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The Food System Economics Commission is an independent academic commission that equips political and economic decision makers with tools and evidence to shift food and land use systems.

POLICY BRIEF 2

Smart Scaling of Innovations to Transform Food Systems

SUMMARY

Smart scaling of innovations is critical to transforming food systems to become inclusive, health-enhancing and environmentally sustainable. By modernizing plant breeding, improving farming systems, digitizing agriculture, integrating small producers into modern value chains, and innovating consumer incentives food system transformation can be radically accelerated. National and international public institutions can play a key role in accelerating the transformation by implementing policy bundles to support smart scaling of innovations.

BACKGROUND

Public policy can help transform food systems to make them more inclusive, health-enhancing and environmentally sustainable. Given the diversity of food systems around the world, there is no universal policy blueprint, but bundling policies into coherent strategies maximizes the chances for impact. Policy tools that can be used to transform food systems can be broken down into three categories: (i) incentives and regulations (ii) innovation, and (iii) investment.

The environmental costs of current food systems are estimated at USD 3 trillion per year, reflecting the negative impacts of current agricultural land use and food production practices. These practices are responsible for a third of global greenhouse gas emissions, including emissions arising from deforestation and environmental damage arising from nitrogen surplus. This needs to change. To feed the world's fast-growing population sustainably, innovation is needed to enhance the use of existing land and minimize emissions. It is needed on farms, through value chains, and on consumption, where innovation can impact consumer behavior. Innovating to increase labor productivity and workers' livelihood opportunities—especially for poorer workers in food systems—can facilitate an inclusive food system transformation.

Food system innovation is progressing at an unprecedented rate, with new technologies ranging from artificial intelligence to sustainable processing technology, from dietary additives and vaccines for livestock that reduce methane emissions to bio-additives that enhance fertilizer uptake and reduce fertilizer use. However, current food system research and innovation needs strengthening in several ways to make sure its results support system transformations that are sustainable and inclusive. Further, commercial incentives are insufficient to scale innovation to millions of farmers and consumers to the degree needed to transform food systems.

While an unprecedented number of new food system innovations are being developed, this currently comes largely from the private sector. National and international public institutions can take action to speed up the development and diffusion of innovations that meet the needs of poorer producers and remove barriers to their adoption. This calls for new investments but also for broader regulatory action and incentives to create an enabling environment for innovation. Priority areas are highlighted in this brief.

KEY FINDINGS

Progress in the following areas of food system research and innovation (R&I) is particularly important to accelerate sustainable and inclusive food system transformations:

Modernizing plant breeding in low- and middle-income countries (LMICs). This requires investment in innovative data collection, digitization, and information management systems in LMICs to increase the efficiency of R&I. Institutional reforms are also needed to support modern information platforms. These improvements should be implemented by partnerships between national and international public research systems, universities, farmer-led breeding initiatives and, where appropriate, private sector bodies. Strengthening research capacity in LMICs in this way would help to improve development of locally relevant crops and overcome the barriers to technology transfer currently created by international protection of intellectual property rights.

Developing more sustainable farming systems. Farming systems can incorporate a variety of practices to become more sustainable, notably: rotation of a wider range of crops including legumes and cover crops; conservation tillage and residue management; improved water management through precision agriculture and water harvesting; improved pasture management; applications of natural pesticides and biofertilizers; and improved manure management systems in livestock-crop systems. Over time, these practices improve productivity and produce a variety of environmental benefits.

Digitizing agriculture for small farmers. Advanced digital technologies such as satellite imaging, remote sensing and in-field sensors can all support precision farming for small farmers, and especially precision agronomy, by delivering essential information to them at a practical scale. To date, these technologies have been mostly used by larger farmers. Rapidly reducing their costs and embedding them in applications that address smallholders' problems will make them more useful and accessible to small farmers. Easily accessible digital advisory services, including appropriate weather information, can help small-scale producers to manage climate risks or crop disease threats. Government investments are key to extending digital technologies to small farmers at scale.

Integrating small producers into modern value chains. through improved digital information systems. These extend small producers' access to markets and affordable inputs by improving links between farmers and processors, reducing post-harvest losses, tracking provenance, and

improving access to cheap credit and crop insurance. Their further integration into modern value chains will depend on institutional innovations, such as aggregating and contract farming. For instance, small producers can increase their power in input and output markets by aggregating in cooperatives or farm clusters. These give them competitive scale in inspection, packaging, food safety regimes and quality management. They also give farmers access to agricultural inputs at lower costs and to micro-finance, thanks to economies of scale, as well as facilitating knowledge sharing among members.

Developing clean cold chains to reduce post-harvest losses by scaling efficient, zero-emission cooling technologies. These include the 'Dearman engine', a novel cooling unit for delivery trucks that could replace traditional diesel-powered systems, and adopting the 'Cold Economy' concept across cold chains. This concept calls for innovations in both technology and business models to exploit the vast potential to improve cold chain efficiency that lies in using 'waste' or surplus energy and coldness to produce liquid air or liquid nitrogen for storage (Center for Sustainable Cooling, 2020).

Supporting the shift to healthier and more sustainable diets. 'Gamifying' for consumers the tasks of improving their diets and nutritional knowledge, and choosing sustainably produced food is one option. 'Gamifying' means using applications, programs, and services with game-based elements, such as interactive challenges, rewards, and progress tracking, to encourage consumers to change their behavior. Another option is to motivate investment in supply chains for alternative foods, such as fermentation-derived microbial proteins. For instance, the Danish plant-based food fund is incentivizing the supply chain investments needed to provide 'planetary health diets' at scale and make high-quality, sustainable alternative proteins more accessible, complementing private investment in meat substitutes, which is already quite substantial.

SOLUTIONS & RECOMMENDATIONS FOR ACTION

Smart scaling for moving forward

Innovation will continue apace creating the potential to shape entire new models of production and consumption in food systems. But this will not happen without the **smart scaling of critical innovations** that allows innovations to reach hundreds of millions of people around the world. To diffuse useful technologies at speed across food systems, **institutional innovations** will be just as important as the new technologies. Policymakers need to pay attention to both, as experience from the Green Revolution illustrates. The new agricultural technologies this revolution introduced would not have spread without their accompanying package of targeted public support, policies, and sociocultural accelerators. These provided the rural infrastructure, agricultural extension services and secure land tenure that made it possible for farmers to grow the new cereal seeds. They were tailored to mobilize all the actors and interests involved in adopting a new way of producing cereals, ranging from farmers, input suppliers and wholesalers to researchers and governments.

The world is different from when the Green Revolution took place and climatic concerns mean a different path must be taken. But policymakers today need to tailor similarly innovative **socio-technical policy bundles** to particular food systems, in all their social complexity, to increase the chances of new technologies leading to beneficial change at scale. The bundle of policies being used to combat micronutrient deficiencies offers a contemporary example of this approach. As part of these efforts, innovation funding has a track record of generating high social rates of return. This includes focusing large-scale funding on innovations with rigorous evidence of impact and cost-effectiveness. In some cases, it is possible to limit risk for the funder while harnessing the creativity and energy of the private sector to address the world's most pressing environmental and social needs through pull mechanisms, such as advance market commitments, that pay based on results. Funders could support specific innovations or groups of innovations or could support a new innovation fund or mechanism based on these principles. This would be a critical component of overall efforts to transform food systems.

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