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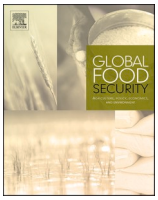

Perspective article: Actions to reconfigure food systems

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A B S T R A C T

There is broad agreement that current food systems are not on a sustainable trajectory that will enable us to reach the Sustainable Development Goals by 2030, particularly in the face of anthropogenic climate change. Guided by a consideration of some food system reconfigurations in the past, we outline an agenda of work around four action areas: rerouting old systems into new trajectories; reducing risks; minimising the environmental footprint of food systems; and realigning the enablers of change needed to make new food systems function. Here we highlight food systems levers that, along with activities within these four action areas, may shift food systems towards more sustainable, inclusive, healthy and climate-resilient futures. These actions, summarised here, are presented in extended form in a report of an international initiative involving hundreds of stakeholders for reconfiguring food systems.

1. Introduction

Policy makers as well as the scientific community are paying increasing attention to food systems. Even though there is not a universally accepted definition of what a food system is, the framework of Bene et. al. 2019) outlines the main challenges in relation to feeding a world today and in the future under environmental constraints. In this framework, the global food system is seen as an interconnected set of activities including input supply, production, postharvest storage, processing, distribution, marketing and retail, and consumption where the impact of food on health, cultural identities, governance and economics, and sustainability, play a prominent role.

Our current food systems are at increasing risk of failing us. Major failures are related to production and nutritional targets, inclusivity and environmental footprint. To address the challenges, many initiatives and targets have been proposed. Unfortunately, progress on many of these goals is patchy, and we are not on track to achieving them. For example, in relation to healthy food systems, we are not reducing child undernourishment fast enough to achieve the WHO Global Nutrition Targets in sub-Saharan Africa, the Pacific and Central and South Asia (Kinyoki et al., 2020). In relation to climate resilient food systems, we are falling short on taking the actions needed to limit global warming and we may be on track to a 3.1–3.7 °C warmer world, which would be disastrous for food systems (du Pont and Meinshausen, 2018). Many food system actors are highly vulnerable: there will be at least 700 million small-scale agricultural producers in 2030, for example, and we are not on the right pathway to build their resilience to extreme events within a short period of time.

There is a large literature on the idea of reconfiguring food systems. Some argue that major changes in governance and use of natural resources are required (Neufeldt et al., 2013), fostered through a pro-poor and inclusive structural reconfiguration (FAO et al., 2019), including gender-based approaches (Wong et al., 2019). Some documents list a menu of different actions (Searchinger et al., 2019a), and others present syntheses, highlighting that food systems changes need to be driven by social, environmental, and economic progress (Meridian Institute, 2020). There is broad agreement in this literature that current trajectories are not going to be enough to meet the Paris Agreement and the

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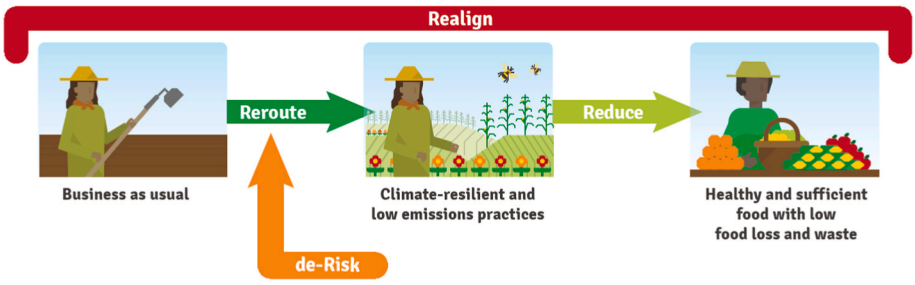

Fig. 1. Four action areas for food systems Reconfigurations (Steiner et al., 2020).

Sustainable Development Goals, and that the current pace of change is worryingly slow (EAT-LANCET Commission, 2019; IPBES, 2019; FAO, 2018; FOLU, 2019; De Cleene, 2019; Dury et al., 2019; Government of Norway, 2019; Herrero et al., 2020; Steiner et al., 2020).

2. Reconfiguring food systems under climate change

Drastic changes in food systems are essential if we are to achieve a food-secure and sustainable future. What might feasible pathways to such a future look like, and what might they involve? Some idea can be gained from looking to the past. Many periodizations of agricultural history are possible; combining elements of culture (Bentley, 1996) and production (Grigg, 1974; Grinin, 2007) we highlight three of several great reconfigurations:

- Sedentarisation, allowing for seed and livestock domestication (first starting in Western Asia about 12,000 years ago);
- Diffusion characterized by agricultural expansion, and local innovations and practices dispersed by the development of large complex civilizations, conquest, mass migration, and international trade (up to 500 years ago);
- The great acceleration, driven by widespread invention and innovation (starting with the scientific revolution of the 16th century and on-going).

For such reconfigurations, human societies needed to reroute themselves onto new trajectories. Early agriculture made it possible for relatively large concentrations of people to live in close proximity, giving rise to large communities and the division and specialisation of labour. The diffusion of crops, livestock and technology such as irrigation and the plough brought about substantial gains in productivity and enormous economic opportunities in some parts of the world. The great acceleration saw the continuing replacement of labour with capital on a massive scale and substantial increases in food availability for burgeoning human populations.

Each of these reconfigurations was also accompanied by great environmental, social and cultural challenges. For example, sedentarisation led to the need to develop new social structures capable of organising cities made up of thousands (later, tens of thousands) of people. Dispersal brought with it exploitation of indigenous societies and transfer across continents of many infectious diseases for which there was no natural population immunity (e.g., Columbian Exchange and spread of Bubonic plague from China to Europe). The great acceleration has involved large yield increases per hectare and land expansion, with many environmental problems arising as a result. Historically, great food systems reconfigurations have involved four interlocking elements, broadly speaking: rerouting old systems onto new trajectories; the emergence and treatment of new socio-cultural issues, as a result; the emergence and treatment of new environmental issues; and realignment or reinvention of the "enablers of change", such as the policies, regulatory frameworks, financial mechanisms and innovation systems needed to make new food systems function.

The change we need in food systems today is of the same order of magnitude as these historical reconfigurations. These reconfigurations have been long, drawn-out processes. We do not have the luxury of centuries of time. By ratifying or acceding to the 2015 Paris agreement, 188 countries and the EU have agreed that these reconfigurations need to happen in the next ten years, if we are to achieve zero hunger, gender equality, and avoid dangerous climate change. Is such rapid, deep-seated change even possible?

From 2018 onwards, the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) worked with partners to consider how to achieve this rapid, deep-seated change in food systems. Background papers on strategic areas to foster these reconfigurations were developed and presented at international events accompanied by deep discussions with over 1000 stakeholders from all over the world. More than 100 partner organizations engaged in participatory processes to evaluate and sharpen this strategic agenda, culminating in the report of Steiner et al. (2020).

That report highlights action around the four interlocking elements identified above: rerouting farming trajectories; increasing the resilience of all the agents involved in rapid change (reducing risks); minimising the environmental footprint of food systems (from a climate change perspective, a focus on reducing emissions); and realigning the enablers of change. Some glimpses of the type of changes needed in each action area are highlighted below.

3. Is this reconfiguration possible?

There are few examples of the simultaneous, relatively rapid and large-scale changes that are needed to reconfigure food systems. One example is the Tigray experience in Ethiopia. Through community work and local leadership, an epicentre of starvation was transformed into a self-sufficient and green region contributing to higher crop yields. More than one million hectares have been restored in Tigray allowing farmers to produce fruits and vegetables even in drought years (Thornton and Kristjanson, 2018). Many concrete examples are presented in Steiner et al. (2020) using the framework in Fig. 1. Even though some have been implemented at only limited scale to date, the examples demonstrate that pathways for changing local food systems in many different parts of the world are already being laid out by food system actors.

These examples go all the way from presenting a Nigeria and US agriculture technology social enterprise (Hello Tractor, 2018), demonstrating how to **reroute farming trajectories** by supporting rural reinvigoration (Cabral and Sumberg, 2017), to highlighting the role of The African Risk Capacity as a mean to address social challenges through actions to reduce risk in agriculture in order to **increase the resilience of smallholder farmers** (www.africanriskcapacity.org).

Similarly, initiatives to **minimise the environmental footprint of food systems** through the reduction of emissions from diets and value chains are presented including plant-based meat alternatives. The industry interest, through an increase in investment towards new alternative protein start-ups, shows that there is potential for significant growth in this sector (Sexton et al., 2019; Byrd, 2018; O'Neil, 2017). Finally, the AGRI3 Fund, which aims to channel US$1 billion for sustainable agriculture and forest conservation, is a good example of

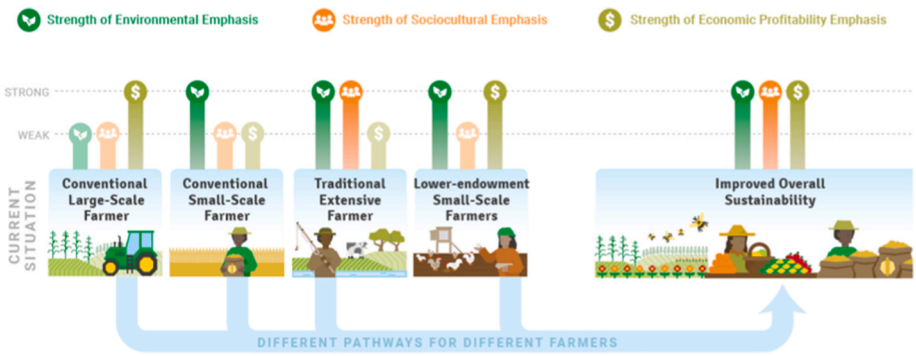

Fig. 2. Different pathways for different types of farmers (Steiner et al., 2020).

realigning enablers of change in order to unlock billions in sustainable finance (Millan et al., 2019).

These are just a few examples of many, which illustrate the breadth and type of changes that will be needed for food system reconfiguration at scale (Steiner et al., 2020).

4. One world but differentiated challenges and solutions

One of the key challenge to reconfiguring food systems is the enormous variability in farm types and farming systems; it is often difficult to generalise from one farm household to another, and there are no "silver bullets" yet identified that will lead to beneficial impacts in all situations (Fraser et al., 2006; Keating et al., 2014; Scoones et al., 2020). Climate change and many other change drivers are already bringing about reconfigurations in farm households in some places - for example, in response to crop and livestock suitability changes and to market signals (Vermeulen et al., 2018). Interventions need to address current needs and future aspirations of farming households, as well as ensuring that economic, social, cultural and environmental benefits are not compromised, now or into the future. Appropriate targeting will help to improve the efficiency of the agricultural development process and avoid unintended omission of particular groups of vulnerable people (Laurent et al., 1999; Lopez-Ridaura et al., 2018).

Many types of farmer exist, but the following four well illustrate the different sets of intervention and enablers needed to move to environmentally, socio-culturally and economically sustainable food systems in the future (Fig. 2). For **larger-scale commercial farms**, of which there are perhaps 70 million globally, pathways will generally need to focus particularly on improving environmental goals. Pathways for **small-scale farms** (320 million globally) characterized by small plot sizes (<0.5 ha) may focus on increasing their integration into local markets, with some farmers accessing digital information and making better decisions (households that are "stepping up", Dorward et al., 2009). **Extensive farm households** such as pastoral and agro- and silvo-pastoral farmers (around 30 million) are often located in environments with high climatic risk; pathways for these households may be more to do with building assets and utilising safety nets to increase their productivity and enhance their resilience (households "hanging in" but in time transitioning to "stepping up"). There are some 150 million **lower-endowment small-scale farmers**, including urban and niche producers (organic, free range) as well as those who are "hanging in" and food insecure. Pathways that revitalise rural economies and help to provide economic opportunities in urban and peri-urban areas can help those who want to "step up" as well as those wanting to "step out" of agriculture to engage in other livelihood strategies (Dorward et al., 2009).

5. Concluding comments

We know what needs to be done: Steiner et al. (2020) identifies the action areas, the actions, the potential partners, the where and the how. Indeed, some of the partners in the initiative, including the UN's World Food Programme (WFP), the World Business Council for Sustainable Development (WBCSD) and the Department for International Development (DFID), are already taking on board the recommendations arising from this initiative to develop their own strategies. However, much more needs to be done, at much broader scale.

What then are the things needed to make this reconfiguration happen? First, we need deeper understanding of plausible, inclusive trajectories of change at local and landscape levels that embrace the variability in farms and farmers. Second, we need the finance. As Herrero and Thornton (2020) point out, governments globally came up with more than USD 8 trillion in the eight-week period from mid-February to mid-March 2020, in response to the COVID-19 pandemic. This shows what is collectively possible when faced with a grave, existential threat; food system configuration has been estimated to require USD 2–3 trillion by 2030 (UNEP, 2016; Searchinger et al., 2019b). Third, we need, now more than ever, the collective will to change. Some of us are producers, but all of us are consumers. Current events are teaching us some extremely hard lessons that need urgently to be applied to our food systems.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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