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Résumé – Cet essai a pour objectif de clarifier pourquoi les systèmes alimentaires alternatifs soutenus par une approche différente en Science, Technologie et Innovation (STI) peuvent contribuer aux Objectifs de Développement Durable (ODD). Ces systèmes sont analysés à la lumière du cadre des ODD et leurs contributions illustrées à travers trois exemples du Québec, qui montrent comment les STI pourraient consolider les systèmes alimentaires alternatifs afin de générer les changements requis par les ODD.

Mots-clés – Sécurité alimentaire, système alimentaire alternatif, innovation responsable, agriculture locale, agriculture soutenue par la communauté

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Abstract – This essay aims to clarify why alternative food systems supported by a different Science, Technology and Innovation (STI) approach can contribute to the Sustainable Development Goals (SDG). To this end, alternative food systems are analyzed in the light of the SDG framework and their potential contributions illustrated through three examples from Quebec. The latter shows how STI could consolidate alternative food systems to generate the system-level changes required by the SDGs.

Keywords – Food security, alternative food system, responsible innovation, local agriculture, community supported agriculture

HOW CAN ALTERNATIVE FOOD SYSTEMS CONTRIBUTE TO THE SUSTAINABLE DEVELOPMENT GOALS?

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INTRODUCTION

In 2015, the United Nations proposed a plan of action comprised of 17 Goals and 169 targets to achieve Sustainable Development by 2030. The pursuit of the Sustainable Development Goals (SDGs) requires coordinated action among different sectors and countries and calls for further reflections on the ways in which Science, Technology and Innovation (STI) may serve as a lever to their achievement (UN, Economic and Social Council, 2016, p. 2). More specifically, our ability to meet SDG2, which aims to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture," requires a closer examination of the whole food system, which relies on an interdependent set of actors oriented towards satisfying consumer needs (Rastoin & Ghersi, 2010).

The last report from the Food and Agriculture Organization shows that hunger affected 821 million people in 2017, notably in developing nations (FAO, 2018). A contradiction to this situation is the fact that almost 2 billion people in the world are overweight or obese (WHO, 2018) and many countries are struggling with the results of a diet rich in calories, but poor in nutriments: an increased prevalence of chronic diseases such as diabetes, cardiovascular problems and cancer.

This situation is partly attributable to the fact that our food comes mostly from an industrial food system, based on intensive modes of production and distribution which have direct and indirect implications for the "three pillars" of sustainable development: economic, social and environmental (UN, Economic and Social Council, 2016, p. 2). Furthermore, while it has contributed to reducing food costs in the past decades, it has also transformed consumer behaviour, increasing the consumption of ultra-processed products that have resulted in negative health impacts. This food system is unlikely to help us to achieve SDG2 while it affects other SDGs negatively. We thus concur with the Eat-Lancet Commission, which stresses that achieving the SDGs will require "great food transformation" (Willet et al., 2019).

Although alternative food systems (AFS) that rely on more responsible modes of production and economic models are not without limitations (Born & Purcell, 2006), they offer a promising avenue (Le Velly, 2017). However, to generate the system-level changes required by the SDGs, AFS need to be supported by a specific STI approach, one that values sustainability and equity. Therefore, this essay aims to explore how AFS supported by a different STI approach could contribute to the achievement of the SDGs.

1. THE ROLE OF STI IN THE EMERGENCE AND DEVELOPMENT OF FOOD SYSTEMS

STI refers to the combination of three powerful means that societies support through taxation to produce and apply novel knowledge. Whereas *science* refers to the "systematic study of the physical

or material world (natural science) and of society (social science)", *technology* entails the application of scientific knowledge to develop and produce goods or services for practical purposes. *Innovation* characterizes the novelty or significant improvement of a product, service, process, social organization or commercial method (UN, Economic and Social Council, 2016).

Schot and Steinmueller (2018) describe two frames that dominated STI priorities in the past and which are still present in innovation policies. The first began in the Post-World War II period during which governments sought to institutionalize public support for science. Focusing on "innovation for growth," this frame posited the value of STI for "prosperity" and "towards mass production and consumption" (Schot & Steinmueller, 2018 p. 1555). Broader implications for the environment or health were either ignored or viewed as the cost of progress (Schot & Steinmueller, 2018). The second frame emerged in the 1980s with globalization and an emphasis on competitiveness, which shaped many national systems of innovation. The consequences or "externalities" of economic growth were partly recognized, but not fully prioritized as inequalities within and between countries continued to increase (Schot & Steinmueller, 2018).

The current food system was established during the Industrial Revolution, in the context of population growth and wealth. The explosion in demand, coupled with an STI approach dedicated to economic growth, allowed companies to develop and shape production, distribution and consumption worldwide. The STI approach that prevailed after the late 1980s and entail profit-driven and highly capital-intensive ways of producing novel products and technologies reinforced the path dependency of the dominant food system. STI advances were indeed generally aligned the needs of this system, supporting specialized production, crop uniformity, economies of scale, discovery of new ingredients to increase products shelf life and palatability.

Although STI priorities are key to addressing food and health challenges, few scholars explicitly sought to identify how STI approaches could better support AFS. According to Khan et al. (2016), integrating food systems research into public health research and examining how "responsible innovation" supports sustainable production of healthy and affordable food is urgent. And it requires a specific STI approach.

2. A DIFFERENT STI APPROACH TO CONSOLIDATE AFS AND BETTER ADDRESS THE SDGS: THREE EXAMPLES

While definitions of what makes AFS "responsible" vary, scholars emphasize modes of production and distribution wherein public and private actors coordinate their actions to successfully address food security while reducing as much as possible their negative social and environmental impacts (Khan et al., 2016; Parent et al., 2016). For instance, a Territorialized Food System (*Système Alimentaire Territorialisé*), which is a form of AFS, is defined as "a set of agri-food chains that meet the criteria of sustainable development, located in a geographical area with a regional dimension and coordinated by territorial governance" (Parent et al., 2016).

For Schot and Steinmueller (2018, p. 1561), the SDGs call for a new STI approach, one that can support the production and use of knowledge related to "greener production, increased social justice, fairer distribution of welfare, sustainable consumption patterns and new ways of producing economic growth." This STI approach should be aimed at "transformative change", which refers to a deep systemic transition and implies social, behavioural and technological change.

Below, we describe how this STI approach could contribute to the consolidation of AFS and enable them to better address SDG2 and other SDGs. We selected three initiatives that operate at different levels – micro, meso and macro – in the Canadian province of Quebec. A report on 100 local initiatives in this province concluded that there is a plurality of local, innovative and responsible ways to produce, distribute and consume food (Parent, 2016). Since initiatives similar to the three, we have chosen are emerging in many parts of the world, our analyses are likely to be of interest to many food system scholars.

2.1. MICRO-LEVEL: URBAN ROOFTOP FARMING

The first example involves an urban rooftop farm, that have emerged as a way to produce fresh food in urban areas by converting unused black-tarred surfaces into productive green spaces (Orsini et al., 2015). Rooftop farms can help to lower air temperature and thus reduce urban

heat island effects (Hoag, 2015). While the multifaceted impacts of these farms on urban life (from air temperature to human well-being) still needs to be better understood (Hoag, 2015), the following example suggests that such initiatives may contribute to the SDGs.

Lufa Farms is a for-profit organization that aims to provide more locally produced food to people in Quebec, with a focus on the largest city, Montreal. This company was the first in the world to create a commercial rooftop greenhouse in 2011 (*www.lufa.com*). Its business model is based on the provision of weekly food baskets to subscribers. The company also established partnerships with other growers to better respond to consumers' demand (around 10,000 households).

Initiatives like *Lufa Farms* may contribute to SDG2 because they promote sustainable local agriculture. They may have a positive influence on SDG9 (industry, innovation and infrastructure) because they combine sustainable economic activities and innovation. In addition, they could have an effect on SDG11 (sustainable cities and communities) since they optimize resource use and have the potential to reduce the temperatures of the roof surface and the surrounding air during summer (Hoag, 2015). Finally, by promoting access to fresh production from a local production, they contribute to SDG12 (responsible production and consumption).

Specific transformative STI efforts are required to design efficient rooftop horticulture systems, to improve how space can be optimized while the crops diversified, and to estimate productivity in view of the resources being used (Orsini et al., 2015). Further STI investments could also be targeted at producing knowledge and tools on ways to mitigate the conflicts between the requirements of the existing buildings and those of the greenhouses to be developed.

2.2. MESO-LEVEL: NETWORK OF AFS ACTORS

The second initiative emphasizes the role of networks that bring AFS actors together and seeks to align their respective activities. Such networks aim to integrate and coordinate a range of actions in order to have a systemic impact. Whereas AFS initiatives are typically small, networks have more power to contest the rules and institutions of the dominant food system (Levkoe, 2014). For Levkoe (2014), it is through networks that AFS can better address the interrelated aspects of food systems.

The *Montreal Food System Council (Système Alimentaire Montréalais – SAM – https://sam.montrealmetropoleensante.ca/)* is a regional network of more than 200 partners, representing different segments of the food system (from production to post-consumption). Its vision is to make sure that by 2025 all Montrealers have access to a healthy, diversified, local and affordable diet. The network provides regional food leadership by engaging stakeholders, advising policy-makers and supporting projects

Initiatives like *SAM* contribute to SDG2 because they connect many actors interested in improving food supply and enable collective discussions to reduce hunger and improve food quality access. Networks like *SAM* may also positively affect SDG16 (peace, justice and strong institutions) by contributing to the development of effective and accountable institutions. Since they enable different actors and organizations to collaborate on a long-term basis, they may contribute to SDG17 (partnership for the goals).

The challenges faced by AFS networks include variations and inequalities in access and the difficulty of achieving or maintaining consensus among participants. Since certain actors could lack the resources or infrastructure needed to participate actively, they could be ignored or left behind. While "networking strategies may enhance the collective power of the network", they may also "increase internal tensions based on class, culture and geography" (Levkoe, 2014, p. 183). Hence, transformative STI efforts should seek to develop and share knowledge on the ways in which appropriate governance structures can enable even access to AFS networks. It is also important to identify practice-oriented mechanisms that can be used to build consensus. Levkoe (2014, p. 184) indeed found that participants often feel that their own "approaches, goals, ideologies, and strategies are being compromised."

2.3. MACRO-LEVEL: COMMUNITY SUPPORTED AGRICULTURE

The third example involves Community Supported Agriculture (CSA), which emerged in Japan in the 1970s to establish direct contact between producers and consumers (Lemay, 2018). To support a more stable annual flow of revenues, consumers pay in advance and, during the harvest, the growers deliver weekly baskets to them at a distribution

point. Such CSA initiatives promote good land management and more security to small growers since they know their production will be sold at a predictable price (Lemay, 2018). For consumers, this model means that they will obtain locally produced fresh products and could be encouraged to cook more and reduce the consumption of processed and ultra-processed foods.

Equiterre family farmers (www.equiterre.org) was created as a non-profit organization more than 20 years ago in order to accelerate the transition toward a healthy, sustainable and equitable society. The organization pioneered agricultural short circuits in the province by implementing and scaling a large CSA model (Lemay, 2018). Today, *Equiterre* has about 18 thousand subscribers. One aspect that could partly explain its success in scaling up CSA lies with the online platform it developed. Using their zip code, consumers can search for distribution points that are the nearest to their workplace or house as well as access details about the specific products growers distribute throughout the year. Through this platform, consumers can choose and "adopt" a grower during the season.

Macro-level initiatives like *Equiterre* contribute to SDG2 through the promotion of sustainable agriculture and nutritious food. From a food production standpoint, they may also have a positive effect on SDGs that are related to the economic context in which the AFS entrepreneurs and workforce evolve. Since such initiatives can help to sustain small growers, improve the predictability of their revenues and reduce commercial disparities between large and small growers, they may contribute to SDG1 (no poverty), SDG10 (reduced inequalities) and SDG8 (decent work and economic growth). From a consumption standpoint, it may positively influence SDG3 (good health and well-being) and SDG12 (responsible consumption and production) because of their focus on the consumption of healthy foods.

One key challenge faced by initiatives like *Equiterre* is the need to develop an infrastructure that can be effectively shared by multiple actors. Since this collective infrastructure needs to be maintained and updated, STI research could examine how such a platform may eventually reduce growers' administrative tasks and increase their responsiveness towards consumers' evolving demand.

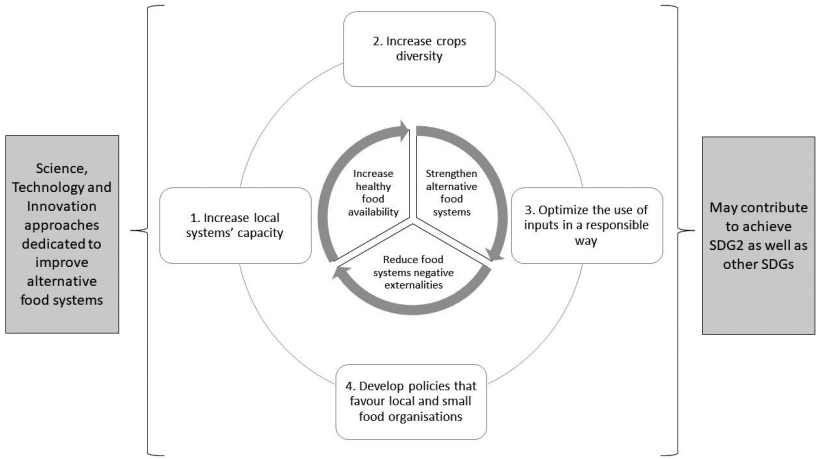

FIG. 1 – A framework to further examine how AFS may contribute to the SDGs. Source: Authors, 2018.

SUMMARY AND CONCLUDING REMARKS

Figure 1 summarizes this essay's key arguments through a framework that could support further research. It suggests that a STI approach dedicated to AFS should seek to produce novel knowledge on ways to: (1) increase local food system capacity; (2) increase the diversity of crops cultivated; (3) contribute to the responsible use of inputs; and (4) inform the development of policies and communication structures that favour sustainable initiatives. The figure also indicates that the application of such knowledge would serve to strengthen AFS, increase the supply of healthy food and reduce social, economic and environmental externalities. Altogether, such STI priorities would address directly SDG2 and move us closer to other SDGs by "changing skills, infrastructure, industry structures, products, regulations, user preferences and cultural predilections" (Schot, Steinmueller, 2018 p. 1562).

In sum, this essay argued that our ability to meet the 2030 agenda requires a closer examination of our food system. Currently established

STI approaches, which frame innovation as a means to "fuel" economic growth (Khan et al., 2016) are poorly aligned with the SDGs. An STI approach dedicated to transformative change can consolidate AFS and enable them to scale and spread. While the shortcomings of AFS still need to be carefully examined (Born & Purcell, 2006) and resistance to change is often strong (Schot & Steinmueller, 2018), the three examples we discussed show their potential. Whether such initiatives will flourish or not depends upon what food systems will benefit from future STI investments. The system-level changes required by the SDGs could be achieved if AFS were supported by an STI approach that values sustainability and equity.

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