.e., ways in which these innovations could be implemented), 3) transforming mindsets, 4) enabling social license, 5) changing policies and regulations, 6) designing market incentives, 7) safeguarding against undesirable effects, and 8) ensuring stable finance.

The study described in this paper builds upon this body of knowledge and methods, contributing to it in four major ways:

1. The approach in this study is ***multi-dimensional***, addressing the potential for each innovation to have a major impact on ***nutrition, environment, equity***, and ***leapfrogging***, and identifying win-win options as well as potential trade-offs and spill-over effects between those criteria.
2. The central research question "Which innovations can be game-changers in making affordable, safe, and nutritious foods available in an environmentally sustainable way by 2030?" is rooted in real-life challenges of ***three distinct food systems contexts*** and thereby tailors innovations to specific geographic and cultural contexts.
3. A virtually coordinated Delphi methodology is applied in this study, engaging a ***diverse panel of experts*** from over 25 different countries and with backgrounds in nutrition, environment, food systems, policy, agri-food business, economics, innovations, digital technologies, art, and journalism to surface and explore a wide set of innovations.
4. ***Concrete, actionable stepping-stones*** towards intended impact are constructed by developing transition pathways, by investigating interactions and complementarities between innovations for portfolio building, and by connecting actors working at different ends of the food system.

The overall goal of the project is to identify innovations that can help ensure that healthy and sustainably produced food is the most accessible, affordable, and desirable choice for all.

This paper discusses results and insights from this Delphi study. We first explain how the Delphi methodology was executed using a virtual and interactive approach with a diverse group of experts. The subsequent sections present the results based on the experts' evaluations. Next, a short description of the 20 innovations scoring highest is presented. The last section discusses the findings and reflections from the process, including a need for synergistic thinking. We conclude with insights on the next steps planned to stimulate stakeholders across sectors to collaborate and act boldly to transform the food system to be able to provide healthy diets to all from a healthy planet.

THE DELPHI METHODOLOGY: OVERVIEW

THREE-STAGE DELPHI PROCESS

We conducted an adapted three-round online Delphi study from March to June 2020. We first convened a multi-disciplinary expert panel of 52 individuals (18 women and 34 men) from over 25 countries and more than 45 different institutions (see Annex 5 for the complete Project Disrupt Biography Book for all participants). Experts shared their experiences and perspectives from across the private and public sectors, the NGO and international development communities, as well as from universities and research centres.

Over the course of the project, this diverse group actively participated in the iterative rounds of the study, using a combination of email communication and online interactive research tools.

Each of three rounds had a different focus: divergence (surfacing and categorising unique innovations), convergence (scoring and ranking innovations), and detailing (back-casting and building pathways to impact). Each round included a virtual discussion session (see Annex 1) using an online video conferencing platform, followed by an online anonymised survey (see Annex 2) to capture expert input and insights. A final fourth virtual webinar was facilitated by the research team to summarise project results, reflect on the process, share lessons learned, and outline next steps. Participants were invited to provide any additional thoughts and feedback in a fourth online survey following the final webinar, with the purpose of obtaining input to improve the overall process as well as additional thoughts from the experts on the innovations surfaced.

GROUNDING THE CHALLENGE IN REAL-LIFE SETTINGS

To avoid overly generalised solutions that lack context specificity, the research question was rooted in the concrete challenges of three distinct geographical settings and food system contexts: 1) a semi-arid rural setting in Ethiopia; 2) a tropical, rural coastal setting in Mozambique; and 3) a tropical urban setting in Bangladesh. Many of the panellists live in or were from one of the three settings, while others were assigned to a setting based on their relevant professional experience and areas of expertise. All participants were given a general orientation to the three settings during the first webinar (summarised below in Table 1). Additional information and relevant details were provided for each setting for the participants to refer to throughout the project (see Annex 3).

Table 1: Summary of relevant dietary, environmental, and socio-economic challenges in each of the three geographical contexts and food system settings.

Domain	Semi-Arid Rural Area Ethiopia	Tropical Coastal Area Mozambique	Urban Area Bangladesh
Dietary challenges (23,24)	▪ Malnutrition is the #1 risk factor driving most death and disability ▪ High levels of deficiencies in quality protein, vitamin A, and Zinc ▪ High prevalence of food-borne diseases ▪ High levels of food insecurity ▪ Limited dietary diversity	▪ Malnutrition is the #1 risk factor driving most death and disability ▪ High prevalence of water- and food-borne diseases ▪ High food insecurity ▪ Limited dietary diversity	▪ Malnutrition is the #1 risk factor driving most death and disability ▪ Very high prevalence of food-borne diseases ▪ Rapid increase of intake in highly processed foods contributing to rising obesity and diabetes over the last decade ▪ Limited dietary diversity
Environmental Challenges (25,26)	▪ Soil erosion ▪ Land degradation ▪ Water scarcity ▪ Changing climate leading to shorter rainy seasons and increasing biodiversity loss	▪ Vulnerable to extreme weather events and climate change: droughts, floods, and cyclones ▪ Water and soil pollution ▪ Changing climate, leading to increasing biodiversity loss	▪ Extreme weather events leading to critical crop water stress issues ▪ High levels of pollution ▪ High GHG emissions
Socio-economic Challenges (24,27)	▪ Limited market access ▪ High poverty rates among farmers ▪ Wide income inequality (Gini index of 35 (of 100), 2015) ▪ Growing population (109.2 Million - 2018 ; population growth rate of 2.6, WB 2019) ▪ Youth unemployment but with increased levels of higher education	▪ High levels of poverty ▪ Wide income inequality (Gini index 54, 2014) ▪ Rapid population growth (29.5 Million - 2018; population growth rate of 2.9, WB 2019) ▪ Limited capacity to adapt to climate change	▪ Wide income inequity (Gini index 32.4, 2016) ▪ Large population (165 million) and high population density 1.265 thousand per square kilometre (WB 2020, 2.5 times the density of the Netherlands)
Percentage of population who cannot afford a healthy diet (28)	▪ 84%	▪ 92.7 %	▪ 74.6 %

DELPHI ROUND 1: DIVERGENCE

The first round of the Delphi study was a 'disruptive innovation scan'. Panellists were asked via a questionnaire to provide three to five innovations that could disrupt business-as-usual in making affordable, safe, and nutritious foods available in an environmentally sustainable way by 2030 in the context to which they were assigned. In addition to the innovation description, panellists were asked to provide information on the leapfrogging potential (see Box 1), maturity status, potential dietary impact, and potential planetary health impact of the proposed innovations.

The innovations surfaced by the experts were reviewed by the research team, and similar innovations were merged. A literature search was also performed, and innovations were chosen to complement those originally surfaced by the experts. The innovations were then grouped into one of six clusters (see Table 2), and individual innovation profiles were developed, including a description, their maturity level, and position in the supply chain. This was the basis for the first version of the Project Disrupt Innovation Catalogue (now included in the final Catalogue, part of Annex 8).

BOX 1: LEAPFROGGING

For the purposes of this exercise, we defined leapfrogging as the potential of by-passing linear or stepwise improvements and applying solutions that are several generations ahead of current approaches - e.g., mobile networks in LMICs by-passing the building of landline networks. This was done looking specifically at solutions that positively disrupt 'business as usual' to improve both human and environmental health.

The innovations surfaced by the experts were reviewed by the research team, and similar innovations were merged. A literature search was also performed, and innovations were chosen to complement those originally surfaced by the experts. The innovations were then grouped into one of six clusters (see Table 2), and individual innovation profiles were developed, including a description, their maturity level, and position in the supply chain. This was the basis for the first version of the Project Disrupt Innovation Catalogue (now included in the final Catalogue, part of Annex 8).

Table 2: Cluster definitions developed for Round 2 of the Delphi study

Cluster	Working Definition
CROPS & ANIMAL PRODUCTION	solutions targeting aqua/agricultural inputs (or the management of inputs), production practices, on-farm resource-use, efficiency, resilience, animal health, or diversity of aqua/agricultural outputs
FOOD SCIENCE & TECHNOLOGY	solutions targeting biotechnology, food design, or postharvest transformation of agricultural outputs (including, for example, processing technologies, increasing food safety, nutrient availability and/or content, upcycling waste products, and food additives)
LOGISTICS & DISTRIBUTION	solutions targeting efficient, safe, and/or transparent ways to ensure users have access to the necessary agricultural outputs, foods, and food products (including transportation, storage, traceability, retail, and packaging)

DIGITAL & AgTECH 4.0	solutions targeting digital advancements, information and communication technologies, and solutions of the fourth agricultural revolution (including data science, digital technologies such as sensors, robots, GPS, aerial imaging, and blockchain)
EDUCATION & OUTREACH	solutions targeting education and outreach for actors across the supply chain - from food producers to consumers
PUBLIC/PRIVATE INSTITUTION	solutions targeting regulation, finance or research mechanisms at the institutional level (e.g., banks, research centres, industry associations, development organisations), including trade restrictions, quality/safety requirements, patent rights, labelling and subsidies

DELPHI ROUND 2: CONVERGENCE

The aim of this round was to score, rank, and prioritise the innovations based on 14 criteria initially proposed by the research team and later refined with the panellists during webinar discussions before Round 2. The criteria were grouped into four sets: 1) dietary health, 2) planetary health, 3) leapfrogging potential, and 4) equity (Table 3, Figure 1). For the purposes of this project, the definition of "equity" was left somewhat broad to refer to the potential of the solution to reduce the disparities between groups that have different levels of underlying social advantage or disadvantage at any point in the food system.

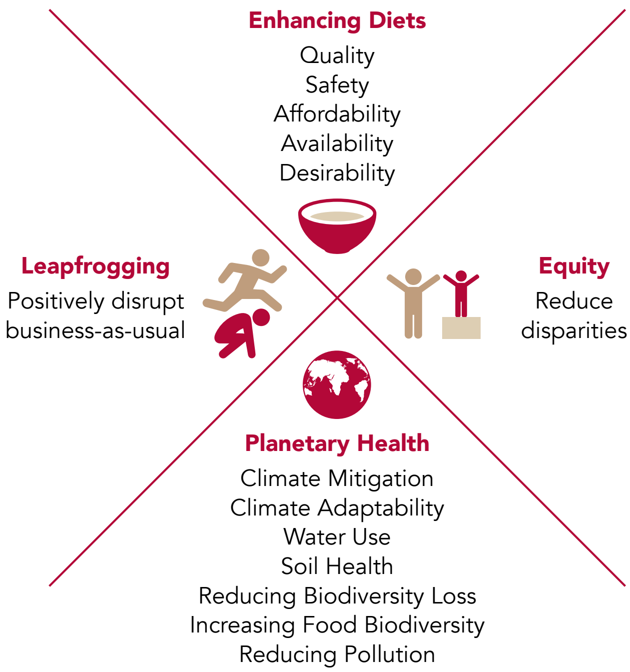


Figure 1: The four sets of criteria developed to assess the potential impact of food system innovations

Each panellist was asked to select from the 85 innovations in the round 1 catalogue their top ten innovations and evaluate these for their specific setting using these 14 criteria. They were then asked to describe the potential for impact on enhancing diets, planetary health, equity, and leapfrogging and provide examples of existing use or impact (if available).

Table 3: Criteria definitions developed for Round 2 of the Delphi study

Criterion	Working Definition
Enhancing Diets	
QUALITY	Potential of solution to improve the nutritional quality of the food basket such that it provides dietary diversity and balanced diets including a range of food groups and all beneficial nutrients (e.g. vitamins, minerals, proteins, essential fats, dietary fibres). Also includes the potential to minimise potentially harmful elements (e.g. anti-nutrients, high quantities of saturated fats, salt and sugars) and diet-related comorbidities.
SAFETY	Potential of solution to minimise biological, chemical, or physical contamination of food product(s), including both sanitation and toxicity issues.
AVAILABILITY	Potential of solution to increase supply and/or access to nutritious foods. Takes into account seasonal shifts in supply, the importance of stability, changes in policy and trade, and excesses/shortages of raw materials needed for a food's production or processing.
AFFORDABILITY	Potential of solution to increase access by reducing the consumer price or increase purchasing power for nutritious foods, either through increased income or entitlements (e.g. social protection mechanisms).
DESIRABILITY	Potential of solution to improve the desirability of nutritious foods or healthy diets, i.e. to make foods or healthy diets more aspirational, tasty, culturally appropriate, convenient, and/or easy to prepare.
Supporting Planetary Health	
CLIMATE MITIGATION	Potential of solution to reduce the greenhouse gas footprint of the food system by reducing emissions or capturing carbon.
CLIMATE ADAPTATION	Potential of solution to increase the food system's adaptative capacity to climate change, e.g., by reducing the impact of severe weather events, droughts, flooding, changing seasons, or other climate related issues.
WATER USE	Potential of solution to decrease the water footprint of the food system, e.g., by increasing water use efficiency, recycling water, or reducing water needs.
SOIL HEALTH	Potential of solution to improve soil health, restore degraded land or avoid land degradation, e.g. by increasing soil organic matter, contributing to soil biodiversity and soil nutrient availability, or reducing soil erosion and risk of gully formation
REDUCING BIODIVERSITY LOSS	Potential of solution to decrease biodiversity loss related to the food system, e.g. by reducing pressure on land and water and chemical pollution, enhancing conservation of species at risk, and/or creating habitat in agricultural lands/aquaculture waters.
INCREASING BIODIVERSITY	Potential of solution to increase biodiversity in the food system, e.g., by diversifying production systems and ingredient portfolios or enhancing use of underutilised species.
REDUCING POLLUTION	Potential of solution to decrease pollution from the food system, e.g., by reducing nitrogen or phosphorus run-off and plastic pollution, or by reducing other types of pollution.
Additional Criteria	
LEAPFROGGING	Potential of by-passing linear or stepwise improvements and applying solutions that are several generations ahead of current approaches. Looking specifically at solutions that positively disrupt 'business as usual' to improve both human and environmental health.
EQUITY	Potential of the solution to reduce the disparities between groups that have different levels of underlying social advantage/disadvantage at any point in the food system.

Panellists rated the innovations on each of the 14 criteria with one of four possible values related to the innovation's potential for impact (plus a 'do not know' or blank score):

- high potential (+1)
- moderate potential (+0.5)
- low or no potential (0)
- potential negative impact (-1)
- don't know (0)

Subsequently, a single-criteria-set score was calculated for each of the four criteria sets as:

- Dietary health [-5;5] = Food Quality + Food Safety + Food Affordability + Food Availability + Food Desirability
- Planetary health [-7;7] = Climate Mitigation + Climate Adaptation + Water Use + Soil Health + Reducing Biodiversity Loss + Increasing Biodiversity + Reducing Pollution
- Equity [-1;1]
- Leapfrogging [-1;1]

Each of the above single-criteria-set scores were then normalised to a 0-25 range. A score for the frequency of selection was also calculated and normalised to a 0-25 range. The score represents the number of experts that chose a specific innovation in their top 10.

Finally, an overall score (range 0-100) was calculated as described in Figure 2.

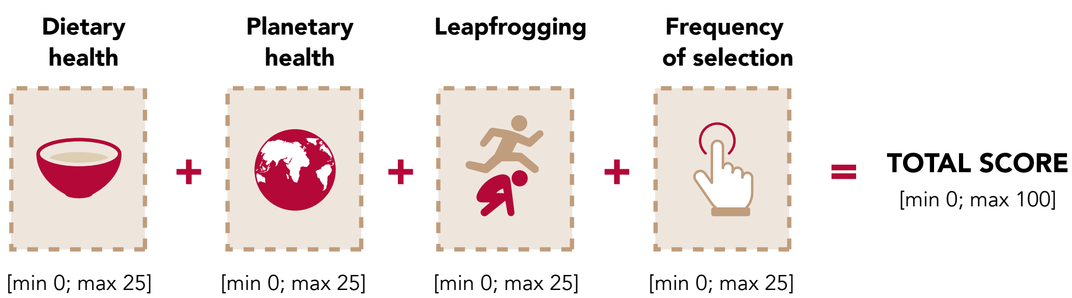


Figure 2: Equation for the overall score. The single criteria score for "Dietary health" includes food quality, food safety, food affordability, food availability, and food desirability and the single criteria score for "Planetary health" includes climate mitigation, climate adaptation, water use, soil health, reducing biodiversity loss, increasing biodiversity and reducing pollution.

The equity score was not included in the overall score because we considered this as something to be addressed in the implementation and scale-up approach.

The innovations were filtered based on a decision tree (Figure 3), which was applied first to the full list of 85 innovations, then narrowed down to the innovations chosen for each setting, and finally narrowed down to the innovations chosen from each of the six clusters. After the decision tree, innovations were ranked based on their overall score, as mentioned above.

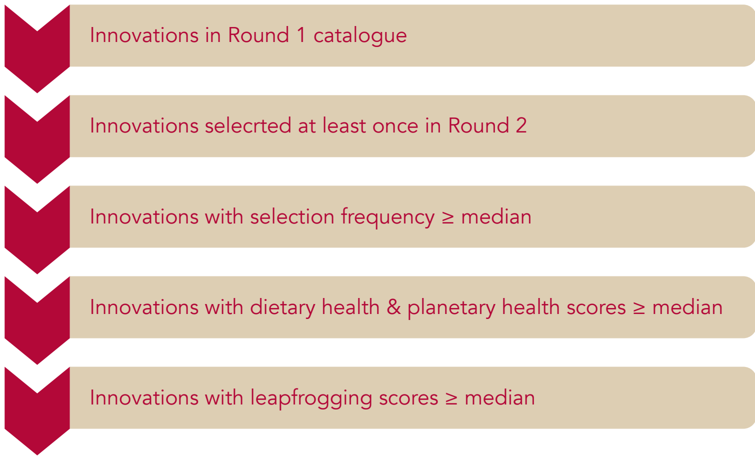


Figure 3: Decision tree for ranking the initial 85 innovations and building consensus among the expert panellists in Round 2 of the Delphi study

The scoring was also used to map innovations based on their potential impact on dietary and planetary health. This mapping flags: 1) potential win-win opportunities (i.e., innovations with both high dietary and high planetary health scores); 2) innovations with high dietary potential but low environmental scores, thereby highlighting the need for complementary innovations to trigger positive change on the environmental side; and 3) innovations with high planetary health potential but low dietary scores. An online scoring database was constructed by the research team to allow panellists to explore these innovations and their criteria scores further (see Annex 7).

This scoring was also used to develop a second, more detailed catalogue to elaborate innovation descriptions, including: the supply chain stage (see Annex 6 for full descriptions); criteria scores for environmental impact, dietary impact, leapfrogging, and equity; and examples of use or impact (if available). In addition, all anonymised comments from all panellists for each of the selected innovations from Round 2 were included in order to allow all panellists to provide informed feedback and input for Round 3.

DELPHI ROUND 3: DETAILING

With the priority innovations identified, the aim of Round 3 was to use a 'back-casting' approach in order to build pathways to impact for the different focus innovations. Back-casting (as opposed to forecasting) involves defining a future vision, then filling in the steps needed to achieve this vision (29) (Figure 4).

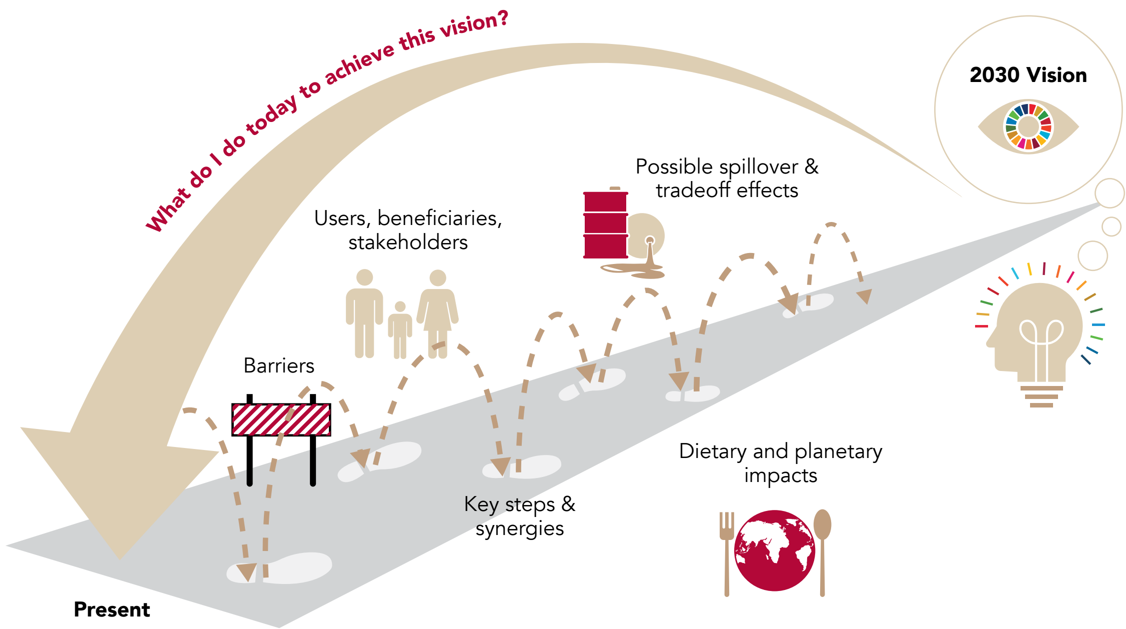


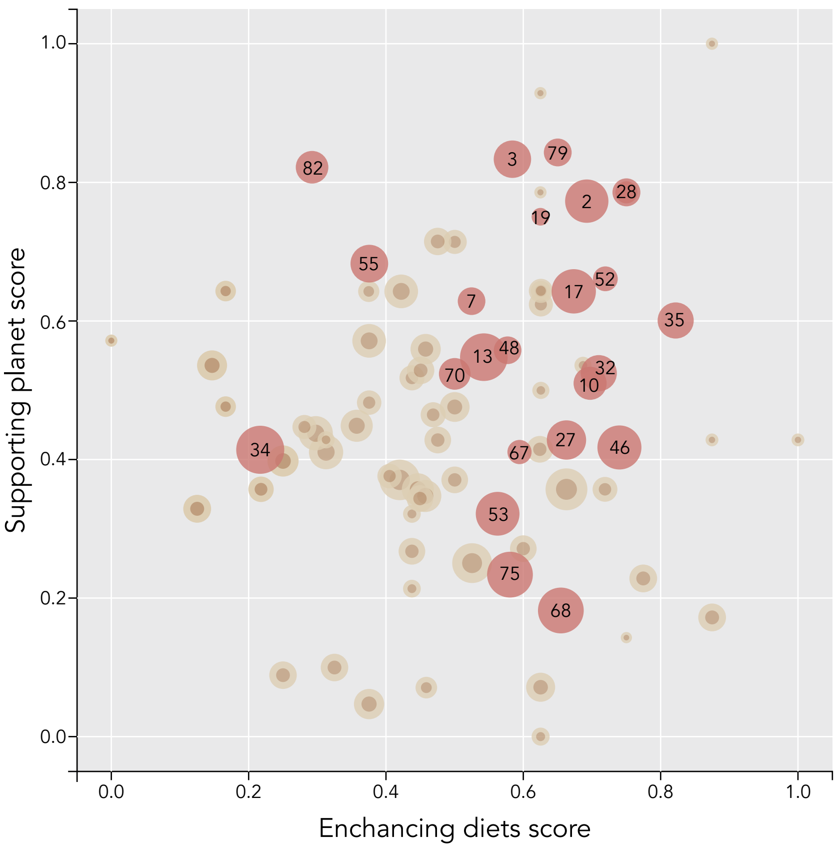
Figure 4: A 'back-casting' approach was used to facilitate the development of more concrete transition pathways for each of the 20 priority innovations in Round 3.

The research team felt that daring to imagine possibilities, spill-overs, and trade-offs while creatively designing steps towards the ideal uptake of these solutions was essential for building more sustainable and equitable transition pathways. Panellists were asked to imagine and describe their vision for how up to two selected innovations would reach their maximum dietary and planetary potential impacts by 2030 in their specific setting and then to detail the specific steps along a 'transition pathway' needed to reach that goal. Panellists were then prompted to elaborate on the expected users of and beneficiaries from the innovations as well as possible dietary, planetary health, and social equity impacts of the effective uptake of the innovations. This information was incorporated into the third version of the innovation catalogue.

The results of this survey were qualitatively analysed to combine, summarise, and standardise the responses to incorporate the key elements noted by all respondents for each innovation.

THE RESULTING INNOVATIONS

The experts surfaced a total of 151 innovations in Round 1. Similar innovations were merged, leaving 71 unique innovations sourced from the panellists. A literature search by the research team for innovations targeting dietary and planetary health provided an additional 14 innovations that were added to the Round 1 Delphi study. This resulted in a total of 85 innovations. The initial 85 innovations included a broad range of targets, involved various stakeholders, and benefited a diverse range of users. These covered a combination of complementary solution types: technological, nature-based, financial, and socio-political. Figure 5 shows the score mapping results for all 85 innovations according to their rated potential to improve planetary health (Y axis) and dietary health (X axis), each on a scale from 0 to 1. The size of the bubble corresponds to the frequency of selection by the panellists. The frequency ranged from 1 to 15. Applying the decision-tree approach to filter for those with the highest scores for potential dietary and planetary health resulted in a shorter list of 23 innovations (the numbered bubbles and the list in Fig. 5). These were then further detailed in a second version of the innovation catalogue. Figure 5 shows the results of the selection of innovations.



- 2 agroforestry for fruit production and soil health
- 3 biodiversity common approach
- 7 hydroponics
- 10 integrated household poultry production
- 13 multi-target crop breeding for climate resilience & enhanced nutrition
- 17 promotion of native and orphan crops
- 19 3d printed plant-based meat
- 27 local high-nutrient food products
- 28 mushroom mycelia for protein
- 32 solar processing for food preservation
- 34 biodegradable/compostable packaging
- 35 blockchain food system traceability
- 46 solar powered cold chain
- 48 agtech incubator
- 52 integrated digital platform for livestock management
- 53 integrated digital platform for women empowerment and financial inclusion in the food system
- 55 open source decision support tools for agricultural data
- 67 mother empowerment by distributing straightforward planetary health guidelines
- 68 nutrient-rich school meals
- 70 urban youth engagement platform
- 75 disincentivize ultra-processed food and sugar addition - trade policies, taxes and marketing
- 79 integrated farmers federation support
- 82 regenerative agriculture certification

Figure 5: The results of the score mapping of the 85 innovations. The size of the bubble corresponds to the frequency of selection by the panellists.

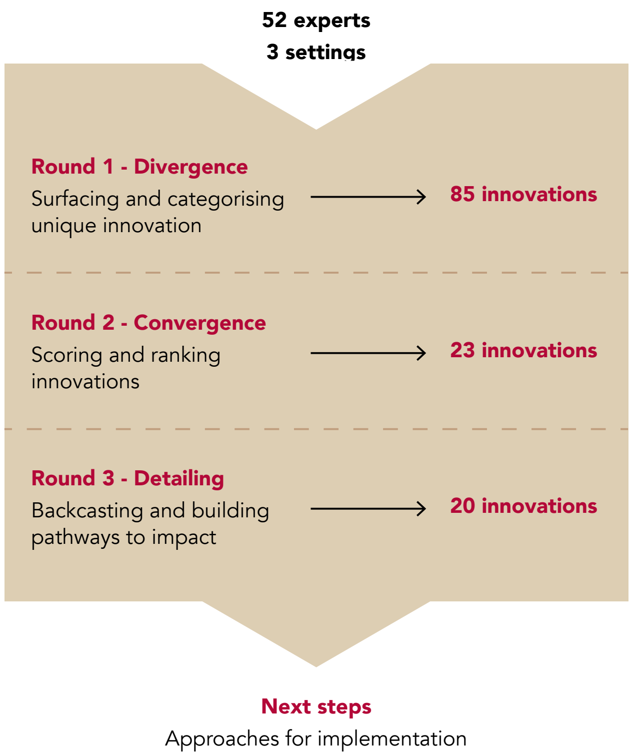


Figure 6: Results from the three rounds of the Delphi study

In Round 3, 20 out of the 23 innovations were selected by the panellists for back-casting to develop transition pathways. There was a wide range of depth to the panellists' responses to the Round 3 back-casting survey; for some innovations, there were up to seven different responses and visions for 2030 impact potential. In most cases, although the innovations were selected by participants in two or three of the geographic settings, the research team chose to develop just one pathway map covering all settings, given time constraints.. However, for one innovation, "mushroom mycelia for protein" (innovation no. 28), two distinct pathways were identified (28.1 and 28.2).

An example of one transition-to-impact pathway is included in Figure 7. Transition pathway maps for all the Round 3 focus innovations can be explored further in the Project Disrupt Innovation Catalogue (see Annex 8).

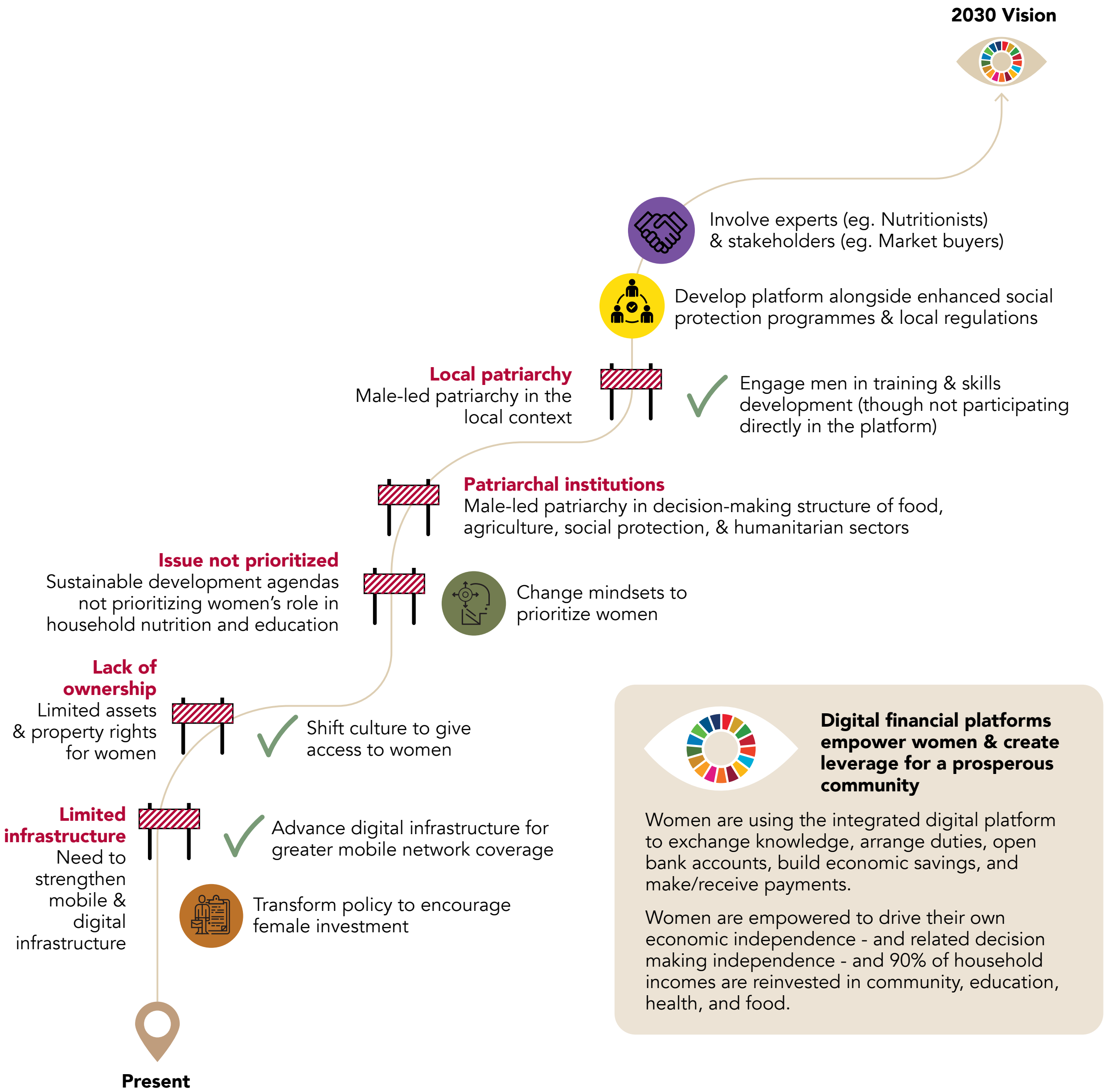


Figure 7: A transition-to-impact pathway map example for the innovation: "Integrated Digital Platform for Women's Empowerment & Financial Inclusion in the Food System" for Mozambique. Barriers (red text with black and white road block symbols), proposed solutions (green checkboxes), and additional key steps (footprints) were identified by the panellists. Additional symbols for relevant key steps were applied here by the research team, adapted from the categorization of "essential elements towards impact" from Herrero et al 2020.

The pathway mapping process uses the ideal impact vision for 2030 provided by participants to locate the key steps, barriers (and possible solutions), and enabling factors elaborated in the Round 3 participant survey. In an effort to be consistent with parallel and similar initiatives, the set of "essential elements for accelerating food system transformation" proposed by Herrero et al. 2020 (21) was applied in this analysis to categorise these key steps, enabling factors, barriers, and solutions. The maps therefore serve as a starting point to build on, providing a framework for interested local stakeholders to add more specific contextual details.

In Figure 8, the 20 focus innovations have been plotted based on their relevance for various types of key actors in the food system: food supply chain actors; community actors, policy actors, and financial actors. It is recognised, however, that this is a very simplified representation of the very complex food system and that successful implementation of various innovations requires a value chain approach with the end consumer as the overarching focus point.

Table 4 lists the 20 focus innovations and an abbreviated version of the 2030 vision for impact summarised from the panellists' responses. Innovations are listed in order of their location in the supply chain, as in Figure 8, and numbers refer to their listing in the Project Disrupt Innovation Catalogue, where more complete information about each innovation can be accessed (see Annex 8). The final Project Disrupt Innovation Catalogue (in Annex 8) includes a description of all 85 innovations and their scores for the potential to enhance diets, planetary health, leapfrogging, and equity. The Catalogue further details the final 20 with examples, transition pathway maps (detailing users, beneficiaries, stakeholders, key steps, synergies, barriers, trade-offs, and spill-over effects), the frequency of the innovation's selection for each of the three settings, and the targeted supply chain segment.

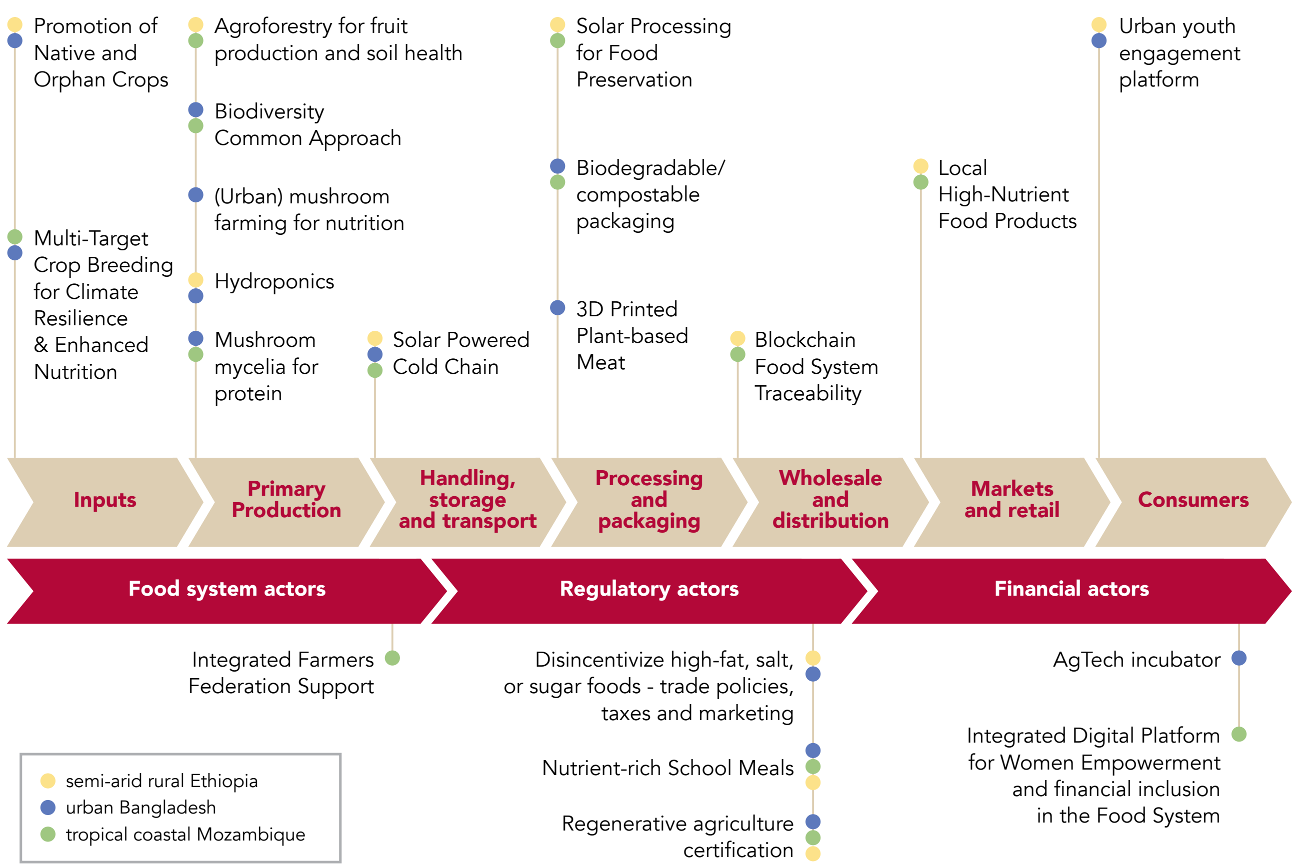


Figure 8: Round 3 of the Delphi study resulted in the panellists converging on 20 priority innovations from across all six innovation clusters, with relevance for actors throughout the food system.

Table 4: Short summaries and "Visions for 2030" impact for each of the 20 focus innovations. Numbered innovation in parentheses.

Promotion of Native and Orphan Crops [17]

There is a rich pool of native or orphan crops, fruits, and vegetables that are currently underutilised and produced in very limited areas. This innovation is a whole value chain approach to promote the production, processing, and consumption of local underutilised and culturally appropriate crops to benefit farmers, diets, and the environment and make them desirable for both farmers and consumers. The innovation covers improved production practices for these crops, creating market demand and supporting initiatives to make food products derived from these crops more easily accessible and desirable. This innovation will also help to identify drought-resistant crops, including fruits and vegetables, and serve as a hedge against climate change.

Vision for 2030: *Unlocking the potential of native crops to benefit farmers, diets, and the environment locally and globally*

Multi-Target Crop Breeding for Climate Resilience and Enhanced Nutrition [13]

For decades, crop breeding has been focused on increasing yields under high-input agriculture, with a focus on rice, maize, and wheat. This has led to less resilient varieties of these staple crops with lower overall nutrient content. "Stacked" germplasm (genetic material) improvements for priority staple crops have enormous potential to incorporate both climate resilience traits as well as an improved nutrient content. This innovation focuses on using advanced plant-breeding technologies to fast track the high-yield traits in existing varieties or, taking the reverse approach, to re-domesticate the original varieties of key crops with high resilience and higher nutrient content.

Vision for 2030: *Resilient, highly nutritious crops with better storage, processing, and cooking features are available for all farmers*

Agroforestry for fruit production and soil health [2]

Soil degradation includes soil fertility decline, nutrient imbalance, and erosion. Such phenomena can lead to decreased capacity of soils to regulate water flows as well as a loss of biodiversity. This innovation proposes to implement nutritious fruit tree plantations through agroforestry practices. This could regulate land degradation and provide income, nutritional benefits, and carbon retention. Further, planting trees in (mountain) watersheds generates resilient and effective watersheds. Drought-resistant fruit trees could be chosen, but other options, such as fodder crops, are also possible and could be used to create multi-functional landscapes.

Vision for 2030: *Agroforestry is taken up at a large scale and contributes significantly to food system resilience*

Biodiversity Common Approach [3]

Monocultures and simplified farming systems, where a single priority crop is the focus of all on-farm efforts, are very vulnerable to pests, diseases, and extreme (and/or prolonged) weather events like droughts or floods. This innovation targets a switch from simplified monocropping systems to mixed farming and agro-ecological farming practices. A biodiversity common approach protects farmers, increases biodiversity in farming systems, and supports the production of better, more valuable food. Multiple components of the innovation follow agro-ecological principles such as conservation farming, sensitising farmers to avoid farming practices with negative environmental impacts (e.g., burning bushes, cutting down trees for charcoal), mixed farming integrating livestock and crops, use of early-maturing crops, diversifying to resilient and nutritious crops, vegetative propagation through soft wood grafting, planting trees with economic and nutrition value , tree pruning, close coordination with support groups and input suppliers, use of recommended crop-specific pesticides, and irrigation via solar-powered borehole systems and drip irrigation.

Vision for 2030: *Smart diversification of farming systems has empowered farmers and consumers and restored landscapes*

(Urban) Mushroom Farming for Nutrition [28.1]

Mushrooms provide a wide range of nutritional benefits and are environmentally friendly crops. However, mushroom production remains largely untapped. This innovation proposes to diversify and increase the production of mushrooms. Mushrooms grow rapidly and yield high economic returns. Growing houses can be made very simply at low cost, using low-tech methods, on small plots of land. The substrate to grow mushrooms can be made of waste material. For instance, oyster mushrooms can grow in cottonseed hulls, cocoa hulls, banana leaves, spent grains, coffee waste, or straw. Shiitake mushrooms grow well on many different woods and forest waste materials. Once the mushroom harvest is over, the spent mushroom substrate has all the nutrients, protein, and medicinal compounds found in the mushrooms themselves. It can be used as compost for other plant or vegetable crops.

Vision for 2030: *Mushrooms become as ubiquitous as rice*

Hydroponics [7]

In many countries, farming is not seen as an aspirational livelihood for young people. Fewer and smaller plots of land and an increasingly challenging farming environment with unpredictable rainfall and raising temperatures make it challenging for young people to enter agriculture. Hydroponics could be an attractive option for producing vegetables. In this production system, plants are grown without soil, instead using mineral nutrient solutions in a water solvent. Although some initial investment is required in the hydroponic facility and energy use, this production system requires just 10-20% of the amount of water used for open-field, soil-based agriculture and little space. It can have a high turn-over rate and yield and makes it more possible to have proximate production facilities which limits transportation costs and may reduce loss and waste. Solar energy is becoming affordable and could be used to obtain reliable, sustainable power for commercial hydroponic agriculture. Hydroponics can be particularly viable in urban settings if based on intensive training of unemployed youth and women among the urban poor.

Vision for 2030: *High-tech solar powered hydroponics: ten times the production with less inputs and a new desirable opportunity for youth*

Mushroom mycelia for protein [28.2]

Animal-source foods are desirable and provide key nutrients beyond just protein. However, production of protein by conventional animal-based systems can be resource intensive and have a high environmental impact, and in many countries, consumption of these foods is already high and/or projected to increase. We need to look for alternative solutions to supplement animal-based foods to fulfil the current and increasing demand for desirable proteins. Fungal mycelium has fast-growing fibres, which can be used to create tasty meat-alternative products or nutrient-dense ingredients for animal feed and human consumption. Non-food applications are also possible, such as for packaging and clothing. The fungi recycle nutrients through a specific fermentation process that digests their surrounding biomass. Waste and by-products from food production (e.g., rice husks, spent coffee grounds, fruit peels, and sugarcane bagasse) can be used as growth material for the fungi. Hence, this solution can contribute to a circular economy, produces limited waste (mostly compostable), and requires minimal energy consumption.

Vision for 2030: *Great tasting, highly functional, inexpensive mycelia protein grown on organic waste*

Solar-Powered Cold Chain [46]

Perishable foods like fruits, vegetables, and animal-source foods are nutrient-dense but are spoiled easily when not stored adequately, contributing to food loss and waste and price volatility and with potential food safety issues. Solar power technology has been decreasing in cost at an exponential rate and is now becoming affordable and competitive with fossil fuels. Solar-powered solutions are becoming accessible even in low- and middle-income countries with poor electrical infrastructure. Solar-powered cold storage units can improve food quality and safety, increase shelf life, and reduce post-harvest loss and waste in environments where the electricity supply is unreliable or limited. They can also be economically attractive in comparison with diesel-driven generators.

Vision for 2030: *Affordable solar-powered refrigerated vehicles and facilities for reduced food loss and increased nutrient-dense food availability, safety, and quality*

3D-Printed Plant-based Meat [19]

Production of meat has a very high environmental impact, and in many countries, it takes up 85% of land to produce fodder for animal feed. This, in combination with negative impacts on animal welfare, has led to increased demand for plant-based meat. To address this demand, solutions are emerging to try to mimic the taste and texture of meat but using plant inputs. This innovation is based on micro-extrusion of plant-based proteins to create a fibrous structure that resembles meat. Various inputs can be used: wasted food, fresh ingredients, or alternative sources like seaweed or insects. The ingredients can be fortified to improve nutritional value. The inputs are made into a paste, which is extruded and can be shaped into 3D forms. It can be eaten directly after extruding or after baking. The product can even be produced at the consumption location. This innovation is being applied at some high-end restaurants as well as in residential care homes to support personalised nutrition.

Vision for 2030: *Low-cost, sustainably sourced, culturally appropriate plant-based protein*

Solar Processing for Food Preservation [32]

Nutritious food is in general prone to microorganism growth, which can impact food safety and shelf life. Post-harvest food losses impact actors along the value chain, and in particular smallholder farmers. Food processing and preservation reduces food losses and waste, increases shelf-stability of produce, and provides business opportunities for value-added products made by local individuals, cooperatives, or small or large businesses. Solar drying is an effective means of food preservation, with reduced environmental impact and improved food safety. It can be used on a variety of produce, from fruit to meat and fish. Water can be collected during the dehydration process and used as a source of clean water. Nutritional retention during solar processing needs to be monitored, however, as some vitamins are very volatile.

Vision for 2030: *Mainstream solar preservation solutions increase the availability of vegetables, fruit, meat, and fish for smallholder families and poor consumers*

Biodegradable/Compostable Packaging [34]

Plastic packaging is wasteful and negatively impacts earth's ecosystems. There is a need for alternative packaging that can maintain food safety and does not cause environmental degradation. This innovation proposes to use biodegradable packaging that breaks down and decomposes into natural elements within a short time after disposal - typically a year or less. Packaging made from mycelium, the root structure of mushrooms, provides air and water performance filters and is one example of biodegradable packaging.

Vision for 2030: *Single-use plastic food packaging is the rare exception, not the rule*

Blockchain Food System Traceability [35]

Lack of transparency in the food supply chain is an issue when trying to trace sources of foodborne diseases and adulterations. To address these, all value chain actors must be able to share reliable data. Blockchain holds the potential to alter modern food systems for the better by enabling storage and distribution of transactional information in a decentralised, tamperproof database. The technology behind blockchain is an automated, decentralised digital record system. Upon each transaction, a timestamped, non-alterable record, or block, is created and distributed throughout an open network. This provides transparency for all previous data points associated with the transaction. Blockchain technology on a mobile phone platform has the potential to connect small farmers to international value chains and markets. Blockchain applications can provide insights into food supply and demand and can help identify inefficiencies, non-value adding activities, and food loss and facilitate fairer pricing mechanisms.

Vision for 2030: *Holistic, transparent, and traceable information from farm to fork boosts food safety, sustainable production, and equity*

Local High-Nutrient Food Products [27]

Stimulating the local economy through processing local ingredients into convenient and affordable food products that provide good nutrition is of prime importance. This innovation proposes to design highly nutritious food products based on locally sourced ingredients to ensure nutrition, food safety, and sustainability and boost the local economy. This will reduce the prevalence of unhealthy imported snacks. Nutritious snacks ,such as bars made of local fruits/ vegetables, plant-based protein, dairy and/or local cereals, could be fortified with minerals, macronutrients, and vitamins to meet the specific dietary needs of communities. Nut milk, such as cashew milk, could also be developed to provide a nutritious and tasty alternative for sugary soft drinks.

Vision for 2030: *Locally produced, high-nutrient food products are a source of local health and pride*

Urban Youth Engagement Platform [70]

Urban youth are a fast-growing population. with the ability to use digital platforms, tools, and knowledge in ways inaccessible to older generations. This innovation proposes a platform designed by urban youth, for urban youth, with a focus on creating demand for safe and nutritious food produced in environmentally sustainable ways. This platform should be fully supported by both the government and the private sector to allow the development of common long-term solutions that engage and incentivise multiple actors, stimulating the private sector to develop healthy and sustainable products, encouraging youth to purchase and eat these products, and sparking the government to invest in and take action to introduce programmes in schools. The goal is to build a change in knowledge, perceptions, and behaviours that will last a lifetime, creating a new normal for engaging in food production and consumption in a more sustainable way.

Vision for 2030: *Engaging the next generation to improve nutrition and drive food system sustainability*

Integrated Farmers Federation Support [79]

Smallholders in low- and middle-income countries have limited capacity to make their farms more resilient to negative impacts of climate change. Support in the form of local needs assessments, development of locally relevant action plans, and external funding to support farmers during emergency situations and in times of extreme weather events is critical to increasing local capacity to adapt to the increasing challenges of climate change or socially or politically induced stress. Integrated farmer support in the form of organised local chapters of a sub-national farmers' federation would help build and sustain capacity for farmer resilience. This innovation includes an Integrated Farmers Federation Support advisory platform to provide farmer households with outreach and knowledge building, agricultural extension and technical training programmes - tailored to local needs - and value chain and market access development, as well as small-scale businesses incubator support and other services determined most necessary in a given context.

Vision for 2030: *Strengthening farmers' capacity to engage across the supply chain and apply cooperative thinking strategies to face new challenges*

Nutrient-rich School Meals [68]

As economies develop and children eat more meals at school, school feeding programmes can struggle to provide nutrient-rich foods that are affordable and acceptable to local communities. Current school feeding programmes tend to focus on school retention and often do not focus on nutritional value. There is a need to provide nutrient-rich foods in school meal programmes in order to maximize physical and intellectual development of youth. This innovation introduces and scales up the provision of locally sourced nutrient-rich foods in school feeding programmes. For example, small fish and eggs could be more frequently used to provide essential nutrients. Nutrients could also be delivered in the form of a tasty nutrient-rich drink.

Vision for 2030: *More school children eat nutrient-rich, affordable, and acceptable school meals*

Disincentivise High-Fat, Salt, or Sugar Products via Trade Policies, Taxes, and Marketing [75]

Global trade influences the food environment, particularly in urban settings. This is leading to a greater presence of ultra-processed foods high in unhealthy types of fats, sodium, and/or sugar (HFSS), including sweetened beverages. In order to combat rising obesity rates and its co-morbidities, HFSS foods need to be a smaller part of people's diets. This innovation proposes reforms to trade policies specifically by 1) using trade policy delegations to train food system legal teams to be present during trade policy negotiations, and/or 2) introducing market-based instruments such as Pigouvian taxes (taxes on HFSS foods to equal the social cost of negative outcomes) in order to disincentivise their purchase and use the collected funds to finance healthier alternatives. Promotion and marketing of ultra-processed foods should also be limited, particularly to children and adolescents, as well as in places where critical food decisions are taken.

Vision for 2030: *Most countries have implemented policies that disincentivise consumption of foods containing excessive amounts of unhealthy types of fats, sodium, and sugar*

Regenerative Agriculture Certification [82]

Many countries are becoming increasingly vulnerable to droughts. To some extent, this could lead to a vicious circle: devastating droughts cause soil loss and degradation, which in turn foster more droughts, crop failure, and malnutrition. One way to break this cycle is by land restoration programmes. Regenerative agriculture describes farming and grazing practices that, among other benefits, rebuild soil organic matter and restore degraded soil biodiversity. Regenerative farming practices can strengthen soil health and create various positive long-term effects, including reversing climate change. As an innovation, rapid, extensive implementation of Regenerative Organic Certification in low- and middle-income countries provides an opportunity for producers in emerging markets to become global leaders in this sector and gain 'first mover' advantages. Certification can provide many benefits to producers, including premium prices, access to fast-growing local, regional, and international markets, access to additional funding and technical assistance, as well as other benefits to the local economy.

Vision for 2030: *Regenerative agriculture certification improves soil health and drives healthy, sustainable diets*

Integrated Digital Platform for Women's Empowerment and Financial Inclusion in the Food System [53]

Social protection programmes focused on women's empowerment have shown promising results in terms of improving women's empowerment and household nutrition, but those programmes have poor coverage and limited reach in urban slums and rural remote areas. This innovation will leverage digital tools to improve the financial inclusion of women, particularly focused on the potential for digital financial services to link women to markets, raise incomes, reduce poverty, and facilitate women's greater control over their earnings and savings, all critical elements of women's economic empowerment. Specific focus will need to be placed on addressing barriers to women's access to digital tools, such as social norm and available funding for initial connectivity.

Vision for 2030: *Women use digital financial platforms to leverage community prosperity*

Agricultural Technology (AgTech) Incubator [48]

Innovation is particularly needed in emerging markets to nourish a growing and urbanising population in an environmentally sustainable way. Around the world - but especially in developing and emerging economies - there is strong demand for increasing local capacity to adapt and/or develop local technologies to address local problems. Technology accelerators - established in partnership with multinationals - offer enormous potential to increase local technological capacity and foster new innovations that offer local solutions. Innovations emerging from these incubators can lead to local, sustainable business development and job creation while at the same time promoting and supporting local solutions to safe and nutritious food availability in an environmentally friendly way.

Vision for 2030: *Inclusive agricultural technology incubators support all kinds of innovations with a particular focus on - and engagement with - vulnerable groups*

DISCUSSION

A NEED FOR SYNERGISTIC THINKING

A critical but not surprising finding of the Round 3 survey was that participants emphatically agreed that there is no 'silver bullet' or 'one-size-fits-all' when it comes to innovative solutions for dietary and planetary health in low- and middle-income countries. Consensus among the panellists clearly pointed to the critical need for different innovations to be combined when possible, allowing for complementary and relevant synergies to support true leaps forward in impact by 2030. This was determined to be essential for leveraging sustainable change while avoiding unfavourable trade-offs. In Round 2, several experts provided portfolios of synergistic innovations, and in Round 3, all experts were explicitly asked to provide innovations that could synergise with their two chosen innovations, to help overcome uptake barriers or to avoid or minimise negative trade-offs, as in the examples in Figures 9 and 10.

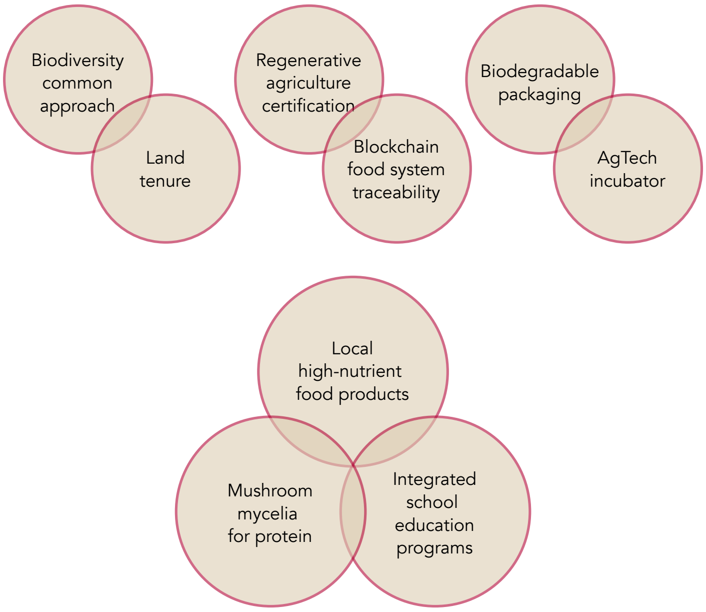


Figure 9: Examples of synergistic solution packages

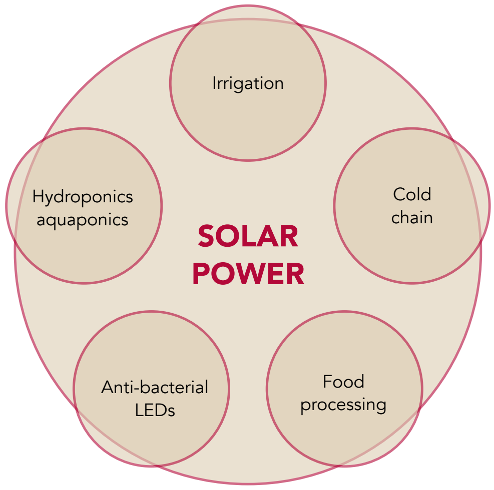


Figure 10: Example of one underlying innovation releasing the potential of a diverse set of innovations

UNIQUE FINDINGS

This project uniquely addressed the challenges in identifying innovative solutions for improving both planetary and dietary health by 2030, using three real-world settings to ground the process. The transdisciplinary approach allowed for the inclusion of diverse panellists with a wide range of experience and expertise to encourage discussion and cross-pollination of ideas. The active recruitment of participants beyond the strict boundaries of the nutrition, agroecology, and climate science fields led to the inclusion of innovations that spanned policy, economics, and the social sciences, which may have been otherwise overlooked.

Although other initiatives have asked experts to evaluate already-compiled innovation lists as a starting point, in this project the research team chose to source new innovations and ideas from the panellists to encourage original thinking and a focus on innovations that were appropriate for certain specific settings. Many innovations surfaced in Round 1 were originally quite generic. However, as panellists were asked to rank, score, and prioritise innovations for potential impact in their setting through the subsequent rounds, innovative solutions with concrete, specific, locally relevant, and actionable uptake steps were clearly identified.

Finally, the combination of using a setting-specific lens and the back-casting approach for developing visions for impact in 2030 allowed the research team to create a uniquely specific set of transition-to-impact pathway maps for the 20 focus innovations for Round 3. These maps provide examples of concrete, actionable steps to accelerate the uptake and impact of innovative solutions.

PROCESS REFLECTIONS

This Delphi study was conducted fully online during the first few months of the COVID-19 global pandemic. This was facilitated by using a rapid, iterative communication process with step-by-step actions that sought to maximise experts' overall input while keeping their time investment as low as possible (roughly 5-7 hours total over the period from March to June 2020). The panellists' involvement remained high throughout the rounds of the study, with only a few participants needing to drop off towards the end of the project.

The Delphi process itself allowed for the identification and evaluation of a large number of ideas sourced from experts from different fields as well as from different contexts, while providing anonymity in the sharing of survey results for all three rounds. All participants' opinions were anonymised and shared with the panel following each survey, including additional thoughts, questions, and discussion points. This created a more equitable platform for all panellists to share their input as well as review and digest the feedback and input of their peers.

By design, the Delphi process aims to build consensus among a group with a shared goal, which in this case was to source and explore truly game-changing innovations for dietary and planetary health. Both the research team and the participants themselves found a contradiction of sorts in the application of a consensus-building process to identify 'outlier' innovations. In this case, the consensus-building process may have led to identifying innovations that had certain 'lowest common denominator' factors; truly innovative, disruptive ideas may have been filtered out because of the Delphi approach's focus on consensus. For example, the scoring approach (using median frequency to select the most popular innovations) may have resulted in a shift away from the innovations that were most novel or risky, as they might also represent a true potential to overturn business-as-usual approaches—which might not be acceptable to the median participant.

INNOVATIVE SOLUTIONS OR INNOVATION IN FACILITATING UPTAKE FOR IMPACT?

Initially, this project aimed to surface innovations capable of disrupting business as usual in food system transformations. Out-of-the-box thinking was encouraged, and the term 'innovation' was used to stimulate the experts to think in creative ways. However, some of the innovations that were surfaced through this project have already been discussed extensively in the literature. This might suggest that many transformative innovations already exist but have not yet reached sufficient scale or uptake to fulfil their potential. This confirms that not just identification but also dissemination and implementation of innovations are essential to achieve impact at scale. To achieve this, stakeholders must review the uptake process and carefully examine the likely transition-to-impact pathways, such as those created through this process. Likewise, there also needs to be more focus on how synergies between solutions can be fostered and supported. Arguably, the most innovative aspect of this project was found in the Round 3 results, wherein panellists were asked to back-cast and offer creative solutions to removing barriers and creating enabling environments for the large-scale uptake of the focus innovations.

CONCLUSION

Thanks to the insightful contributions of the 52 experts, this Delphi study resulted in surfacing 85 innovations and developing in-depth assessments, including transition-to-impact maps, for 20 diverse innovations across technological, nature-based, and policy/ institutional themes. Essential actions along transition pathways were identified and can be used to inform action strategies. Cross-pollination between experts, innovations, and contexts was a motivating benefit of the process and resulted in a constructive exchange of solutions.

The Delphi consensus-building methodology did not lead to the surfacing of previously unimaginable solutions; rather, it emphasised that existing technologies, when contextualised in place and analysed across environmental, health, and social impact criteria, have significant potential to support positive transformation. The process also revealed that 'game changing' is also about building portfolios of synergistic interventions, creating enabling environments, facilitating flexibility, and supporting interactions across value chains.

NEXT STEPS

This exercise will have limited impact unless the ideas are taken up by food system actors, including businesses and development partners, and sufficiently resourced by public- and or private-sector actors to reach the scale necessary to truly transform food systems for better nutrition, better planetary health, and greater equity. To support the process of moving to action, the partners of this study have initiated collaborations with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Cornell University, which are also working on identifying innovations with the potential to transform food systems. Together, we plan to build an extensive public catalogue of innovations, aiming to match specific innovative solutions with investors and implementers. To ensure these represent relevant, actionable solutions for key food system actors, a series of consultations will take place. In addition, we will encourage discussion sessions wherein participants jointly create pathway-to-impact maps and offer their insights on the key steps, barriers, synergies, and enabling factors. We hope that this work can feed into other ongoing processes, such as Food Systems Dialogues and the 2021 UN Food Systems Summit.

Finally, the innovations surfaced through the Delphi process and described here represent just an initial selection of exciting innovations; the study suggests that massive potential for additional innovations remains in the pipeline. Others can learn and replicate the methods and results reported here. For groups that may want to undertake a similar Delphi study, a toolkit has been developed that can be used and adapted to other specific settings.

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ANNEX

1. Delphi Study Webinar slides and recordings [link to SharePoint files]
2. Delphi Study Participant Surveys [link to SharePoint files]
3. Full Settings Descriptions [link to SharePoint file]
4. Delphi Study Innovation Cluster Descriptions [link to SharePoint file]
5. Delphi Study Panellist Bio Book [link to SharePoint file]
6. Delphi Study Supply Chain Descriptions [link to SharePoint]
7. Delphi Study Round 2 Innovation Scoring Results Database [https://bioversity.github.io/disrupt-graph/home.html]
8. Delphi Study Full Innovation Catalogue [link to SharePoint file]
9. GAIN Delphi Process Toolkit [To be published early 2021]