

Info Note

A 6-part action plan to transform food systems under climate change

Creative actions to accelerate progress towards the SDGs

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NOVEMBER 2018

Key messages

- In order to achieve the SDGs, **global food systems need to transform within the next decade**.
- Actions **led by farmers and consumers**, which enable **leapfrogging of traditional learning curves** through application of technology and adoption of best practices, will be key.
- **Non-traditional models of leveraging private and public investment** are needed to finance this transformation.
- **Supply chains, food retail, marketing and procurement systems need to be reformed** to improve efficiencies, reduce waste and respond to challenges posed by climate change.
- An enabling environment to support this transformation needs to be in place, which **addresses existing inequalities in food systems**.
- In the medium to long term, paradigm shifts are necessary, including **development and application of next generation technologies**, and **development of differentiated adaptation and development pathways**.
- **Changes in consumption patterns** are inevitable to realize a food systems transformation, and can include changes in consumer choices and social organization, as well as new products, markets and investments.

If we are to achieve the Sustainable Development Goals (SDGs) related to poverty, climate change and food and nutrition security, the agricultural development community (research institutions, private sector, farmer

organizations, national and international agencies) will have to work collectively with the world's 700 million small-scale farmers by 2030 to transform the way food is produced, processed and consumed. Never before have we faced such ambitious goals.

Achieving the SDGs will not be easy, as it will have to be met in the context of climate change impacts on all aspects of food and nutrition security, increasing resource constraints and trade-offs, massive urbanization, an ageing farming population, a need to rapidly reduce emissions from food systems, and dietary shifts. The pace of changes required has never been seen before, and necessitates radical changes as opposed to incremental adjustments. Effectively designed and implemented, such changes can generate multiple benefits, including improved productivity, nutrition, health and water quality, and empowerment of women and youth, translating into transformed and thriving rural livelihoods and communities.

We consider climate change challenges in relation to poverty and food and nutrition security as the focus of the transformation discussion: what will it take to increase agricultural productivity, enhance food and nutritional security and health outcomes and raise farmer incomes to get rural communities out of poverty in a world where climate is changing? How will we build resilience to climate change and other stresses, and reduce agriculture and food systems greenhouse gas emissions and other agricultural environmental impacts? In this context, this Info Note discusses a comprehensive action plan to transform food systems and accelerate progress towards the SDGs.

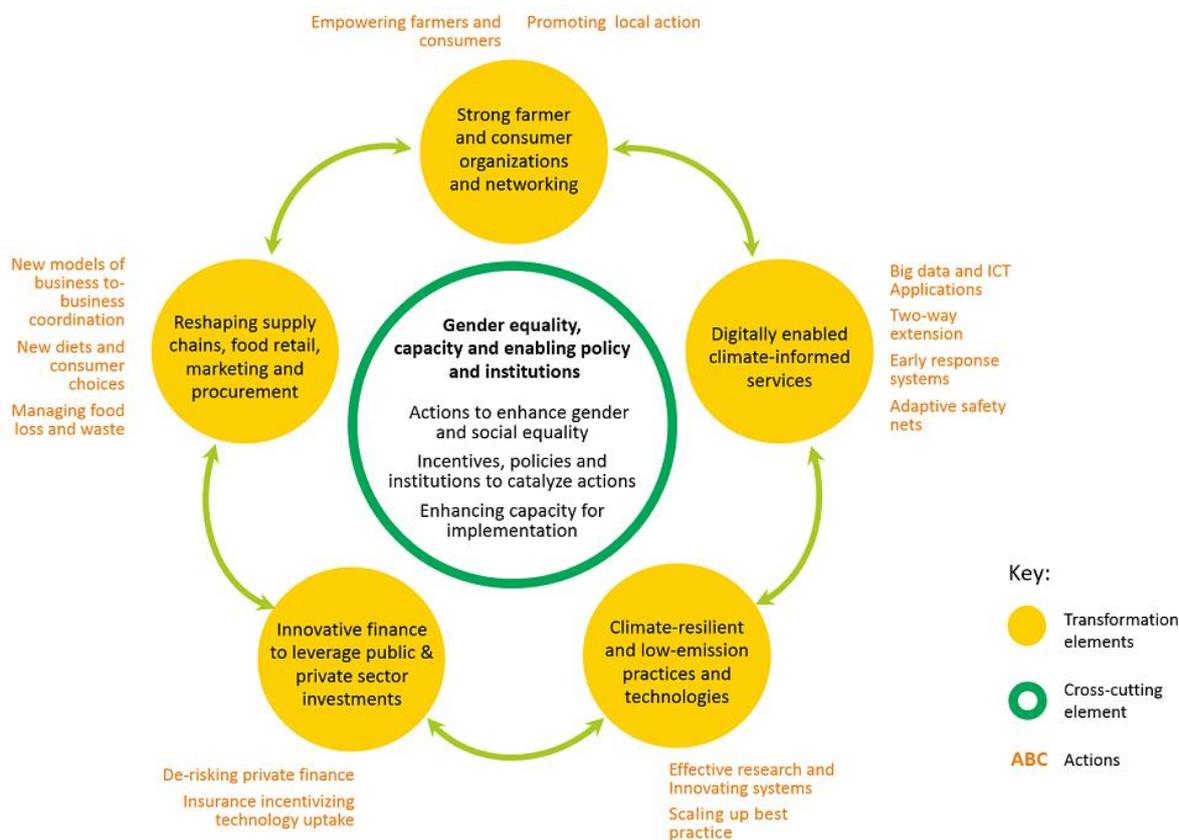


Figure 1. Transforming food systems under a changing climate: a six-part action plan

Elements of a comprehensive action plan to transform food systems under climate change

1. Strengthen farmer and consumer organizations and their networking

For food systems transformation to be successful, farmers and consumers must have a central role. Therefore, strengthening farmer and consumer organizations, and strengthening their networking, will be part of the efforts to drive transformation. Such a bottom up approach can help drive more effective implementation and scale up successful actions. Examples of farmer-led actions are emerging, for example, in Ethiopia, [a citizen science approach with farmers enables testing of new seed varieties](#).

2. Usher in the digital era in food systems

Agriculture and allied sectors have lagged behind in the use of information and communications technologies (ICTs). Changing this, and ushering in the digital era in food systems, can accelerate food systems transformation. This shift will be characterised by increased interaction between food systems actors to improve efficiencies, reduce costs and enable better decisions in the context of climate change impacts. Such changes are emerging; for example, [in Colombia rice farmers saved USD 1.7 million in 2014](#), following advice based on big data analysis, carried out by researchers at

the International Centre for Tropical Agriculture (CIAT). Scaling up such best practices and improving extension services through ICT tools can deliver benefits for the sector.

3. Scale up climate-resilient and low-emission practices and technologies

Adoption of climate-resilient and low-emission practices and technologies in agriculture are still not at desirable levels. [It is estimated that current technologies and practices only deliver 21-40% of the emissions reductions needed in agriculture to meet the Paris Agreement goal of limiting global warming to 2°C](#). If agriculture is to deliver its share in realizing the Paris Agreement goals and the SDGs, climate-resilient and low-emission practices and technologies will need to be scaled up. In addition, new technologies and practices will need to be developed, and effective research and innovation systems are needed.

4. Innovative finance to leverage public and private sector investments

Innovative finance solutions are needed to drive food systems transformation, as current levels of financing are inadequate. Blended finance can play an important role in mobilizing private capital and unlocking new market opportunities. This will require public investors to shift their focus towards de-risking and mobilizing private sector capital, and private investors to move away from the “business as usual” assessment of investment

opportunities and focus on the long-term growth potential. More innovative financial structures, as well as greater coordination between public and private investors and more “investment-ready” projects, will be critical to making capital flow. In addition to increasing the flow of capital at the macro level, financial instruments such as well-designed [index insurance schemes](#) can help protect farmers’ productive assets in the face of extreme climate events, and promote the adoption of improved technologies and access to credit and market opportunities.

5. Reshape supply chains, food retail, marketing and procurement

Food supply chains in developing countries are going through rapid transformation, recognizing and harnessing these rapid trends would seem an intelligent strategy for assuring lasting food systems transformation at scale. For example, small and medium enterprises are driving change in many countries, installing processing and cold chain facilities that may underpin future resilience to climate change in critical food systems. Reductions in post-harvest losses and in food waste throughout the supply chain is another opportunity that has the potential to deliver on multiple SDGs. One key expected impact is a reduction in demand on agricultural systems, delivering large reductions in the environmental impacts of farming and fishing. A further benefit might be increases in the profit margins, incomes, savings and resilience of small-scale farmers, delivering on food and nutrition security, poverty reduction and climate change adaptation.

6. Foster gender equality, capacity and enabling policies and institutions

Actions are also needed to create a conducive enabling environment that encourages innovation, promotes gender equality and enhances the impact of actions. Advancing gender equality is a priority, given women's prominence among people living in poverty, their lack of access to resources and power, and the disproportionate labor burden they face. Moreover, advancing gender equality will generate positive outcomes for food and nutrition security: it is estimated that [if women had the same access to productive resources as men, the yields on their farms could increase by 20–30%](#). Key elements of an enabling environment include policies (for agriculture as well as other sectors) and incentives. This will need to be complemented by efforts to enhance capacity at various levels for effective implementation.

Business unusual: driving innovation to achieve transformation at scale

While the above elements represent immediate priorities for a comprehensive action plan, this will need to be complemented by beyond ‘business as usual’ actions to successfully result in a transformation. We have identified

five key areas that need to advance within the next decade, which have the potential to redefine the way the food systems function.

Next generation technologies to drive transformation

There are many examples of potential technologies that may have transformational (even disruptive) effects over the next 20 years. There have been recent high-profile developments around artificial (in vitro) meat. There are also many research groups working on a wide range of genetics-related production issues such as nitrogen fixation in cereals, reconfiguring plant photosynthesis to increase its efficiency, and asexual reproduction in staple food crops, to name just a few. Replacement protein sources, including algae, seaweed and insects, are rapidly being developed and marketed, and one day molecular printing of proteins may be possible. Digital agriculture developments include robotics, high-precision farming, and management of inputs and outputs using big data analytics. Social media is already being used to target food products to specific segments of society, and food packaging that includes microchips with information on sourcing and environmental metrics is not that far away. On the consumption side, we may soon see nutrition status sensors that optimize diet for a person’s physiological status, with automatic diet supplementation.

There are prospects for total reconfiguration of agriculture itself: mass vertical farms operating hydroponically, for example, or the rise of small, self-sufficient farming communities coupled with robotic and drone technologies that minimize use of land and human labor. In the next two decades, many of these technologies will pass from the realm of science fiction into reality—some already have—and their effects could be huge. For some of these technologies, there are profound socio-cultural and governance issues associated with them—highly-targeted genome editing, for instance. Such technologies have far-reaching ethical and moral challenges that society will have to grapple with.

Differentiated adaptation and development pathways

Farming systems are increasingly differentiated. For some farmers, agriculture is their sole livelihood activity and income source; others maintain a small-scale subsistence focus with highly diversified livelihoods, including beyond the agricultural sector, especially where returns from agriculture are insufficient to survive. Still others are integrated into capital intensive global trading systems. This diversity encompasses a range of different motivations and reasons for farming superimposed over a complex mosaic of cultural identities, incentives, technologies, subsidies and sanctions. Systemic shifts that activate adaptation and transformational pathways that support different types of farmers across the globe are needed, specifically:

- Adaptation and development pathways need to be tailored to context and to the nature of the farming system.
- Many pathways offer opportunities for climate resilient development, but challenges remain as inequalities should not be exacerbated.
- Food sovereignty pathways to transformation emphasize communities and claim a more just and sustainable approach that recognises the importance of local decision-making and the maintenance of genetic diversity in enhancing resilience.
- Innovations in urban and peri-urban agriculture, e.g. through vertical farming or urban horticulture initiatives, to allow closer links to be made between production and consumption.

Policy enabling environments that facilitate the transition

For a true transformation in food systems—one that enables food and nutrition security for all, today *and* tomorrow—policy has to create incentives, foster a level playing field, ensure support for those left behind, and catalyze investment and action in food systems that meet the SDGs and the goals of the Paris Agreement. It must address the drivers of inequality and degradation that we see in today's food systems. Those drivers leave over 800 million people chronically hungry and over 2 billion overweight or obese; they relegate women to the margins despite their rights and roles in livelihoods and household well-being; they render hundreds of millions of small-scale food producers unable to grow or buy enough food; and they generate rising greenhouse gas emissions and increasingly degraded ecosystems.

Policy change is needed beyond agriculture strictly as a means of food production. That policy change may be in extension services, land rights, and seeds; food safety and dietary guidelines; trade, market regulations, and technology; and the list goes on. For some countries, transformation in agriculture and food systems will mean a transformational change in the economy itself. And because any kind of transformation will come with trade-offs between actors, policy that galvanizes transformation must be grounded in a commitment to equity and sustainability. The pathways to achieving policy change will be a critical means of demonstrating this commitment and therefore must engage the wide range of actors in food systems. This transformation will demand action from all and must begin with political and public will.

Aligning finance to drive the transformation

To accelerate a transformation in food systems, public finance must be used to address key market failures and emerging opportunities, and to de-risk and leverage private capital that can be invested at scale. For instance, countries can ensure that the annual average of USD 600

billion of support directly provided to agricultural producers is designed to improve productivity, enhance resilience of farmers and promote sustainable practices, while reducing greenhouse gas emissions and leveraging private capital. In addition, a significant amount of the annual USD 87 billion directed to general services supporting the sector can be allocated to designing effective enabling environments, and accelerate innovations in scientific knowledge, infrastructure (both digital and physical) and delivery of advisory services.

Transformation of global food systems presents attractive investment opportunities in a variety of areas, such as health and nutrition, resilience of markets and supply chains, resource efficiency of business operations, innovative technologies to change the shape of food demand, promote value-chain linkages and create effective production systems, etc. Such investments in food systems will take different forms, from company investments, to infrastructure and fixed income assets. To seize these opportunities, new partnerships, including public-private partnerships, will be needed to promote entrepreneurship and more innovative arrangements. A radical shift is also needed to develop adequate financial products and delivery channels, as farmers and agribusiness will need working and investment capital, along with a set of innovative financial and non-financial services, to undertake transformative actions. Disruptive technologies will be critical not only in connecting farmers and agribusiness with public and private financiers, but also in bringing increasingly more informed and demanding consumers into the finance conversation.

Smarter consumption patterns

Food systems are wasteful, converting large inputs of natural and synthetic resources into under-nourishing diets, excess calories and substantial amounts of discarded food. Overconsumption is driving startling increases in obesity and non-communicable diseases such as diabetes, coupled with growing negative impacts on climate change, species loss, nitrogen pollution and competition for freshwater. Meanwhile, micro-nutrient deficiencies remain a global phenomenon, and hunger and undernutrition are entrenched among many poor communities in Africa and South Asia.

The trend of ever-growing, yet inefficient and non-nourishing, food supply and demand is supported by many parts of the agrifood industry and abetted by governments that prioritise economic development over positive outcomes for health and environment. The transition that is needed—towards both efficiency and sufficiency—faces steep challenges from the prevailing political economy. But this agenda is not impossible. It will take a combination of incentives for individual behaviour change and wider institutional shifts. Key areas for innovation and change include: new products (and associated markets) that substitute for unhealthy and

unsustainable options, for example diverse plant-based foodstuffs that substitute for meat or dairy; changes in social organisation that create the conditions for healthier eating, for example communal cooking and meals; original technologies or processes that reduce waste and inefficiency, for example edible sprays that prolong vegetable shelf-life without need for packaging; changes in consumer choice architecture that make sufficiency and sustainability the easier option, for example food delivery services that by default provide a portion-controlled and climate-friendly meal; and a continued deployment of smart nutrition interventions that improve the health and resilience of poor consumers, for example cash transfers and promotion of breastfeeding.

A way forward

The combination of the six elements and emerging areas of innovation constitutes the foundation of a theory of change for achieving transformed food systems. Certainly, this theory of change needs to be operationalized using concrete examples that can lead to implementation. The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) and its partners are committed to operationalizing this theory of change, through the generation of research, informing policies, aligning finance, and developing capacity, which will radically change the future of agriculture and food systems around the world and will define the future working agenda for many organizations.

Further Reading

- Campbell BM, Hansen J, Rioux J, Stirling CM, Twomlow S, Wollenberg E. 2018. [Urgent action to combat climate change and its impacts \(SDG 13\): transforming agriculture and food systems](#). *Current Opinion in Environmental Sustainability* 34: 13-20.
- Loboguerrero AM, Birch J, Thornton P, Meza L, Sunga I, Bong BB, Rabbinge R, Reddy M, Dinesh D, Korner J, Martinez-Baron D, Millan A, Hansen J, Huyer S, Campbell B. 2018. [Feeding the World in a Changing Climate: An Adaptation Roadmap for Agriculture](#). The Global Commission on Adaptation. Rotterdam and Washington, DC.

This info note sets out a theory of change to achieve transformation in food systems, underpinned by six elements and emerging areas for innovation.

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The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is led by the International Center for Tropical Agriculture (CIAT). CCAFS brings together some of the world's best researchers in agricultural science, development research, climate science and Earth System science, to identify and address the most important interactions, synergies and tradeoffs between climate change, agriculture and food security. Visit us online at <https://ccafs.cgiar.org>.

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