DISCUSSION STARTER

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Collaboration Models for Food System Innovation

Addressing barriers to private sector innovation in plant nutrition, sustainable livestock, and next-generation crops

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Introduction

Aligning food systems with global climate goals requires accelerated development and scaling of innovations that drive both climate mitigation and adaptation of the sector. Agrifood systems account for approximately a third of all greenhouse gas (GHG) emissions globally, making climate mitigation in this sector essential. At the same time, agricultural production faces risks of being disrupted by climate impacts, making climate adaptation another top priority.

Stronger collaboration between different innovation actors—including corporations, philanthropies, non-profits (NGOs), public research bodies, and entrepreneurs—can help accelerate the development and scaling of climate-aligned innovations in the food sector by bringing in the private sector and enabling joint action. This discussion starter explores different collaboration models for climate-aligned food system innovation that help to harness synergies, bring climate to the forefront of research and development (R&D), and enhance knowledge sharing, market development, and cost efficiency.

This brief focuses on three crucial innovation areas: plant nutrition, sustainable livestock, and next-generation crops. Two of the most significant sources of

agricultural GHG emissions are fertiliser manufacturing and application and methane emissions from livestock production.[1] Innovations in the plant nutrition domain help decarbonise fertiliser production and improve nutrient use efficiency of fertilisation, while innovations in livestocks can increase resilience and productivity while curbing emissions. Next-generation crops—designed with enhanced traits—have significant potential to boost farmer livelihoods, as well as supporting climate mitigation and adaptation.

Accelerating and scaling climate-aligned food system innovation requires greater private sector engagement

In order to cut GHG emissions in line with Paris Agreement targets and simultaneously end hunger in the Global South, it is estimated that innovation investment needs to increase by USD 10.5 billion annually.[2] Mobilising private sector investment in agrifood innovation, which currently stands at 50% of total agrifood R&D,[3] is considered one of the key opportunities to bridge this investment gap. This becomes even more critical at a time when some global leaders are stepping back from multilateral development cooperation, and funding for agricultural innovation is stagnating. Since 2015, public agrifood R&D spending has grown about one-third less per year than in earlier decades,[3] while global venture capital for agrifood-tech has declined sharply, from around USD 61 billion in 2021 to about USD 16 billion in 2024.[4] Private R&D investment offers market access, innovation capabilities, and scaling models, and it is crucial in preventing food sector innovation from being steered away from climate-aligned developments.[5]

Collaboration addresses key barriers to private sector involvement in driving climate innovation

While several constraints limit greater private sector engagement in climate-aligned innovation,[5] fostering creative collaboration could help overcome them. Profitability concerns are a primary reason for the reluctance of corporations to invest in climate innovations as they might be perceived as riskier and slower to gain market traction. Since IP rights are needed to recover costs, they might also reach limited levels of diffusion. While policy and consumer pressures drive climate-related private sector innovations to some extent, competition between corporations to position themselves as sustainability leaders also limits collaboration across the industry.

Collaboration has been identified as both a key lever to address these barriers and a cross-cutting enabler of scaling climate-aligned food system innovation. It helps to make the most of the strengths of different innovation actors, raises the profile of climate on the R&D agenda, enhances knowledge and best practice sharing, and facilitates the consolidation of findings, thereby ensuring efficiency and coherence. Furthermore, innovation partnerships along the value chain can help build market demand and reduce investment risks by tailoring innovations to user needs. Combining R&D resources can improve cost efficiency and scale, while creative forms of collaboration can attract new actors and mobilise new resources. Importantly, forms of collaboration that grant open-access availability foster the diffusion of innovations and generate knowledge spillovers.[5]

This discussion starter provides an overview of collaboration models for climate-aligned food system innovation, drawing on a literature review and six interviews with experts involved in agrifood innovation programmes across academia, international organisations, an industry association, an intermediary organisation, and an innovation partnership.

The brief (1) outlines the actors involved and their motivations for collaborating, (2) creates a framework for collaboration models based on their purpose, (3) compiles the barriers and success factors for collaboration, (4) provides an inventory of collaboration case studies, and (5) provides practical steps on how to identify fit-for-purpose collaboration models for specific innovations.

Key actors and their motivations to collaborate

Food system innovation involves a range of public, private, and hybrid actors that contribute to the development, diffusion, and adoption of new technologies, products, services, and processes. Understanding the added value these actors can gain from collaboration is key to effectively leveraging partnerships to accelerate innovation in food systems. Based on our interviews, the following key roles and motivations for collaboration for climate-aligned agrifood innovation were derived:

Actor	Role in innovation	Motivations to collaborate
Farmers and farmers' associations	Users of agricultural innovation Innovators (farmer-led innovation) Co-innovators (initial input/user experience feedback)	Place user issues at the centre of the innovation process Adapt standard solutions to local conditions and specific applications[6] Provide farmers with access to new solutions
(Public) research and education institutions	Key producers of knowledge (both fundamental research and applied science)	Improve practical relevance of research Reduce time lags in adoption Complementary funding
Entrepreneurs/startups	Transform the potential of new knowledge, networks, and markets into business opportunities by creating novel goods, processes, and services[7] Change agents for system transformation	Financial and technical support in addressing challenges at different steps from scientific discovery to markets Provision of income during the innovation process Visibility Opportunities for upscaling and market access[8]
Large agrifood corporations	Incremental innovation through in-house R&I[9] Create (international) markets to scale and disseminate innovations through direct relationships with producers and consumers[7, 10] Standard-setting power throughout the value chain affecting innovation selection and distribution[8]	Understand industry trends Share R&D costs Strategic investment in dynamic start-ups that align with their business motivations Adapt to/influence disruptive technologies competing with their core business[8] Meet corporate climate commitments through roll-out of emission-reducing innovations in their supply chain
Intermediary organizations (agricultural extension services, farmer cooperatives, NGOs) & innovation brokers	Intermediaries: bridge the gap between innovation development and practical implementation Innovation brokers: bring together different innovation actors[11]	Intermediaries: facilitate knowledge transfer at the local level, driving the dissemination and scaling of innovations[12] Innovation brokers: facilitate many-to-many interactions to build synergy and capacity for collective innovation
Venture capital (VC) providers	Traditional VC providers (private equity funds, investment management firms, sovereign funds, and banks): invest in agrifood innovations at the ready-for-market stage[8] Small VC investors (seed funds, startup accelerators, science venture funds, and government agencies): invest in early-stage innovations[8]	Traditional VC investors: attractive return on investment (ROI) Small VC investors: catalyse disruptive innovation Corporate VC investment: strategic interests (see 'large agrifood corporations' above)
Governments, international (development) organizations, and philanthropies	Fund foundational, long-term research Provide financial policy instruments to support green technologies and industries[7]	Mission-driven approach to help fund innovations aligned with public objectives and early-stage R&D[8] Attract investors in lower-income countries via collaboration (interview 1)

Table 1: Key actors and their motivations to collaborate

Core challenges for climate-aligned food system innovation

Climate-aligned food system innovations face challenges to develop and scale (box 1). Our interviews unveiled how these challenges play out differently across the three focus innovation domains. Because barriers to innovation development and scaling often shape the goals of a collaboration, understanding them can guide us in determining the most effective type of collaboration.

Climate-aligned innovations in the food sector face seven main challenges:

- The majority of **investment in agrifood innovations is focused on solutions downstream in the value chain rather than upstream (agricultural) solutions, even though the latter hold the most potential for climate** mitigation and adaptation, as they account for more than 60% of carbon emissions.[8] However, innovations such as digital food service, functional foods, and e-commerce solutions more easily fulfill investors' requirements—namely, a net return through fast and relatively secure exits.[8]
- Agricultural innovations typically have **long timelines, as they are bound to harvesting cycles** and seasonality dictates the possible timing for testing.
- They often r**equire robust evidence under diverse geographical conditions**, which necessitates testing in different locations.
- There are significant **regulatory hurdles** for many innovations in the sector. Startups need to secure regulatory approvals for new technologies, which leads to lengthy and sometimes costly product validation cycles depending on the domestic requirements. It also makes it hard to reach international scale since regulatory requirements differ between jurisdictions, requiring localised adaptation.
- The scale-up challenge is especially prominent for agrifood innovations because **price competitiveness with conventional products** is a major prerequisite for market success (interview 2). Many agricultural technologies are typically capital-intensive, and bringing production costs down to competitive levels requires economies of scale.
- **Experts have observed that there is insufficient support available for the early stages of idea development.** While well-developed innovations at later stages generally secure capital, the point before formal startup formation—when ideas are still being explored, tested, and refined, and sometimes fail before reshaping—is an underappreciated bottleneck in the innovation journey. **Early-stage support, however, is crucial for enabling disruptive innovations, which often have the highest potential for climate mitigation** (interview 3).
- **The adoption of sustainable agricultural innovations represents a challenge in itself**, as farmers often need to make upfront investments (e.g., for equipment needed) and face temporary income risks (such as reduced yields as soil systems adjust, or due to incorrect implementation), knowledge gaps, and uncertainty about the effectiveness and financial benefits of adoption. Some disruptive innovations, such as new inputs or practices which do not simply replace unsustainable options, also require establishing and growing a market from scratch to build awareness, necessary infrastructure, and demand (interview 4).[13]

Box 1: Main challenges for climate-aligned innovations in the agri-food sector

Plant nutrition

In the plant nutrition area, challenges include long development and validation cycles driven by seasonality, the need for robust evidence under diverse conditions, high capital intensity, and highly varied customer markets. The underlying science of plant nutrition is often complex—spanning intricate biological, chemical, and physical systems, from soil health to human nutrition—which can prolong development cycles. Solutions must also be applicable by an enormous range of geographies and farming practices, which results in long validation cycles (interview 3). Fertiliser production accounts for a significant share of the sector's environmental footprint. While disruptive production technologies have the potential to deliver transformative impact (interview 3), they also tend to be highly capital-intensive and need to outcompete traditional fertilisers, which usually benefit from economies of scale and subsidy support.

Sustainable livestock

In the sustainable livestock area, challenges tend to be technology-specific, as there is a wide range of technological developments used to reduce GHG emissions. **Regulatory hurdles can be significant** in this subsector, and ensuring the safety of technologies is important for securing social acceptance. This is the case for some methane-reducing feed additives and bolus technologies (ingestible capsules given to ruminant livestock that gradually release compounds such as bromoform in the rumen to suppress methanogenic microbes). Conducting the required trials to obtain regulatory approval is costly and time-consuming, especially if a startup aims to enter the global market. That requires approval by the Codex Alimentarius Commission, a body established by the UN FAO and the WHO, which is used as a reference point for many national regulations (interview 4). **Some solutions are highly capital-intensive and need to scale to be cost-effective**; for example, treatment systems for effluent ponds require farmers to make a high initial investment and can also come with high operating expenses. **For biotechnology-based innovations with long scientific iterations, raising venture capital can be challenging**. This is, for instance, the case for some vaccine-based solutions that reduce methane emissions (interview 4).

Next-generation crops

In the next-generation crops sector, key challenges are linked to limited inclusiveness, intellectual property concerns, and weak public acceptance. Given the high market concentration in the sector, the current focus of next-generation crop innovation is on high-value markets. This leads to uneven technology adoption as smallholder farmers and poorer consumers are not reached, and technologies are not applied to a wider diversity of crops. Intellectual property and benefit-sharing over genetic resources and data are contested and not yet efficiently regulated, which limits the sharing of these key resources. Concerns over consumer safety currently limit public acceptance, leading to distrust, high regulatory barriers, and long commercialisation timelines for gene editing and other biotech solutions.

Collaboration models: a framework

In line with the purpose of this brief, this report focuses specifically on collaborations that bring together different types of stakeholders to advance innovations aimed at climate adaptation or mitigation. The models identified and outlined below leverage diverse partnerships to achieve certain collaboration purposes by increasing synergies and efficiency in the innovation process, addressing scaling challenges, and creating the necessary conditions to accelerate innovation.

The collaboration models are clustered into six categories according to their main contribution: (1) information sharing, (2) innovation ecosystem building, (3) solving wicked sector-wide problems, (4) user-focused co-creation and testing, (5) combining specific expertise and resources, and (6) pooling resources to support startups from ideation to scaling (figure 1).

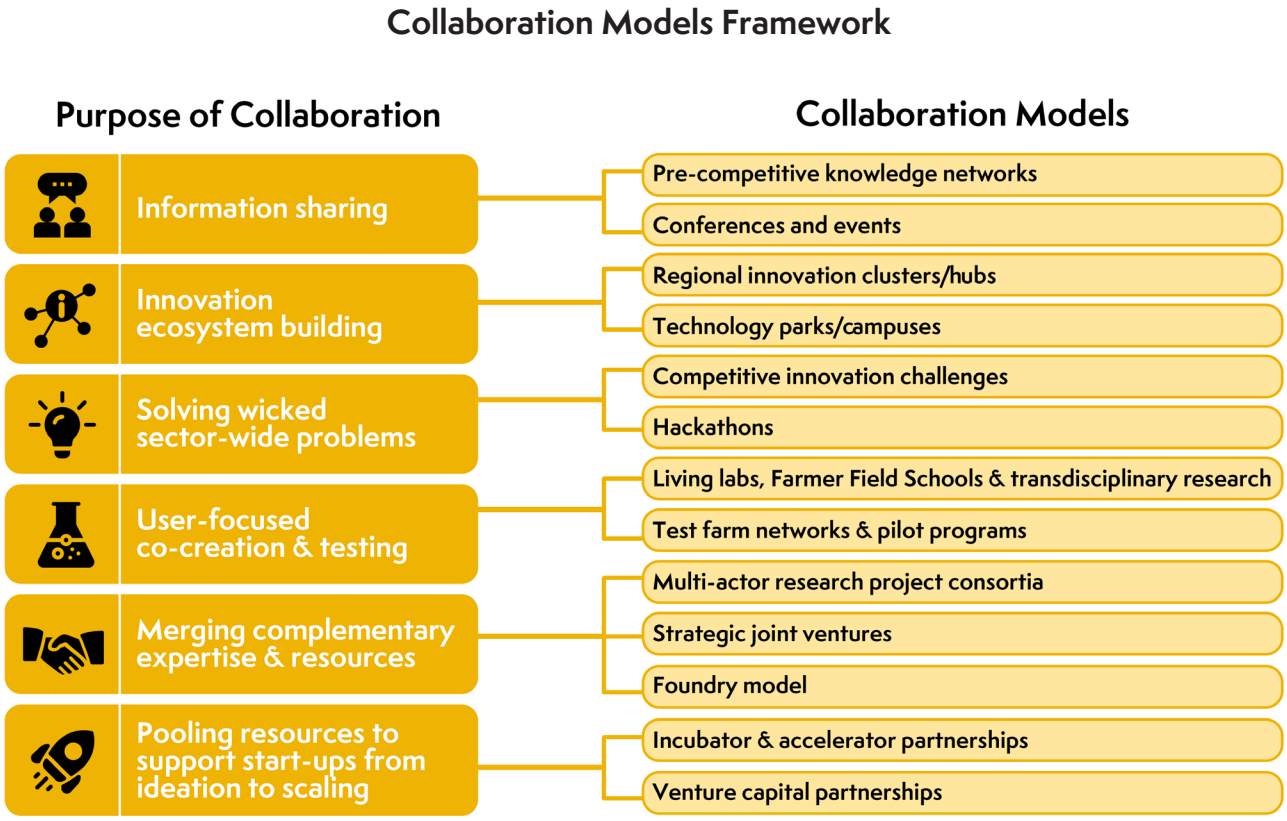


Figure 1: Framework of collaboration models for food system innovation across different purposes of collaboration

Information sharing

Pre-competitive knowledge networks

A knowledge network or platform is a multi-stakeholder engagement format that brings together a community in which there is continuous information exchange and learning between different innovation actors, and where connections are facilitated for potential further collaboration.

These networks can be particularly important in early innovation phases because the exchange of information stimulates knowledge development, helps innovators to consolidate knowledge, and aligns with different stakeholders' expectations.[7] They can also play a significant role for upscaling as it gives innovators visibility to capital providers and market actors who might be interested in a more structured partnership (interview 1).

Both the scope of the network and the combination of actors involved can vary from case to case. They usually consist of startups and entrepreneurs, often joined by academic researchers, experts, investors, and corporations. Networks either focus on a sector or societal system, a specific innovation area (e.g., the Africa Dryland Crops Improvement Network), or they can span across industries and innovation areas (e.g., the WEF Innovator Communities) (interview 3; interview 1).

Often, engagement in these platforms is organised through working groups that collaborate on advancing knowledge on specific topics and might produce reports or other knowledge products (interview 1). Knowledge platforms that are relevant to climate-aligned food system innovations are often convened and funded by international development organisations, industry organisations, research institutions, and NGOs.

Conferences and events

Conferences are in-person convening spaces for dialogue, foresight, and knowledge exchange, and they can help explore more in-depth collaboration opportunities (interview 3). While conferences usually target a specific scientific community or research topic, they can also be used to bring together actors within a specific innovation ecosystem. Often, these events are instrumental for existing innovation initiatives to influence stakeholders beyond their immediate networks. For example, the IFA Innovation Hub's Cultivating Tomorrow Conference focuses on sustainability and innovation in plant nutrition, helping to align perspectives across the industry, startups, investors, and the wider innovation ecosystem (interview 3). The World Food Programme (WFP) Innovation Accelerator uses ecosystem events as an instrument to foster collaboration: Curated gatherings bring together startups, government bodies, donors, and private sector and community actors to exchange knowledge, validate innovations, and build partnerships.[14]

Innovation ecosystem building

Regional innovation clusters/hubs

Regional or local food innovation hubs (also known as innovation platforms) are precompetitive, multi-stakeholder initiatives with a regional presence that aim to strengthen the local innovation ecosystem—and ultimately unlock cooperations and investments. They do so by focusing on capacity building and long-term engagement between stakeholders such as farmers, research institutions, NGOs, (local) governments, startups, agrifood firms, and venture capital providers.[15] This can help, in particular, to address local context-specific concerns, hinging on the involvement of partners or brokers who have deep, embedded connections with local farmers (interview 5).

For example, the WEF Food Innovation Hubs aim to build collaborative ecosystems for innovation at a regional or national level, and are designed to address context-specific issues in the respective countries—such as focusing on arid climate agriculture solutions in UAE (interview 1). While governance models vary, regional innovation hubs are often launched as public-private partnerships (as co-investment of governments, companies, research organisations, etc.) and are often hosted by local research organisations (interview 1; WEF, 2025).

Technology parks/campuses

Science clusters and technology parks/campuses are usually established by governments or public research institutions, with the aim to further strengthen the local innovation ecosystem by fostering opportunities for collaboration between the industry and universities.[16] Often, technology parks are located on a university campus, which can help companies build technological competencies and reduce R&D costs as they benefit from the academic research and knowledge base. Meanwhile, the universities expect the input of practical knowledge and contribution to their funding. They often provide a supportive environment for the development and funding of spin-offs. This kind of cooperation is often rather informal and flexible.[17]

Solving wicked sector-wide problems

Competitive innovation challenges

Thematic innovation challenges aim to identify and support small startups that develop solutions addressing a specific issue. Thematic challenges are often launched by mission-driven actors like philanthropies and international organisations (like IFAD's Moonshots for Development: Open Innovation Challenge on AI for Climate Resilience), but also by food corporations or industry associations seeking targeted solutions (interview 1). For instance, inspired by the ARPA model, the US innovation challenge AgARDA supports high-risk, high-reward research to develop disruptive innovations that address particular food and agriculture challenges, including climate mitigation. Other examples include the Smarter Climate Farmers Challenge and the THRIVE Global Impact Challenge, which focus on key challenges for sustainable agriculture and food systems.

Hackathons

Hackathons are short, time-bound events (typically 24—72 hours) in which interdisciplinary teams develop prototypes or solutions to predefined challenges, typically in competition with each other. They often combine technical, business, and design expertise to generate rapid innovation and prototype development. Like competitive innovation challenges, this is a targeted form of collaborative innovation to stimulate solutions for specific innovation gaps. Winners are usually picked by a jury and receive prize money or follow-up incubation support (interview 3).

Hackathons focused on climate-aligned food system innovation are co-developed and hosted by multiple actors, including universities and research institutions, international organisations, business associations, corporations, innovation hubs, and government agencies.

User-focused co-creation & testing

Living labs & transdisciplinary research

Living labs are user-centred innovation environments where new solutions are developed and tested in real-life settings through collaboration between researchers, companies, public actors, and end users. Integrating user information into the innovation process is critical for customer trust (interview 3). An example is the Climate Smart Agriculture Living Lab, set up in West Kenya by the International Livestock Research Institute (ILRI) in collaboration with the Kaimosi Agricultural Training Centre, which facilitates co-creation of local, farmer-led climate-smart solutions.

Transdisciplinary research is a research approach that integrates knowledge from non-academic stakeholders and multiple academic disciplines to jointly address real-world problems. Transdisciplinary food system research includes the participation of different food system actors in co-creative processes, as well as the sharing of local knowledge between practitioners and scientific actors. Farmer-led innovation for climate mitigation and adaptation is often inspired by smallholder farmers' traditional sustainable practices and local and historical knowledge (like planting certain crops together as a pest control, and how that transforms into cuisine), which can translate into place-based innovations (interview 5). For example, the Mazingira Centre, a CGIAR-funded livestock research institute in Nairobi, is exploring cattle breeds, grasses, and farming practices with reduced methane emissions, based on indigenous knowledge. An example of transdisciplinary agrifood research is the European Innovation Partnership for Agricultural Productivity and Sustainability, which funds multi-actor partnerships that bring together complementary types of knowledge with the aim of accelerating impactful innovation.[18]

Test farm networks & pilot programs

A **test farm** network coordinates farmers who are compensated for giving entrepreneurs access to validating their innovations under real-world conditions. Unlike living labs, which focus on earlier innovation

stages, test farm networks are used to trial how a prototype performs under different conditions. The 'matchmaking' is usually carried out by an intermediary organisation, which pairs the testing conditions required by the startups with the geographical location and type of the test farms. EIT Food, for example, coordinates a test farm network across Europe, where startups can apply once a year, specifying the testing conditions they require. EIT Food then matches them to farms in their network and compensates the participating farmers. Farms interested in participating are found through working with consultants or other regional actors with strong connections to the farming community (interview 2). While these collaborations for testing are currently somewhat of a gap in the food system innovation pipeline, they are critical for reducing adoption risks, generating credible performance data, and accelerating the transition from pilots to scalable solutions (interview 3).

Research pilot programmes are implemented either in the context of research projects or by agrifood companies in collaboration with their suppliers in a selected region or for a specific type of commodity. They are often in partnership with research organisations and agronomic advisors who carry out the data collection, research, and technical support activities. The aim is to test, evaluate, and demonstrate the effectiveness of innovations on the ground, and to create a knowledge base for scaling and disseminating them. A prominent example is the Climate Farm Demo project, a pan-European network of around 1,500 pilot demonstration farms, where climate-smart practices are implemented and evaluated. Outcomes are shared through on-farm demonstrations and advisor support to encourage wider adoption.

Merging complementary expertise & resources

Multi-actor research project consortia

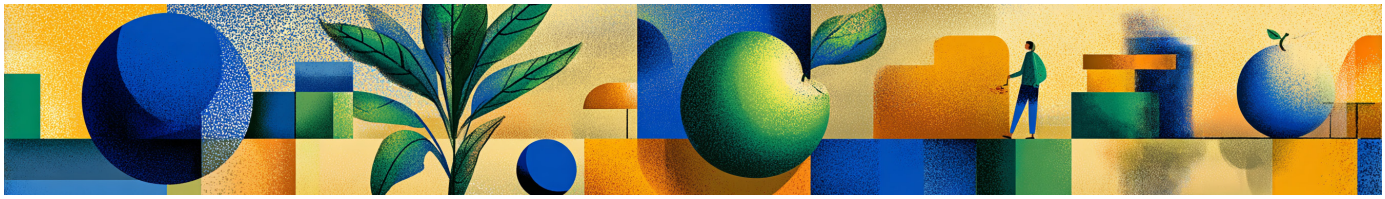
Project-based collaboration between different R&D actors is a classic form of collaboration, often involving academy and industry partners who bring in complementary expertise needed to achieve the research objective. The research may be either co-funded by the partners themselves or through public programmes. The emergence of such consortia is sometimes linked to networks where multiple stakeholders co-design a research agenda, such as the European Technology Platform ' Food for Life' where stakeholders jointly develop R&I priorities for the sector. An example of a public-private research consortium for sustainable food innovation is the Efficient Fertilizer Consortium, coordinated by the Foundation for Food & Agriculture Research. It pools industry, academic and public research resources to develop and scale enhanced-efficiency fertilisers that improve agronomic performance while reducing environmental and climate impacts. The research consortium co-designs a mission, research focus, and governance framework to guide and fund research and generate actionable results.

Strategic joint ventures

Joint ventures are strategic innovation partnerships that are more resource-intensive than other forms of collaboration. They include strategic long-term alignment of objectives as well as direct investment. Joint ventures are usually private-private collaborations—formed between a large firm and a startup or SME, or between two SMEs (to pool resources and capabilities), or sometimes even between firms and research institutions. The partners engage closely across the multiple phases of the innovation process and share capital, technology, data, and infrastructure to co-develop innovations.[9] Governance mechanisms are set up to share risk and reward between the partners.

Foundry model

The foundry model refers to a complex manufacturing or research infrastructure that is used by different innovators or companies on a service contract basis. This model originated in the semiconductor sector and was pioneered in Taiwan's integrated circuit manufacturing industry. In the context of food system innovations, the model is mostly applied in the biotechnology industry in the form of 'biofoundries'. Biofoundries are high-throughput, automated labs which significantly accelerate the design, development, and testing of synthetic microorganisms—thus addressing the big bottlenecks for scaling biotech innovations.



This is facilitated by the combination of multiple scientific fields, namely bioinformatics, synthetic biology, robotics, and AI.[19] Biofoundries usually offer access to this lab infrastructure, including all the physical and analytical equipment needed, as a service for different R&D actors. One example is the biofoundry by Ginko Bioworks, which offers high-throughput, automated labs as well as the use of their databases and programmes for research projects. Biofoundries are still a new concept, though it is increasingly explored by both private and public funders.[19]

Pooling resources to support startups from ideation to scaling

Incubator and accelerator partnerships & networks

This collaboration model focuses on incubator and accelerator programmes that are set up as partnerships between multiple stakeholders, or that cooperate with a wide network of existing innovation programmes and institutions.

Incubators typically support entrepreneurs in the early stages of innovation with resources and mentorship to validate ideas and transform them into commercially viable ventures, including equity-free seed funding or grants and support with market discovery and networking.

Accelerator programmes support startups that already have a prototype or minimum viable product by providing financial and technical support, guidance, and access to networks to help scale innovations into market-ready solutions. The selection of startups through a 'call for innovation' can be portfolio-based or challenge-based (interview 1). Incubator and accelerator programmes are usually launched by different types of actors like government agencies, universities, impact investors, or private companies.

Some programmes further leverage collaboration through multi-stakeholder partnerships or networks. The EIT Food Accelerator uses the infrastructure of a large network of already existing, locally rooted accelerators across Europe instead of replicating the efforts. EIT Food—affiliated startups are then matched with existing accelerator programmes based on the innovation theme and receive extra support across the network. Beyond Europe, EIT Food collaborates with FoodTech Hub Latam in Brazil to support startups across Latin America in accessing their global accelerator ecosystem.

As an example of a partnership-based programme, the Global Methane Hub's Enteric Fermentation R&D Accelerator invests in scalable breakthrough solutions to mitigate livestock methane emissions, and is funded by an alliance of public and private partners including the government of Ireland, Danone, and philanthropies.

Venture capital partnerships

Venture capital is crucial to support innovative startups, but traditional venture capital models are designed for fast-scaling, high-liquidity sectors. Consequently, they tend to clash with the conditions of agricultural innovations, in particular the longer time horizons and the need for robust evidence under diverse geographical conditions. Many ag-tech startups experience prolonged commercialisation timelines, difficulties achieving broad adoption, and limited exit opportunities. The steep decline in ag-tech investment between 2021 and 2024, following an initial period of enthusiasm, reflects this mismatch.[20]

Venture capital partnerships address this issue by pooling funds to support startups that clash with venture capital's traditional timing and ROI expectations. This is often made possible through the participation of a mission-driven (public or philanthropic) investor. For example, the public-private partnership AgriZeroNZ which provides venture capital for innovations lowering methane emissions in pasture-based sheep and beef farming, pools funds from New Zealand's government, agrifood corporations, and agricultural banks. The financial arrangement of the partnership—where the government matches private investments equally with public funds—was a key motivation for the companies to get on board. Startups (both early and later stages) receive equity investments between NZ $1—10 million on the condition that they bring their technology to New Zealand. AgriZero NZ also actively supports the ventures in navigating the regulatory landscape, which can be a significant barrier to scaling startups.

Barriers & success factors for collaboration

Our discussions with experts show that while barriers to collaboration on food system innovation are often context-specific, **common barriers include limited alignment of partners' interests, greenwashing risks, uncertainties about consumer acceptance, and a highly fragmented innovation ecosystem**.

While collaboration usually requires a certain level of compromise, partnerships fail to materialise or become fragile when the participating actors must make too many compromises, specifically when their individual objectives are not sufficiently aligned with the shared goals of the partnership (interview 4). For instance, the private sector's motivation for climate innovation is often tied to its commercial value. Related to this is the risk of collaborations on climate-aligned innovation being primarily motivated by corporate publicity without substantial interest in advancing the innovations. (interview 2).

In cases where user or consumer acceptance of innovations is particularly uncertain, the risk of attracting public criticism can undermine companies' motivation to proactively collaborate. The case of widespread misinformation on social media about the methane-inhibiting feed additive Bovaer, and the calls for boycott that followed, highlights the importance of having a social licence to operate (interview 4).

In some geographical regions and innovation areas, the innovation ecosystem is highly fragmented. Understanding the landscape of different innovation actors and efforts—and identifying the right collaboration partners—becomes more challenging in a space with many uncoordinated initiatives (interview 1).

Success factors for collaboration on innovation include an alignment of interests among partners, reducing the risk through funding and governance structures, and a good understanding of the specific innovation ecosystem.

One of the main success factors when initiating a collaboration to foster climate-aligned innovation is to **design it as a 'coalition of the willing'**. Partners' individual objectives should be closely aligned with the overarching goal of the collaboration—a point highlighted by several interviewees. Strong coherence between the participating actors' interests ensures partners' long-term commitment and motivation to achieve the joint goal.

Committing to support innovations over a longer term is a factor that provides certainty for innovators and increases the chances of collaborations successfully bringing about climate-aligned innovations, especially given that food system innovation often has longer development and validation cycles (interview 4).

Ensuring robust science and market viability of the innovations can enhance success. This can be done, for instance, through a technical due diligence process that confirms the efficacy of a product. Collaborations can support these efforts by leveraging the partners' technical expertise or their network connections. While strict regulation can pose a hurdle to the innovation process, obtaining approval within a robust regulatory system can also enable success by signalling quality and safety (interview 4).

Risk-reducing funding and governance structures are another success factor that lowers the threshold for actors to collaborate. Government participation and public co-funding can act as an 'anchor' in innovation partnerships and provide stability. Governance structures can also be set up in a way that reduces the liability of collaboration partners; for example, the public-private partnership AgriZero NZ is set up as a limited partnership with its own board, which means the partnership can take risks that the government would not be undertaking alone (interview 4).

The interviewees emphasised that when collaborations aim to support innovation in a specific region, **having a thorough understanding of the local innovation ecosystem and finding trusted local partners** as an entry point are critical success factors.

Depending on the purpose of the collaboration and the stage of innovation supported, **appropriate scoping of the technology focus (either a broad and open scope or a targeted and narrow scope)** can drive success. When the goal is to introduce solutions to the market that have high maturity, a narrow technology focus can enable targeted action (interview 4). In contrast, intentionally broad programmes without a themed technology focus are more apt to support new, potentially high-impact discoveries for which commercial pathways are less clear (interview 2).

Applying the framework & overarching recommendations

Practical steps to applying the collaboration model framework

This section provides practical steps to identifying which collaboration models might be best suited for certain innovation areas, innovations, or regions. It draws on the overview of actors, innovation challenges, collaboration barriers, and success factors outlined so far, as well as insights from case examples (see page 13). The following steps and prompts can help narrow down the suitable collaboration models.

1. Define the context: **Is the support aimed at**...
   - a specific innovation area (e.g., sustainable plant nutrition),
   - a specific innovation (e.g., a methane inhibitor), or
   - a specific region (e.g., Sub-Saharan Africa)?
2. **Identify main innovation bottlenecks based on relevant barriers.**
   - Which barriers relevant to climate-aligned food system innovation apply? (e.g., regulatory hurdles; see also box 1)
   - If the support targets a specific innovation, which innovation stage is it in, and what typical challenges is it linked to? (e.g., scaling challenges)
   - If the support targets a specific region, what are the local barriers? (e.g., lack of innovative capacity)
3. **Identify potential collaboration partners by matching the value added** from developing the innovation (area) **with interests of key stakeholders.**
   - What is the main value added? (e.g., climate mitigation, increased productivity)
   - Which stakeholders (see also table 1) have interests that could align with the value added? (e.g., corporations aiming to reduce Scope 3 emissions)
   - Which stakeholders have the capacity and capabilities to address the main innovation bottlenecks?
4. **Define the main purpose of the collaboration** (see framework on page 6) based on bottlenecks and actors' interests, and identify **fit-for-purpose collaboration models.**
5. **Identify context-specific collaboration barriers** through stakeholder engagement, and use lessons learned and success factors from existing examples to address them.
   - What collaboration barriers (see also page 11) could the collaboration face in the specific context? (e.g., uncertainty about consumer acceptance)
   - What success factors (see also page 11) could apply, and which existing initiatives could provide lessons learned? (e.g., robust technical due diligence)

Actions to foster climate-aligned food system innovation collaboration

To further foster collaboration for climate-aligned food system innovation, greater attention is needed in the following areas.

Strategic grant funding remains important for climate-aligned innovation and should be targeted towards underfunded upstream innovation, potentially disruptive early-stage innovation, and mission-aligned innovation broker organisations. Since many sustainability innovations deliver public goods that are difficult to monetise, public sector funding and philanthropic grants remain indispensable to bridge the gap between societal value and private sector return expectations (interview 5).[8,20] Fostering innovation broker organisations that bring together actors and link existing infrastructure can play a significant role in building the connections necessary to form collaborations that foster climate-aligned innovation in the food sector.

Creating mechanisms that support the pre-startup phase—through stipends, pilots, open experimentation programmes, or applied research pathways—would help expand the pool of viable ideas and unlock a more diverse pipeline of climate-aligned solutions. Organisations that de-risk this early stage and help form the innovation ecosystem through collaboration are particularly valuable in addressing this gap (interview 3).

Tapping into the potential of co-creation and farmer-led innovation could help source innovations based on traditional farming knowledge and create better testing opportunities, harnessing the potential of local, traditional knowledge and practices for climate mitigation and adaptation. This does not necessarily require a lot of funds but rather relies on leveraging trustworthy local connections and networks (interview 5). There is also a risk that food system innovation aimed at internationally applicable, large-scale solutions might lead to the exclusion of smaller markets or stakeholder groups with less purchasing power, who consequently may benefit less from ag-tech developments.

Inventory of Collaboration Cases

COLLABORATION MODEL	CASE EXAMPLE
Pre-competitive knowledge networks	Africa Dryland Crops Improvement Network The network connects over 200 scientists from 17 countries across Africa and various disciplines. They work on improving dryland crops, aiming to strengthen partnerships and improve regional crop breeding pipelines.
	WEF Food Innovators Network The platform brings together 250+ agrifood innovators, incl. farmers, startups, corporates, financiers, multilaterals, and governments, to facilitate knowledge exchange. The community interacts through events and working groups, which jointly produce knowledge products. The broad thematic focus includes climate-smart crops, alternative feedstocks, and biotechnologies for climate adaptability.
Conferences and events	International Fertilizer Association's 'Cultivating Tomorrow Conference' The international Cultivating Tomorrow Conference focuses on innovative solutions for the fertiliser industry, bringing together leaders in sustainability, innovation, corporate strategy, policy, and communications.
	United Nations' Global Conference On Sustainable Livestock Transformation With a focus on scaling innovations, knowledge sharing, and promoting collaboration, the international conference brings together policymakers, farmers, industry, NGOs, researchers, and development agencies to showcase solutions for the sustainable transformation of the livestock sector.
Regional innovation hubs	WEF Innovation Hub Viet Nam The Food Innovation Hub model is tailored to different contexts and brings together local expertise and partners to create an enabling innovation environment. The Food Innovation Hub in Viet Nam specifically aims to strengthen the innovation ecosystem for low-carbon rice cultivation.
Technology parks/campuses	Wageningen University's Freshtech & Robotics Facility The facility offers researchers and partners of Wageningen University a wide range of equipment to test and develop solutions that can help improve cold chains for fresh produce and horticulture. They also host workshops, training sessions and meetings offering a collaborative space to exchange knowledge and showcase results.
Competitive innovation challenges	AgARDA (Agriculture Advanced Research And Development Authority) Inspired by the ARPA model, the US pilot AgARDA supports high-risk, high-reward research to develop disruptive innovations that address particular food and agriculture challenges.
	Agritech Innovation Challenges The AgriTech Innovation Challenges, implemented by CGIAR's Accelerate for Impact Platform across Africa, focus on context-specific research challenges that are determined by the key stakeholders in the respective region.
	International Fertilizer Association (IFA) Innovation Hub's 'Cultivate Challenge' The innovation challenge program focuses on identifying high-potential entrepreneurial talent and technologies aligned with priority impact areas for the fertiliser sector—such as energy efficient ammonia production, novel phosphate fertilisers, and nutrient-use efficiency tracking. Selected innovators receive targeted support to accelerate the innovation development.

COLLABORATION MODEL	CASE EXAMPLE
Hackathons	Reboot The Earth Hackathon 2025 On Climate And Agriculture The 2-day events of the Reboot the Earth hackathon series in 2025 challenged participants to develop solutions for climate mitigation and adaptation in agriculture. They took place in different locations around the globe and were co-hosted by UN FAO, Carnegie Mellon University, Digital Public Goods Alliance, and Salesforce.
Living labs & transdisciplinary research	Climate Smart Agriculture Living Lab Set up in West Kenya by the International Livestock Research Institute (ILRI) in collaboration with the Kaimosi Agricultural Training Centre, the living lab facilitates co-creation of local, farmer-led climate-smart solutions.
	Accelerating Reduced Emissions In Indigenous Breeds In Africa The 3-year transdisciplinary research project brings together advanced genetics, Africa's indigenous cattle breeds and farmer knowledge to breed cattle that produce less methane.The project is a collaboration of the International Livestock Research Institute, the Bezos Earth Fund, and the Global Methane Hub.
	European Innovation Partnership For Agricultural Productivity And Sustainability (EIP-AGRI) This EU research program funds projects run by multi-actor partnerships that focus on real problems or opportunities for farmers and bring together complementary types of knowledge, with the aim to speed up impactful innovation.
Test farm networks & pilot programs	EIT Food Test Farm Network EIT Food coordinates a test farm network across Europe, where startups can apply once a year. EIT Food matches the testing conditions needed with farms in their network and compensates the participating farmers.
	Mars' Net-Zero Dairy Pilot Farms As part of its collaborative sustainable dairy initiative 'Moo'ving Dairy Forward', Mars partners with its dairy suppliers DMK Group and Friesland Campina to set up net-zero pilot farms that test and evaluate new methane-lowering practices and technologies over five years.
	Climate Farm Demo Project Climate-smart practices are implemented and evaluated across a pan-European network of around 1,500 pilot demonstration farms. The outcomes are shared through on-farm demonstrations and advisor support to spur wider adoption.
Multi-actor research project consortia	Efficient Fertilizer Consortium Coordinated by the Foundation for Food & Agriculture Research, the consortium pools industry, academic and public research resources to develop and scale enhanced efficiency fertilisers that improve agronomic performance while reducing environmental and climate impacts.
	AgNAV Research Cooperation AgNav, a digital sustainability tool for livestock farmers and agricultural advisors in Ireland, has been developed by a research collaboration between Teagasc (Ireland's national body for agriculture and food development), Bord Bia (the Irish Food Board), and the Irish Cattle Breeding Federation, with support from the Irish Department of Agriculture. The cooperation leverages data, expertise, and resources across state agencies and industry.

COLLABORATION MODEL	CASE EXAMPLE
Strategic joint ventures	Enifer - Foods Of Norway- Bio-3 Partnership Enifer, the developer of PEKILO®, a single-cell feed ingredient for aquaculture, faced scaling challenges. The startup entered strategic partnerships with the Foods of Norway Centre, which carried out critical research, and Bio-3, a mycoprotein facility that licensed the production process.
Foundry model	Ginkgo Bioworks' Biofoundry The biofoundry by Ginko Bioworks offers high-throughput, automated labs as well as the use of their databases and programs for research projects. One of the key services the platform provides is fast enzyme engineering—an essential R&D component for many biotech companies—from concept to commercialisation.
Incubator and accelerator partnerships	Global Methane Hub's 'Enteric Fermentation R&D Accelerator The Accelerator invests in scalable breakthrough solutions mitigating livestock methane emissions. It is funded by an alliance of public and private partners, including the government of Ireland, Danone, and philanthropies.
	India Agritech Incubation Network Launched by the Bill & Melinda Gates Foundation and Tata Trusts, in partnership with Social Alpha and IIT-Kanpur, the incubation network provides early-stage support for entrepreneurs. Furthermore, it fosters collaboration to support the development of innovations for smallholder farmers.
	Adaptation Fund Climate Innovation Accelerator (Afcia) Program A partnership between the WFP Innovation Accelerator and the Adaptation Fund, this program focuses on accelerating region-specific climate adaptation solutions in Nepal, Pakistan and the Philippines.
Venture capital partnerships	AgriZero NZ The public-private partnership between New Zealand's government, agrifood corporations, and agricultural banks provides venture capital for innovations lowering methane emissions in livestock. Private funds are matched equally with public funds.
	EIT Food's 'Seedbed Venture Catalyst' Program EIT Food uses a network approach to help entrepreneurs access venture capital and partners with leading venture builders and venture studios across Europe, offering catalytic funding to selected founding teams. The program supports early-stage innovation, bridging the funding gap for entrepreneurs in the ideation phase.
	AIM For Scale The organization, launched at COP28 by the United Arab Emirates and the Gates Foundation, develops customised 'Innovation Packages'—a structured investment blueprint focused on a single high-potential innovation area—and secures partnerships and funding to bridge the gap between pilots and implementation at scale.

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Interviews by actor types

Interview 1: International organisation representative

Interview 2: Intermediary organisation representative

Interview 3: Industry association representative

Interview 4: Innovation partnership representative

Interview 5: Academic expert

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