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Transforming Innovation Systems to Deliver Impacts at Scale

JANA KOERNER, ANGELE TASSE, LEANNE ZEPPENFELDT, SOPHIE HEALY-THOW, EVAN GIRVETZ, WALTER E. BAETHGEN, DHANUSH DINESH, AND SONJA VERMEULEN

Highlights

- Transforming our food systems will require changing our innovation systems, in which organisations on agricultural research and innovation can play a crucial role.
- Key success factors for change can be organised into three dimensions: designing and managing transformative innovations, culture and structures of innovation organisations, and their engagement with the wider innovation ecosystem.
- Failures are crucial elements of innovation processes. It is key to rapidly test, share, build on and learn from successful, and failed, innovations.
- This connects to the paradigm 'Open Innovation 2.0', which is widely applied in the private sector but not yet applied and evaluated for research and innovation organisations in the public sector or tertiary education.
- Four key principles emerge: (1) big-picture action-oriented thinking, (2) entrepreneurial organisational culture, (3) close attention to partnerships and contexts, and (4) diverse investment portfolios, with different levels of risk. These also imply – and require – the upstream transformation of funding and incentive systems.

14.1 Fit-for-Purpose Innovation Systems to Accelerate Sustainable, Equitable, and Resilient Food-Systems Transformation

> *Do research to create knowledge. Do innovation to create impact.*
> *Marco Ferroni, Chair, CGIAR System Board*

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Innovative opportunities for food-system impact range from land use and food production to distribution, consumption, and waste management. While many climate-resilient technologies and practices already exist, adoption rates and their corresponding impacts remain low. Responding to local needs will require the bundling of innovations into different technological components – for example, finance products with insurance or climate information – while considering context-specific and social factors such as policies, social licence, and competing actors (Barrett et al., 2020). Innovation, however, has not always led to positive outcomes. Evidence shows that previous growth-driven approaches have made food systems a major driver of habitat degradation, climate change (Bene et al., 2020), and social inequalities (Box 14.1), with innovation sometimes further exacerbating negative externalities. To transform food systems, innovation must be fit-for-purpose – for example, using artificial intelligence to track deforestation or satellite monitoring of land-use emissions for transparency and better reporting – and able to address inequalities and imbalances of power.

In that context, transforming food systems also requires a transformation of the underpinning innovation systems (Steiner et al., 2020). As part of the UNFSS Innovation Lever, four areas have been identified as critical to building fit-for-purpose innovation systems: (1) the development of national and regional ecosystems to improve how we innovate; (2) better collaboration through societal and institutional innovation; (3) improved knowledge systems, including different

Box 14.1
Addressing Power Issues in Innovation Systems

The 2021 UN Food Systems Summit (UNFSS) process reminds us how important and how difficult it is to frame innovation broadly and inclusively to enable countries and communities to transition to more sustainable and equitable food systems. Integrating different ways of knowing, including traditional and scientific knowledge, is key to understanding power dynamics in food systems. This requires involving all social actors – including those who have yet to benefit from the various services that food systems provide – in building the evidence base for transformation. Furthermore, this also means fostering co-creation, knowledge-sharing, and explicit power-sharing in the development of innovations, across entire value chains. Indeed, innovations can be designed and used to rebalance power relations within value chains, to ensure there is fairness, equity, and transparency in the distribution of risk, and to empower farmers to adopt, scale, and ultimately benefit from innovation. At the same time, as part of a full value-chain approach, consumers must be accounted for, as they will ultimately drive demand for more sustainable, climate-resilient practices, while at the same time being subject to continuous – hidden or open – external influence through aggressive advertising and lifestyle models, for example.

kinds of knowledge, that is, scientific, indigenous, and other types; and (4) a better integration of data and digital systems.

As highlighted in Chapter 12, a large investment gap in research and innovation – typically associated with high investment risk – has hindered progress in these four areas. The existing investment does not support sustainable or equitable futures. Of the US$50–70 billion annual public spending on agricultural innovation in low- and middle-income countries, only 7 percent explicitly targets environmental outcomes, of which only around half include social or human objectives. An additional US$10.5 billion per year – combining US$4 billion for research and development and US$6.5 billion for uptake of climate-smart technical options – would deliver significant progress towards zero hunger and limiting global warming to 1.5°C, through redirecting incentives and/or unlocking private finance (CoSAI & FCDO, 2021) . The need to increase investment efforts is at the core of the ClimateShot campaign and its Global Action Agenda for Innovation in Agriculture launched at COP26 (Box 14.2).

Box 14.2

The ClimateShot Campaign and Global Action Agenda for Innovation in Agriculture

Launched at COP26 in Glasgow, the Global Action Agenda for Innovation in Agriculture is the culmination of a year-long global campaign co-chaired by CCAFS and the UK Foreign, Commonwealth, and Development Office, which set out a vision to transform agricultural innovation for people, nature, and climate. In line with the Glasgow Agriculture Breakthrough, the ClimateShot campaign brings a wide range of stakeholders into an informal alliance that draws from across the climate, agriculture, and food sectors, and which calls for collective action to achieve four key objectives:

- Increase investment in agricultural research and innovation to create more climate-resilient, low-emission technologies and agriculture practices.
- Focus at least a third of agricultural research and innovation investments on delivering demand-driven solutions across food systems that protect nature and limit climate change.
- Showcase successful business models and promote public–private partnerships that deploy these innovations on the scale needed to meet the climate and food security challenge.
- Forge consensus on the evidence of what works where, and facilitate inclusive dialogue among food and climate champions around the world on appropriate public, private and civil society solutions.

A set of priority initiatives as well as contributions from the campaign's 'allies' – nearly 200 organisations, including 20 countries – will ensure the successful implementation of the Global Action Agenda's vision and objectives.

For further information, visit www.climateshot.earth.

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Provided sufficient investment is unlocked, research programmes have an essential role to play in further supporting change-makers and facilitating food-system transformation. Research can provide evidence, tools, and methodologies for planning change and measuring impacts, co-developing and scaling innovative technologies and practices, and informing and building capacity for different purposes, stakeholder groups, aspects, and levers of food-system transformation. To do this, however, agricultural research and innovation institutions must be fit-for-purpose (CoSAI & FCDO, 2021) .

As highlighted in Chapter 3, the successful uptake of knowledge requires demand-driven, targeted, co-produced, and timely evidence. This chapter offers some insights on the changes required in the procedures and institutional set-up of agricultural research and innovation organisations, and how they engage with the enabling environment. It then reflects on the importance of failing, and distils key mechanisms that connect stakeholder groups across these dimensions, aiming to rapidly share, build on and learn from successful and failed innovations. We discuss these practical learnings under the concept of Open Innovation 2.0 and present four principles for rethinking research and innovation as part of wider, systemic change. We conclude that such change both entails and requires an upstream transformation of funding and incentive systems.

14.2 Lessons of the CGIAR Research Program on Climate Change, Agriculture, and Food Security Enacting Transformative Change

> *Problems do not come in disciplinary boundaries. Solutions don't, either.*
> *Walter E. Baethgen, Director, Regional and Sectorial Research Program, International Research Institute for Climate and Society, Columbia University*

Both the UNFSS and the ClimateShot campaign emphasise that transformative changes will cut across many different dimensions, levels, and geographies. The impulse for innovations will often emerge as a need from the wider innovation system, in which the agricultural research and innovation institutions form only part of the puzzle. As part of this broader puzzle, research and innovation actors must work together with the wider stakeholder community (Chapter 16), fostering coherent and joined-up research design, implementation, and funding strategies that address the needs of the many (Steiner et al., 2020). The scale and pace of identifying, bundling, and scaling

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innovations that can drive food-system change depends largely on how compatible these innovations, and different innovators, are within their respective contexts, and with each other.

Such innovation approaches would require research and innovation organisations to rethink and accelerate their processes of innovation development and scaling, shifting from a rather technology-centric perspective to one that embraces sustainable change at scale (Woltering et al., 2019). To do so, we must ensure that research is more action-oriented and identify the best practices that improve knowledge generation, exchange, and use processes, ultimately supporting the food-system transformation (Steiner et al., 2020). In parallel, finding innovative ways to integrate and leverage policies and finance, alongside private-sector and civil-society actions is essential.

Systemic approaches that have been proposed to tackle these questions can be challenging for research and innovation institutions to implement (Govaerts et al., 2021). In the following sections, we aim to provide guidance on how research and innovation organisations could accelerate the transformation of innovation systems, with lessons derived from multiple evaluations, learning events, and synthesis documents from the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), and articulated through examples of ten years of CCAFS implementation (CGIAR-IEA, 2016; Koerner et al., 2020; Nelson & Morton, 2020). These are grouped into three dimensions: the process of designing and managing transformative innovations, the characteristics of successful innovation organisations, and their engagement with the wider innovation ecosystem.

14.3 Designing Transformative Innovations

Innovations must be useful for end users in practice, not only in theory. At the same time, decisions on what to invest in will depend on the goals and priorities of each individual, public, and private decision-maker. A balance is to be struck between desirability, scalability, and the possible impact of the respective innovation bundles. At the same time, particularly at moments of agenda-setting and prioritisation, power relations and the inclusion or exclusion of respective stakeholder groups need to be monitored, made transparent, and accounted for. The following are examples of good practices:

Participatory Priority Setting: Participatory prioritisation tools can help stakeholders at different levels identify their climate vulnerabilities, assess coping strategies, and evaluate impacts and trade-offs. Application areas range from

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countries' determining their contributions to the Paris 2015 Agreement to participatory rural appraisal tools applied at farmer and community levels.

User-Centric Design Approaches: Agricultural research and innovation institutions increasingly apply methodologies like co-design or co-creation, particularly when innovations have a direct user interface, as for example in climate or financial services. These methodologies increase the potential for later uptake of the innovation, involve users from the very beginning, and can be adapted to different, multi-stakeholder groups and contexts. Examples include co-designing farming systems with farming communities, addressing sectoral bottlenecks with value-chain actors, and defining pathways for transforming innovation networks at the policy level.

Innovation Portfolio Management: Well-balanced innovation portfolios can increase the efficiency of research and innovation institutions in several ways. For example, they can balance investments in innovations that are likely to be successful, with innovations that have high-impact potential but that are not yet fully proven. Countries or research and innovation institutions could also have regional or thematic portfolios, thus directing bundled efforts towards key areas for change (Box 14.3).

14.4 Designing Organisations as Innovation Environments

Becoming an innovation organisation will become a matter of self-interest for agricultural research and innovation institutions that wish to remain relevant, competitive, and be able to keep contributing to accelerated food-system transformation. To become an innovation organisation, a key shift is to nourish a culture of innovation that depends on investing in both people and spaces, as follows:

A Culture of Transdisciplinary (Knowledge) Exchange and Cooperation: Innovations should be viewed in a transdisciplinary way, involving multiple stakeholders, integrating different forms of knowledge, and fostering transitions across different food-system dimensions. Creativity is unleashed in safe spaces, which can be both physical or temporal, with the quality of interaction being more important than the quantity (Gloor, 2007). Transdisciplinary design is fostered by a shared vision, trust, complementary roles, and easy communication, yet also requires 'hard factors', like the innovation of intellectual property management practices, and incentivising and tracking the generation of societal outcomes.

Skills and Roles for Innovation: Engaging in innovation partnerships and communities also requires actors to take on different roles and skills, like

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Box 14.3

Bundling and Scaling Innovations in the Program Accelerating the Impact of CGIAR Climate Research for Africa

In 2020, the World Bank funded the three-year Accelerating the Impact of CGIAR Climate Research for Africa (AICCRA) program, to bundle and scale climate-smart technologies in six African countries and beyond. Innovation bundles could, for example, be coupling agricultural credits with climate services (CS), or coupling CIS with agricultural advisories. Using experiences from CCAFS, workshops were held on how to prioritise and bundle innovations, offering sets of different tools for each step. These tools are tailored to the needs of different stakeholders and user groups, from farm to landscape levels, market actors or regional, national, and global policies. The tools are freely accessible online and can be used in complementary ways. For example, Climate-smart Country Profiles can be complemented by Country Investment Profiles and/or scaled down to Community Adaptation Plans, and vice versa. An example of this is the AICCRA Zambia program, which developed a portfolio of four innovation bundles around solar pumps for specific value chains, integrated aquaculture-agriculture systems, seed varieties, and diversified integrated chicken/goats/legume systems, which it now aims to link to end-user finance approaches to reach scale.

convening, facilitating, negotiation, and change management (Wigboldus et al., 2016). A special challenge for agricultural research and innovation scientists can be the so-called expert–learner duality (Pugh & Prusak, 2013), that is, the capacity to easily switch between the roles of expert and learner. To attract young people to scientific careers, it is crucial to offer and invest in positions that require more general skills and knowledge, rather than specialised but siloed ones.

Orchestrating and Engaging with Different Innovation Spaces: Innovation spaces, such as multi-stakeholder networks, can play different roles in articulating, designing, mainstreaming, or creating an enabling environment for innovations. Depending on their respective goals and member compositions, such innovation spaces can take on different forms and dynamics, and work on different levers of food-systems transformation by promoting sector development, cross-sectoral cooperation, policy incidence, or social mobilisation, for example (Koerner et al., accepted).

An example of fostering a culture of innovation through investing in both people and spaces can be seen in Box 14.4.

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Box 14.4
The CGIAR Research Program on Climate Change, Agriculture and Food Security as an Innovation Organisation

CCAFS exemplified its status as an innovation organisation by establishing a core team matrix of country and flagship programs, led by both CGIAR centres and partner institutions, and guided by a shared vision spelled out in the program-wide theory of change. This set-up provided a safe space in which knowledge, tools, and methodologies could be shared and adjusted to the respective contexts, across themes and disciplines. The mix of core- and project-funding provided both the continuity and the flexibility to develop, test, and evaluate new initiatives with small grants and seed funding. The outcome-oriented planning, reporting, and allocation of budgets incentivised an increasing number of people to engage in scaling activities, adding the roles of designers, conveners, and facilitators to their roles as scientists and experts. These factors also enabled program activities to span from farmer- and community-levels up to national policy or private-sector engagements, and linked these to global dialogues and innovation platforms (Koerner et al., 2020).

14.5 Engaging with the Wider Innovation System

Innovations are not designed or scaled in isolation. Crucial elements of wider innovation ecosystems are strategic partnerships, funding packages, and policies that create an enabling environment for deploying and scaling innovation. Another accelerator can be fostering local and national innovation capacities (Box 14.5). Below are some transferable lessons from the experience of CCAFS and CGIAR:

Strategic, Complementary, Out-of-the-Box Partnerships: Partners are increasingly chosen to open new use areas for scientific contributions in the sustainable finance or humanitarian sectors, for example. Important criteria for choosing, managing, and communicating partnerships are due diligence, clear roles and responsibilities, transparency, and clear future-use agreements.

Innovation Funding Packages: Funding is one of the main bottlenecks for developing and scaling innovations. Funding or financing packages should allow for and cover initial risks of early innovations while providing the needed safety and continuity to achieve transformative change. For example, funding packages based on theories of change allow adaptive management, flexible pathways, and reflexive monitoring and reporting (Schneider et al., 2019).

Innovation Policies: Policies that foster innovation need to provide and protect spaces both for innovation and for diverse opinions and approaches towards food-

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Box 14.5
The Philippines Department of Agriculture's Adaptation and Mitigation in Agriculture program

Since 2015, the Philippines Department of Agriculture (DoA) has mainstreamed climate-resilient agriculture across all its programmes, functions, and agencies through the national and system-wide Adaptation and Mitigation in Agriculture Program. Supported by the International Center for Tropical Agriculture (CIAT) and CCAFS Southeast Asia, the DoA partnered directly with the CCAFS' partner-NGO, the International Institute for Rural Reconstruction, to institutionalise their bottom-up Climate-Smart Village approach in 17 of its provinces. For that purpose, the DoA provided funds for learning and capacity building for their Regional Field Offices and extension services, to support farmers in identifying, assessing, testing, iterating, and scaling their own climate-resilient community adaptation plans (Koerner et al., 2019).

systems transformation, including the demand side of innovations. Another lesson is to invest in the informed decision-making capacity of policymakers with regard to food-systems transformation. Likewise, long-term, coherent policy signals are needed to attract the necessary investments to scale innovation (Dinesh et al., 2021).

14.6 The Importance of Failing Fast and Intelligently

While the factors above will shape innovation systems that deliver successful innovation, failures are an inevitable and crucial part of realising those successes. This is especially true for the uncertain, complex dynamics in which food-system innovation takes place, as these require exploratory and diverse innovation avenues (Cannon & Edmondson, 2005). Inevitably, some efforts will fail. However, if anticipated and understood, failures can be a key, and sometimes the only, source of information and inspiration for learning. Of course, avoidable failures can be identified at the start of the innovation pipeline through research and adopting best practices. In addition, conversations around failure need to move beyond first-order causes and specific and/or individual blame to enable in-depth learning (Box 14.6). Both individual and organisational leaders should push for and showcase a profound change in the appreciation and response to failures.

Unforeseeable failures deserve a space in the innovation system as a valuable resource for learning. Early recognition of failures, through explicit lean or intelligent experimentation and fast feedback loops, is crucial to limit sunk costs

Box 14.6
Setup for Failure: Balancing Short- and Long-Term Priorities

An outcome-orientated research program such as the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) that is focused on informing policy and decision-making at the farm level often faces challenges in balancing defined priorities. For example, activities in necessary foundational work may be penalised for being too slow to demonstrate evidence of its impacts, given the urgency of doing so. A typical, additional challenge for balancing priorities arises when a concrete opportunity is identified to effectively inform policy. In some cases, eagerness to take advantage of those opportunities jeopardises the required process of technical validation, meaning steps are prone to criticism by external experts.

and manage limited resources (Blank, 2013). Hence, innovation systems and the organisations in them need built-in processes for systematically and rapidly recognising and analysing failures. The following three key mechanisms can be distilled from the previous section's lessons learnt and examples, connecting stakeholder groups across dimensions, themes, and levels, to rapidly share, build on and learn from (un)successful innovations:

Knowledge, Tools, and Methodologies that Speak to Each Other: One way of accelerating food-system innovation is to generate knowledge, tools, and methodologies that can flow relatively freely across organisational boundaries, with actors sharing and building on each other's generated – or discarded – innovations. Examples of this could be open-source data, peer-to-peer platforms, waiving patents, and private copyright predatory practices, and allowing also for crowdsourcing of data, information, and activities. Such open innovation platforms could then allow for flexible adaptation of innovations, embedded within existing national investment strategies or scaled-down based on country-specific development plans (Box 14.3).

Structures for Rapid Testing and Iteration: Flexible and iterative tweaking of the innovation, based on frequent check-ins and feedback, can aid early and robust responses to failure. Supporting structures can be formal innovation pipelines with stage gates, or less formalised 'pit stops' focused on frequent check-ins, adaptive benchmarks, and flexible course correction, supported by funding schemes flexible enough to allow for trial and error (Box 14.4).

Innovation Capacities across Levels: Capacity building for innovation users is often limited to guidance in the use of the innovation. To accelerate the transformation of our food systems, it can be more effective to explore and build

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up users' capacities to innovate, and to increase the role of farmers and other food-system participants, shifting them from end users or implementers to co-designers, owners, and decision-makers. This will allow them to adapt innovations to context-specific conditions and uses (Box 14.5). Another effect of involving users, in crowdsourcing activities, is the increase of data points and the democratisation of data generation and use (van de Gevel et al., 2020).

14.7 Underpinning the Practical Lessons with the Concept of Open Innovation 2.0

The lessons and best practices above allude to the concept of Open Innovation 2.0, which gained momentum in the private sector with the arrival of large-scale digitalisation. The main idea of Open Innovation 2.0 is that all actors – including business, society, research, and policies – have the opportunity to create, share, and improve transformative solutions more quickly for recurring societal problems. Starting with a shared purpose, and resulting in shared outcomes, the main characteristics of Open Innovation 2.0 are (1) innovations that explicitly plan for adoption and create value for the respective stakeholders and visions; (2) an agile 'production style' that promote transdisciplinary, non-linear roles and networks; and (3) ecosystem orientations that foster formal and informal collaboration, leading to win-win solutions. Central to innovation systems that follow the Open Innovation 2.0 principles, would then be innovations. Knowledge, tools, and technologies with exchangeable components or modules, and structures for rapid experimentation and learning, allowing for the equal sharing and growth of the competencies and capacities of innovating actors (Curley & Salmelin, 2018).

Translated to the context of research and innovation organisations, as outlined in the previous section, an Open Innovation 2.0 system can be illustrated as in Figure 14.1. However, the concept of Open Innovation 2.0 is not necessarily fully transferable to reality. For example, it assumes that all stakeholders' visions and inputs will be on an open and even playing field, whereas our lived experience tells us that power imbalances are the norm (Box 14.1). In such models, failing, or 'trial and error', is often embedded in the design phase of new technologies, by using stage gates or pit stops. However, failures are far less visible and accepted in downstream innovation processes such as scaling-up or science-policy engagement.

14.8 Way Forward

This chapter has explored recent lessons – both from the literature and from the authors' working experience – on why innovation systems matter for creating sustainable, equitable, and resilient food systems, and how research and innovation organisations can become better innovators. However, we recognise that not all

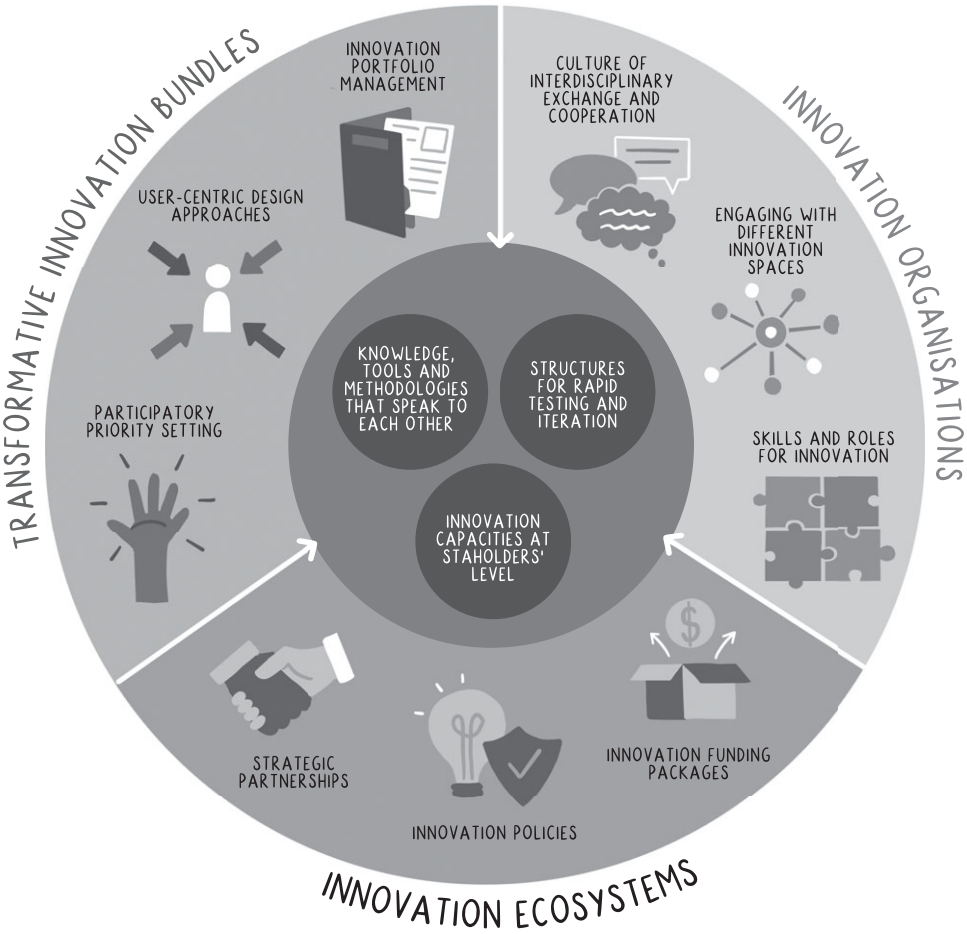

Figure 14.1 How an Open Innovation 2.0 System could look for research and innovation in development institutions

aspects of innovation are under our control. Rather, we outline a number of deliberate approaches that we can take in our own organisations and with our partners, to cultivate innovation systems likely to deliver positive, scaled impact.

Four key principles emerge. The first is big-picture action-oriented thinking, setting a shared ambition to solve societal challenges, not just to develop a technology or pilot an intervention. This also includes the academic institutions where researchers are educated. Societal challenges are not organised in typical academic disciplines. A new culture is needed in both academic and research institutions, one that continues to ensure advances in disciplinary knowledge but that also makes significant effort to create the right environment to integrate transdisciplinarity.

The second is to nurture a creative and entrepreneurial organisational culture. This should provide a safe space to pursue new ideas, implement nimble budgets and

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staffing, focus on rapid learning, and allow pivoting without fear of failure. This also implies breaking disciplinary silos as early as possible in young scientists' education and formation, and incentivising transdisciplinarity throughout their careers.

The third is to pay close attention to partnerships and contexts. Listening carefully to stakeholders' often unfamiliar priorities and needs, undertaking purposeful design with clients and beneficiaries, understanding that every scaling context and geography is different, and supporting experimentation and adaptation in new settings are all crucial to success. This includes improving the interaction of research institutions with user communities, from policymakers to farmers. Interactions with users establish and strengthen trust, leading to participation in co-design, which ensures that innovations are locally adaptive and quickly adopted.

The fourth is to stimulate diverse investment portfolios, with different levels of risk. This entails running a portfolio of work that combines higher-risk, higher-pay-off options with more reliable but incremental outputs, alongside the targeting of a diverse set of co-investors who accept risk-taking.

Transforming research and innovation organisations to improve innovation systems also requires transformation among public and private financiers. Investment agendas aimed at societal changes would need to balance the two priorities of financial returns on investments and social and ecological impacts. They further need to promote transdisciplinarity and diverse incentive systems. The finance ecosystem would also need to adopt an innovation culture, including embracing early failure and learning from experience.

Finally, mapping out a shared future vision can help to anticipate risks and provide a safe space for transformative change. The path of innovation is uneven; impacts might not be readily obvious and there might even be a plateau or 'backtracking' phase where projects seem stagnant or worse than at their starting point. For example, a shift from intensive to organic farming might mean lower yields for one to three years. A first step that research and innovation institutions could undertake together with their food-system innovation partners could be to build trust and a shared understanding with funding institutions about the complex, messy, and unpredictable character of innovation processes.

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