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Toward Sustaining Global Food Systems for the Future

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FOOD SYSTEMS: SOME FUNDAMENTALS

Food system as a concept has evolved over the decades and has been viewed in diverse perspectives. Historical context of global food systems involve economics and socio-political, corporate world, environmental and ecological, as well as community-based dimensions, just to mention a few (Feenstra, 1997). Food systems largely envelope set of activities ranging from production through to consumption, encompassing such contexts as availability, access, and utilization. Broadly speaking, food systems can include interactions between/within biogeophysical and human environments, outcomes of contributions to food/environmental security and social welfare as well as other determinants of food security (Ericksen, 2008).

Food systems can be likened to an hourglass, where bottom constitute millions of farmers and farm laborers producing both food and fiber, and at the top there are billions of consumers, both rich and poor. However, the middle narrow part would constitute dozen or so multinational companies—the input suppliers, food processors and retailers earning profit for every transaction (Thompson et al., 2007). It will be remise to discuss food systems without highlighting food chain activities, which involves: (a) manufacturing and distribution of inputs (animal feed, fertilization, pest control, seed); (b) primary and secondary processing, packaging, storage, transport, and distribution; (c) catering; (d) agricultural product (crops, fisheries, livestock, etc.); (e) waste disposal; (f) marketing and retail; and (g) domestic food management (Vermeulen et al., 2012). Food systems, not only involves food chain activities, but also the governance of these activities and (any) corresponding outcomes. On the other hand, there is human participation in food systems, which is inevitable as it comes with multiple objectives: environmental stewardship, livelihood, profit, and securing food (for nutrition, pleasure, and social functions) (Vermeulen et al., 2012).

Having been involved in sustainability aspects for a long time, food systems appear to interlink both activities and element aimed at production, processing, distribution, and consumption of food. Holistic approach to food system is therefore necessary/useful because of its complexities involving food, human health, and social components (Smetana et al., 2019). Nonetheless, learning about the food system at the local level is also very important, because in the process, not only is one able to appreciate and understand the background/foundation of agricultural production as well as the self-reliance capacity of the existing system, one can be guided to identify with local/seasonal development of food production within the market domains (Feenstra, 1997). On the other hand, understanding food systems at regional levels can help provide informative/valuable insights about how to develop a thriving food economy, from local/sustainable agriculture, marketing and consumer studies, to urban food system aspects (Feenstra, 1997). But owing to demand-side drivers (population growth, shifting pattern of consumption, urbanization, and income distribution) and trends in food supply, food systems at the global stage are in a flux with changing institutional and social processes within, such as trade liberalization, associated market penetration by transnational food companies, restricting of retail supermarkets, food industry marketing as well as consumer attitudes (Vermeulen et al., 2012).

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SOME CHARACTERS AND CHALLENGES OF MODERN FOOD SYSTEMS

Multiple perspectives and worldviews generally persist in global food systems, the most useful conceptualization having circled between production (the "field") and consumption (the "table") with specific emphasis ascribed to marketing, processing, and multiple transformation(s) (Ericksen, 2008). Some character comparisons of major categories of global food systems are presented in **Table 1**. A closer look, characters of food system are shown with key components, from principal employment in food sector, supply chain, food production system, typical farm and food consumed, purchased food bought from, nutritional concerns, to major environmental concerns and influential scale. Also, **Table 1** enumerated, not only these abovementioned characters but distinguished between the major categories, that is, "traditional" and "modern" food systems (Ericksen, 2008). Further, nutrition and food systems has been linked using a conceptual framework where health and nutritional outcomes could impact on biophysical/environmental, demographics, infrastructure/innovation/technology, economical/political, as well as sociocultural drivers. In addition, politics can associate with food environment (such as food availability, advertising/promotion, and food quality/safety), consumer behavior (choice of what/where food to cook, eat, and or store), as well as Sustainable Development Goals (SDGs) (HLPE, 2017). Notwithstanding that food systems can be influenced by economic, environmental, political and sociocultural contexts, food systems still constitute different types—from short chain, low value, rural/traditional to long chain, high value and industrial, and may as well be found within a country (Branca et al., 2019). Clearly, there are multiple actors involved in food systems as well as broad array of environment and social interactions (Ericksen, 2008).

Largely, challenges of modern food systems would (directly) involve: (a) areas of production of raw materials for food; (b) huge increase in "value-added" activities arising in the area of processing and packaging of raw materials into food products; (c)

TABLE 1 | Some character comparisons of major categories of global food systems.

Characters of global food system	Additional/associated features/sectors	Major categories of global food systems	
		"Traditional" food systems	"Modern" food systems
Principal employment in food domain/sector	Health, Nutrition, Market, Politics, Time, Consumer, Population, One or more countries, etc.	Principal employment include those within food production	Principal employment include those within food processing, packaging, and retail
Food supply chains and (any) corresponding network(s)	Health, Nutrition, Market, Politics, Population, Time, Consumer, One or more countries, etc.	Food supply chain/network involve both short and local aspects	Food supply chain/network involve long with many food miles and nodes
Food produce cycle and (any) corresponding production system(s)	Health, Nutrition, Market, Time, Politics, Sales, Consumer, One or more countries, etc.	Productivity can involve diverse and varied	Productivity can involve few crops, but can be with intensive, high inputs
Typical farm/plantation/ranch	Health, Nutrition, Market, Time, Politics, Storage, Population, One or more countries, etc.	Farm/plantation can be family-based, ranging from small to moderate	Farm/plantation can be industrial, and large in size
Typical food consumed at all social level/status	Health, Nutrition, Market, Time, Politics, Storage, Culture, One or more countries, etc.	The typical food consumed are largely basic staples	The typical food consumed are largely processed food with a brand name, with increases in animal products
Purchased food and where it has been bought from	Health, Nutrition, Market, Time, Quality, Politics, Culture, Storage, One or more countries, etc.	The place of purchase is small, like a local shop or market	The place of purchase is large supermarket chain
Nutritional concern(s) regardless of social level/status	Health, Nutrition, Quality, Politics, Culture, Time, One or more countries, etc.	The nutritional concerns is largely "under-nutrition"	The nutritional concerns is largely chronic dietary diseases
Main source(s) of national food shocks	Health, Nutrition, Market, Politics, Weather, Time, Population, One or more countries, etc.	The main source of national food shock include poor rains as well as production shocks	The main source of national food shock include international price and trade problems
Main source(s) of household food shocks	Health, Nutrition, Market, Politics, Weather, Population, Time, One or more countries, etc.	The main source of household food shocks include poor rains as well as production shocks	The main source of household food shocks include income shocks that can lead to food poverty
Major environmental concerns/issues	Health, Nutrition, Climate/Weather, Culture, Population, Time, One or more countries, etc.	Major environmental concerns/issues include soil degradation and land clearing	Major environmental concerns/issues include nutrient loading, chemical runoff, water demand, and green house emissions
Influential measures/scales	Culture, Population, Health, Nutrition, Market, Weather, Time, One or more countries, etc.	Influential measures/scales range between local and national	Influential measures/scales range between national and global

Source: Adapted from Ericksen (2008), HLPE (2017), Branca et al. (2019), and Cottrell et al. (2019).

distribution and retail activities, where networks have expanded greatly extended/improved with globalized and transportation market routes; as well as (d) significantly changing global food consumption trends. **Table 1** also suggests that challenges of food system occupy either between basic and complex (for example: basic staples to processed food for typical food consumed; family-based to industrial for typical farm) and or small and big (national to global; local to national) scale(s) (Ericksen, 2008). Moreover, when food production takes place at long distances from consumers for example, it would certainly come with economic costs (Peters, 1997). Here, it is important to reiterate that within the global food system, each dollar (and applicable to any other currency) a consumer spends on food is divided among many players. This is explained further after a raw product leaves the farm, the subsequent storage, processing, distribution, marketing and retailing all influence the consumer cost of the food (Peters, 1997). From the health perspective, Branca et al. (2019) have understood that food systems can equally be confronted with challenges of malnutrition and poor healthy diets, which are logical consequences of major changes associated with food production, sales, marketing, and consumption, among other factors. Thus, to transform current food systems, there is need for additional focus on improved affordability, availability as well as uptake of nutrition and sustainable diets.

ENHANCING SUSTAINABILITY OF FOOD SYSTEM PATHWAYS

To help understand the pathway food systems follow in order to achieve sustainability requires the knowledge that characterizes (agro)food systems, which can include: (a) the dynamic of production; (b) integrated agri-food systems; (c) market failures; (d) public sector interventions; (e) socio-cultural systems; (f) heterogeneity and diversity; and (g) collective action (Thompson et al., 2007). Pathways to sustainable (agri)food systems can be found within six elements, namely: (a) framing the sustainability challenge via unpacking what is meant by sustainability in (agri)food systems; (b) exploring multiple pathways via linking ecological social and technological elements that potentially cover the full rate from "high market modernist agriculture" through range of other "future agricultures"; (c) scale of analysis that must involve understanding individual farmer's options and opportunities as it relates to processes, from local to global; (d) dynamic system properties underpinned by how variety of different pathways (normatively/politically) respond to internal and external shocks/stresses and how resilient, robust, durable and stable they are; (e) governance analysis underpinned by key questions such as: What influences the framings of the problem? How inclusive and deliberate are the policy definition processes? What governance processes influence both system properties and their broader content dynamics? What pathways are constrained by current/existent arrangements, and also, what options might be opened up? What are the sustainability implications if alternative governance arrangements were to be envisaged? and (f) from analysis to practice via facilitating design of (agri)food systems so as to meet up with future challenges of sustainability (Thompson et al., 2007).

Sustainable system is believed to pay attention to the health of community/environment notwithstanding that current globalized food systems are so complex where connections/linkages of food, health and environment are not always clearly visible (Peters, 1997). Thus, if a broad-based system approach of (agri)food as well as willingness to confront emergent challenges/issues were to be respectively created/developed, it is required that experts within this specialist field together with relevant stakeholders must have to become leaders to help influence/shape appropriately the consumer food choices in the view to attain a sustainable future (Peters, 1997). As profound changes emerge from anthropogenic pressures, the global food system needs to significantly improve its resource use efficiency and environmental performance if it targets to assure sustainable food consumption and production (Herrero and Thornton, 2013). Although there are (potentially) positive impacts of sustainable intensification of global food systems, it is imperative that sustainable intensification extends not only beyond improving efficiency and productivity but also incorporating other aspects such as creating the needed incentives/investments to achieve/enable intensification, as well as developing limits/regulations for intensifying systems (Herrero and Thornton, 2013). Essentially, waste reduction can equally play a crucial function/role to improve food systems especially in terms of food production. Oftentimes, between 30 and 40% of food appears as wasted throughout the food system—in fact, at all stages of food chain, from production and harvest, all the way through to post-purchase by consumer. In developing countries, losses/wastes can reach a peak at post-harvest stage owed to such factors as spillage and spoilage arising from inadequate transport and storage infrastructure. In developed countries however, losses/wastes can be found in households after purchase, even though retail, distribution, and processing do equally contribute significantly (Godfray et al., 2010).

CONCLUDING REMARKS

This terse opinion piece calls for increased efforts in developing more ways of sustaining food systems specifically for the future, given the ever-increasing global population and inevitably increasing competition for global food resources. Author agrees with previous workers, that have reiterated there is hope for the future of global food systems, because major advances in sustainable food availability and production are attainable with concerted application of current technologies given adequate political will as well as investing in research sooner than later to enable food systems cope with future challenges (Godfray et al., 2010). To wrap up, there is need to reiterate the new urgency given to on-going discussions of food sustainability within the context of 2030 United Nations Agenda. And as such, developing a global agricultural system capable of meeting up with food safety and at the same time, attain economic, environmental, and social sustainability remains a

complex challenge that requires political negotiation as well as representations of extended participation, which would involve citizens, consumers, policy makers, practitioners as well as scientists (Saltelli and LoPiano, 2018).

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

REFERENCES

Branca, F., Lartey, A., Oenema, S., Aguayo, V., Stordalen, G. A., Richardson, R., et al. (2019). Transforming the food system to fight non-communicable diseases. *BMJ* 365:L296. doi: 10.1136/bmj.l296

Cottrell, R. S., Nash, K. L., Halpern, B. S., Remenyi, T. A., Corney, S. P., Fleming, A., et al. (2019). Food production shocks across land and sea. *Nat. Sustain.* 2, 130–137. doi: 10.1038/s41893-018-0210-1

Ericksen, P. J. (2008). Conceptualizing food systems for global environmental change research. *Glob. Environ. Change* 18, 234–245. doi: 10.1016/j.gloenvcha.2007.09.002

Feenstra, G. W. (1997). Local food systems and sustainable communities. *Am. J. Altern. Agric.* 12, 28–36. doi: 10.1017/S0889189300007165

Godfray, H. C. J., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F., Nisbett, N., et al. (2010). The future of the global food system. *Philos. Trans. R. Soc. B* 365, 2769–2777. doi: 10.1098/rstb.2010.0180

Herrero, M., and Thornton, P. K. (2013). Livestock and global change: emerging issues for sustainable food systems. *Proc. Natl. Acad. U.S.A.* 110, 20878–20881. doi: 10.1073/pnas.1321844111

HLPE (2017). *Nutrition and Food Systems.* A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome, 152. Available online at: http://www.fao.org/3/a-i7846e.pdf (accessed January 03, 2020).

Peters, J. (1997). Community food systems: working toward a sustainable future. *J. Acad. Nutr. Diet.* 97, 955–956. doi: 10.1016/S0002-8223(97)00230-7

Saltelli, A., and LoPiano, S. (2018). Doing the sum right or the right sums? Techno-optimist numbers in food security scenarios. *Front. Sustain. Food Syst.* 2:6. doi: 10.3389/fsufs.2018.00006

Smetana, S. M., Bornkessel, S., and Heinz, V. (2019). A path from sustainable nutrition to nutritional sustainability of complex food systems. *Front. Nutr.* 6:39. doi: 10.3389/fnut.2019.00039

Thompson, J., Millstone, E., Scoones, I., Ely, A., Marshall, F., Shah, E., et al. (2007). "Agri-food system dynamics: pathways to sustainability in an era of uncertainty," in *STEPS Working Paper 4* (Brighton: STEPS Centre), 79.

Vermeulen, S. J., Campbell, B. M., and Ingram, J. S. I. (2012). Climate change and food systems. *Annu. Rev. Environ. Resour.* 37, 195–222. doi: 10.1146/annurev-environ-020411-130608

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