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Enhancing the ability of agriculture to cope with major crises or disasters: What the experience of COVID-19 teaches us

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ABSTRACT

The COVID-19 outbreak was an unprecedented situation that uncovered forgotten interconnections and interdependencies between agriculture, society, and economy, whereas it also brought to the fore the vulnerability of agrifood production to external disturbances. Building upon the ongoing experience of the COVID-19 pandemic, in this short communication, we discuss three potential mechanisms that, in our opinion, can mitigate the impacts of major crises or disasters in agriculture: resilience-promoting policies, community marketing schemes, and smart farming technology. We argue that resilience-promoting policies should focus on the development of crisis management plans and enhance farmers' capacity to cope with external disturbances. We also stress the need to promote community marketing conduits that ensure an income floor for farmers while in parallel facilitating consumer access to agrifood products when mainstream distribution channels under-serve them. Finally, we discuss some issues that need to be solved to ensure that smart technology and big data can help farmers overcome external shocks.

1. Introduction

COVID-19 appeared as a black swan, which puts at risk the lives of millions of people through its massive spread (Whitworth, 2020), simultaneously prompting new fears about the economic recession that is expected to follow the pandemic (Goodell, 2020; Snooks, 2020). After the identification of the first infections in China in December 2019, the virus began surging in other countries in February 2020 (Pedrosa, 2020). On March 11, 2020, the World Health Organization officially announced the COVID-19 outbreak a pandemic (WHO, 2020). To protect public health, governments around the world – even those whose leaders expressed denial of COVID-19 at the beginning of the pandemic – initiated several measures (ranging from media announcements to partial or even complete lockdown) to mitigate the disease. These measures led to profound changes in consumers buying behavior and food consumption patterns, disturbances in transportation networks, and the closure of some food suppliers (Nakat & Bou-Mitri, 2020). Such an upheaval created uncertainty shocks that impacted every sector of social and economic life, including agriculture.

Scholars argue that COVID-19 generated a crisis that has economic (Nicola et al., 2020), social (Blofield et al., 2020), and political dimensions (van der Ploeg, 2020). Crises are events that have disruptive and damaging or potentially destroying effects on social systems (Pauchant & Mitroff, 1990). A crisis has three identifying features: first, its likelihood of occurrence is low; second, it creates abnormal conditions associated with high-risk consequences (Shaluf et al., 2003); third, it is difficult to forecast its potential effects and to program appropriate resolution schemes (Pearson & Clair, 1998). Undoubtedly this pandemic presents all these characteristics, also possessing the most typical attributes that identify a high-impact disaster: it leads to massive damages, referring to both the economy and human life (Parker, 1992), whereas it is expected to have a social cost over a long period (Shaluf et al., 2003).

From previous major crises and disasters, we learned that such events might have severe and long-lasting effects on agriculture. For instance, the recent credit crunch crisis in Europe generated strong shocks in the agricultural sectors of the Euro area periphery (Mamatzakis & Staikouras, 2020), whereas, during the months that followed the Chernobyl disaster in 1986, farmers from countries not bordering the Soviet Union (like Italy, Greece, France, and The Netherlands) were urged to withdraw from sale their products (Morrey et al., 1987).

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Notably, disasters and crises disproportionally affect the poorest of people (Masozera et al., 2007), thus creating serious problems for small-scale farmers (Williamson, 2018).

However, the COVID-19 pandemic differs from any other high-profile crisis or disaster in that it is global in nature, and it is difficult for the scientific community to predict its future course. Hence, its potential long-term impacts on agrifood systems can be highly disruptive and unmanageable. In this short communication, based on the COVID-19 experience, we reflect on some of the immediate effects that major crises or disasters have on agriculture, and we discuss three potential mechanisms which, in our opinion, can mitigate these impacts: first, the development of resilience-promoting policies; second, the promotion of community marketing schemes; third, the application of smart technologies and big data in agriculture.

2. Impacts of COVID-19 pandemic on agriculture

The COVID-19 pandemic was a jolt to current agrifood production and distribution systems, heavily impacting agricultural production and, consequently, food security (Stephens et al., 2020). Much more than any other previous crisis or disaster, the COVID-19 pandemic uncovered the interconnections and interdependencies between agriculture, society, and economy; and revealed the vulnerability of agriculture to external disturbances. Supply chain issues such as backhauling (Sharma et al., 2020), workplace absenteeism in food processing and manufacturing companies (Walters et al., 2020), and the increase of unemployment rates along with the economic uncertainty resulting from business restrictions (Leduc & Liu, 2020), are negatively impacting the trade of all agrifood products.

Of course, agriculture is not uniform around the world, and the differences between agrifood systems are quite broad. Although the pandemic has varying impacts on different agricultural sectors and different countries, its disruptive character is more than evident already from the appearance of the disease. The shrinkage of farmers' income and the observed deficiencies in essential inputs (including farm labor) are the two more obvious direct impacts of COVID-19 on agricultural production. Below, by using some examples, we present how pandemic mitigation measures, changes in consumption patterns, and disruptions in supply chain operations impacted agriculture both directly and indirectly.

The pandemic experience teaches us that the restrictions posed by governments during major crises or disasters, in combination with the changing consumers' behavior, can cause market fluctuations with considerable effects on agrifood production. From the early stages of the COVID outbreak, panic consumption and food stockpiling – not only by consumers (Hobbs, 2020) but also by some governments (Almeida & de Souza, 2020) – exerted considerably high pressure on food production and distribution systems (Hobbs, 2020). Mainstream distribution channels faced great difficulties in satisfying the high demand for some basic foodstuffs, while other products experienced a remarkable drop in both sales and prices.

The closure of restaurants, hotels, caterings, and bars further depressed sales and prices for these products (Commodity Market (Commodity Market Outlook, 2020)), whereas some farmers – having difficulties in accessing markets – destroyed their unsold production. For instance, wine sales in the European Mediterranean countries were cut by half, putting at stake grape farmers' income (REUTERS, 2020). The financial losses were even more dramatic for some "luxury" perishable agricultural products, like cut flowers. New York Times reported that, until April 2020, Dutch flower growers destroyed about 400,000,000 flowers that remained unsold (Siegal, 2020). Under such conditions, farmers face high levels of income uncertainty. In parallel, the reduction of consumers' purchasing power (Béné, 2020) – one of the aftermaths of any crisis or disaster – is expected to reduce farmers' income in the long term. In its turn, this decrease of farm income leads farmers (mainly small-scale producers) to reduce the expenses associated with crop protection and livestock health, thus jeopardizing the quality and quantity of production. Gortázar and de la Fuente (Gortázar & de la Fuente, 2020) offer an example of how income losses can negatively affect the surveillance and control of animal tuberculosis.

The closing of borders was a strategy used in many countries to control contagion risk, which, however, led to shortages of both farm inputs (e.g., seeds, pesticides, and fertilizers) and farm labor since, in some regions of the Northern hemisphere, harvest depends on the migrant workforce (OECD, 2020). Although the production of staple crops, being highly mechanized in the developed world, was not seriously affected, the more labor-intensive crops (fruits and vegetables) require large amounts of human labor, thus being more vulnerable to the effects of COVID-19 (Laborde et al., 2020). The pandemic has revived the discussion of the vital role migrant workers occupy in current agrifood systems, also reminding us that these workers represent one of the more vulnerable groups to contagious diseases and that their access to health services remains restricted (Liem et al., 2020).

Moreover, the pandemic might have some indirect impacts on agrifood production. For example, social distancing measures affect the operation of extension services, especially in countries of the global South, where the existing infrastructure cannot support the provision of e-extension. Access to farm machinery repair services may also be problematic. Finally, epidemic prevention measures, in combination with market uncertainty, might cause delays, cost overruns, and other disruptions to agricultural innovation projects.

3. Three potential mechanisms to mitigate the impacts of major crises and disasters on agriculture

3.1. Developing crisis management plans and designing resilience-promoting policies

To protect agriculture from the oncoming crisis, some governments took a series of remedial measures. For instance, the Canadian government increased the budget available for enhancing the lending capacity of farmers by offering in parallel a grace period of loan payment (Ker, 2020) while the government of the United States of America launched a $19 billion fund (Coronavirus Food Assistance Program) to ensure that farmers and supply chain actors will continue to produce and distribute food amid the pandemic (USDA, 2020). Nevertheless, serious concerns are expressed about the ability of these funds to relieve all farmers. According to Brown (Brown, 2020), several commentators note that relief funds are unequally distributed among U.S. farmers in favor of wealthier, large-scale landowners. The European Union also announced a series of "Exceptional measures" (European Commission, 2020). However, farmers claim that these initiatives are too poor to help them overcome the crisis (Burke-Kennedy, 2020).

Obviously, remedial measures are essential in ensuring farmers' (short-term) survival amid crises. However, to secure the provision of agrifood products – and, consequently, consumers' wellbeing – farmers should not only survive but thrive. Hence, governments and national/international organizations must proactively develop crisis and disaster management plans that anticipate potential threats, forecast their impacts on agriculture, and create mechanisms to manage these threats. These tools should include prevention plans, emergency response plans, and resumption plans (Devlin, 2006). The pandemic experience exposed the lack of such tools not only in developing but also in developed countries.

That is not surprising given that, so far, agricultural policies were based on a ceteris paribus premise, assuming a stable or incrementally evolving external context and overlooking potential disruptions and punctuations. The COVID-19 pandemic is an example of how factors unpredictable and uncontrollable by the actors involved in agrifood systems can create hyperturbulence. Similar or more intense future disturbances due to environmental (like climate change) or economic forces are not improbable. New policies aimed not only at facilitating the

adaptation of agriculture to potential extensive and sudden shocks (environmental, economic, or social) but also at promoting a paradigmatic change of agrifood systems are needed. Enhancing agrifood systems resilience by increasing their buffer ability, adaptability, and transformability can be the first step in this direction (Darnhofer, 2014). To achieve this, governments should ensure more system reserves, such as natural, economic, and social resources (Meuwissen et al., 2019), by offering ongoing long-term funding and institutional support to farmers. On the other hand, it is about time for public agricultural policies to promote the cultivation of a transformational culture, which can lead to morphogenetic changes in agriculture.

However, to build resilient agrifood systems, we also need to acknowledge the peculiarities of the many different "agricultures" (e.g., large-scale and small-scale agriculture; high-input agriculture and agroecology; industry-oriented and community-oriented agriculture) that operate in tandem. Different approaches to agriculture generate varying levels of vulnerability that must be taken into consideration in the designing of both resilience-promoting policies and crisis or disaster management plans. Hence, relevant public policies should be tailor-made to the particular characteristics of different production systems and regions. Although, traditionally, agricultural policies tend to support intensification and uniformity, promoting the diversity of agrifood production systems can be the key to deal with crises or disasters in the future (Altieri and Nicholls, 2020). However, diversity-promoting policies should go beyond the margins, helping diversified agricultural production systems to enter value chains and linking them with new market constellations (IPES-Food, 2016). By revealing the interdependency and the risk transmission between sectors and regions, the COVID-19 pandemic can be a turning point for creating alternatives to dominant agrifood systems.

At the other end of the spectrum, it is critical to strengthen farmers' ability to fundamentally alter their operational paradigms to ensure the sustainability of their enterprises when external perturbations occur. From the field of evolutionary biology, it is well known that organisms unable to change when discontinuities and environmental disturbances occur are at extinction risk. The same seems to be true for every enterprise or organization: when managers are able to change the modus operandi of their enterprises, they can secure their viability or even their prosperity (Tushman & O'Reilly III, 1996). Nevertheless, to do so, they have to be ready to initiate well-focused innovations that increase the resilience of their enterprises (Senge, 1990). That constitutes a challenging task for agricultural innovation policies. Although resilience has a central position in the agenda of innovation support services, the linkage between innovation policies and farmers' capacity to change and survive when external turbulence occur is questionable. The shift towards what Hekkert et al. (Hekkert et al., 2020) term "mission-oriented innovation policy" and the articulation of clearly defined submissions of innovation systems (Klerkx and Begemann, 2020) seem to be necessary to achieve this purpose.

Finally, resilience-promoting policies must pay close attention to the issue of farmers' and farm workers' health. To keep agricultural systems productive during periods of upheaval like the current pandemic, governments should protect the health of those involved in the practice of agriculture (Savary et al., 2020). Despite what is commonly assumed, several indications from different countries suggest that farmers have lower health status than the general population (see (Fragar et al., 2011) for a relevant study in Australia). As, globally, the farming population is getting older its vulnerability to health risks increases (O'Meara, 2019). The COVID-19 pandemic experience re-emphasizes the need to offer farmers, their families, and farm workers inclusive (Wypler & Hoffelmeyer, 2020), affordable, and high-quality health care services (Neef, 2020), and to craft income-sensitive health insurance plans (Becot et al., 2020).

3.2. The need to create and exploit community marketing schemes

The COVID-19 pandemic brought to the surface many questions about the ability of mainstream supply chains to cover consumers' needs during major crises or disasters. As we noted above, panic buying, along with the shrinking of the food industry and the problems in logistics operations that followed the first months of the pandemic led to shortages in many agrifood products or even to empty supermarket shelves (Barrett, 2020; Liu, 2020). The access to mainstream retail channels became problematic for some population sub-groups, like people living in remote rural regions, elderly consumers, and persons with disabilities, because of the mobility restrictions and limitations in the number of customers allowed in-store imposed by local or national authorities. To serve these segments, retailers adopted bricolage strategies instead of engaging in generative change (e.g., rebuilding their supply networks, relying more on local food producers). Simply put, retailers continued to follow their logic and operating paradigms, making only some minor adaptations aimed at helping them ride out the storm. Practices like online selling and home delivery were initiated, however, elderly consumers and individuals with chronic diseases or special needs – who are more susceptible to infection (Liu et al., 2020b; Liu et al., 2020a; Otu et al., 2020) – are not always able to use these services.

In parallel, as we noted in Section 2, the closure of the catering and tourism sectors led farmers to sell their products at significantly lower prices or even to destroy a part of their perishable production. The retailer-dominant supply chain paradigm, although functional in "normal" periods, has proven unable to adequately remedy these problems, revealing the need to open up new and to enhance already operating community marketing conduits.

The term community marketing refers to distribution channels formed through partnerships among actors with the aim of reaching specific, under-served from conventional marketing schemes, segments of people (Thakur, 2015). Such configurations aim not only at the economic profit (albeit financial gain is in itself a central purpose of every marketing scheme) but also at the reciprocal production of value. Hence, in community marketing schemes, the term "marketing" is used not to describe the praxis of exchange (selling and buying) but the process of co-creating and sharing value within a community consisting of socially and emotionally bonded individuals. Although such schemes usually operate in niche markets, in periods of economic and social instability caused by major crises or disasters they can also serve other segments.

During the pandemic, community marketing schemes like community-supported agriculture, farmers' markets (Richards & Rickard, 2020), and other short food supply chains (Butu et al., 2020) have reduced the workload for mainstream food distribution channels, thus offering solutions to the crucial issue of access to food products, especially for those community members that are most vulnerable to the virus (Oliveira et al., 2020). On the other hand, it is well known that such schemes can offer farmers better prices and, consequently, incomes (Verhaegen & Van Huylenbroeck, 2001). Hence, in periods of external disturbances, they can ensure an income floor, even when they are used as secondary distribution channels. In addition, community marketing systems can play a significant role in food assistance programs, making easier the access of needy families to food.

In a post-COVID world, community marketing schemes can occupy a more central position in food supply systems. Besides, apart from their role in facilitating the smooth and continuous supply of food during crises, such configurations produce less environmental footprint than conventional distribution channels, whereas they may foster social sustainability (Schmutz et al., 2018). However, to promote the development of community marketing conduits, the cultivation of trust between producers and potential buyers (Giampietri et al., 2018), and the increase of community markets performance (De Bernardi et al., 2020) through efforts to enhance farmers' entrepreneurial competencies (Charatsari et al., 2019) are two key preconditions.

3.3. Can smart farming technologies and big data help farmers deal with major crises or disasters?

Smart farming technologies emerged as a set of tools aimed at leading to agrifood systems transformation by helping farmers improve farm efficiency (Virk et al., 2020) and overcome their reliance on human labor (Charania & Li, 2020). The latter parameter gained considerable attention during the COVID-19 pandemic. As Mitaritonna and Ragot (Mitaritonna & Ragot, 2020) note, such technologies have the potential to replace farm workers in the post-COVID era. Indeed, autonomous systems like driverless tractors, fruit picking robots, and spraying drones can drastically reduce the number of workers employed in farms. However, do we really want to pursue such a goal? Farm laborers, especially those working in seasonal jobs, are usually low-skilled persons for whom the opportunities to make a living outside agriculture are limited (Lioutas & Charatsari, 2020). In this vein, the introduction of smart technologies may generate more social problems than that it intends to solve (Rose et al., 2020). Besides, many questions about the inclusiveness of smart farming (Klerkx & Rose, 2020) or the compatibility of smart technologies with different production systems (Lioutas & Charatsari, 2020) need to be answered.

On the other hand, big data applications in agriculture increase farmers' decision-making capacity (Newton et al., 2020), whereas by connecting the farm practice with other fields of economic activity (Ribarics, 2016), they offer farmers better opportunities to timely anticipate black swans and to take corresponding actions. This attribute makes big data a valuable tool for helping farmers cope with major crises and disasters. However, issues like big data quality and farmers' ability to deal with data complexity remain to be solved.

So, should post-COVID agriculture become more autonomous or even farmerless? To answer this question, we need to identify potential benefits, risks, and threats for farmers, farm workers, consumers, and other stakeholders, by following systemic approaches and building upon the principles of responsible research and innovation.

4. Conclusions

In this short communication, based on the lessons learned from the experience of the COVID-19 pandemic, we attempted to present the impacts that major crises or disasters have on agriculture and to discuss mechanisms that can help farmers overcome such crises or disasters. In our view, there is a need for governments and international organizations to craft effective crisis management plans and to launch resilience-promoting policies that aim at enhancing farmers' ability to change operating paradigms when external turbulence appears on the horizon. However, to do so, governments should acknowledge the peculiarities of different farming systems and secure resource stocks (not only economic but also institutional and natural) for every type of agriculture. In parallel, innovation policies should identify and pursue clear missions that go beyond production increase in "normal" times.

On the other hand, the reconnection of farmers and consumers through community marketing schemes can facilitate the distribution of agrifood products to consumers during periods of instability while generating a flow of income for farmers. Of course, this is not to say that mainstream distribution channels should be replaced. Community marketing schemes can operate in tandem, offering farmers a hybrid distribution system. Finally, smart farming technology and big data can help farmers overcome dependency on farm labor and make better decisions when the external environment changes suddenly.

These three mechanisms can be combined to increase the capacity of agriculture to deal with crises or disasters. For instance, smart technology can be a vital resource for enhancing farm systems resilience, whereas it can also increase the performance of community marketing schemes. Policies – like the Common Agricultural Policy in European Union – already pay attention to these issues; however, some indications confirm that despite the good intentions, they often fail to enhance the transformability of agriculture (Buitenhuis et al., 2020). More effort is needed to promote generative changes in agriculture. The COVID-19 crisis offers some opportunities to reflect upon problems and make decisions about the future of agriculture and 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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