

# Food Security and the 2015–2030 Sustainable Development Goals: From Human to Planetary Health

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## Abstract

Food security exists when “all people, at all times have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” ([http://www.fao.org/wfs/index\\_en.htm](http://www.fao.org/wfs/index_en.htm)). Close to 800 million individuals do not have access to enough food, >2 billion individuals experience key micronutrient deficiencies, and ~60% of individuals in low-income countries are food insecure. Food insecurity negatively affects human physical, social, emotional, and cognitive development throughout the life course and is a major social and environmental disruptor with serious repercussions for planetary health (i.e., the health of human civilization and the state of the natural systems on which it depends). Food security is related to all of the United Nations Sustainable Development Goals (SDGs). Improved food security governance based on sound, equitable, and sustainable food systems that benefit from modern information and sustainable and equitable agricultural technologies is essential for countries to meet the SDGs. *Curr Dev Nutr* 2017;1:e000513.

## Food Security Definition

At the 1996 FAO Rome World Food Summit, food security was defined as a condition that exists when “all people, at all times have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (1). Therefore, the key dimensions of the household food security construct are as follows: physical availability of food, economic and physical access to food, and adequate food utilization that is a function of the ability of the body to process and use nutrients as well as of the dietary quality and the safety of the foods consumed. Because of the central role that food security plays in human development, it is recognized as a universal human right (1) that is currently unmet for billions of individuals globally (2–5).

## Causes of Food Insecurity

Household food insecurity (HFI) is the result of poverty, poor health of the household member or members, and suboptimal livelihood and household management strategies (6). Food security is closely related to, but not synonymous with, nutrition security and health. Nutrition security is attained by individuals when the body tissues are exposed to optimal amounts of nutrients and other essential substances. Nutrition security results from the combination of household food security, health care access security, and access to other basic human needs including adequate sanitation. Food security and the other determinants of nutrition security are linked with each other (6). For example, a household with limited economic access to food may decide to not seek medical care for a child or to not purchase prescribed medications. For food security to be a reality, households need to have unrestricted access



**Keywords:** food security, sustainable development goals, governance, human development, planetary health

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to a healthy and nutritious diet. Access to healthy diets, in turn, depends on having adequate economic resources and for foods to be readily available in the country, region, and communities in which the households are located. National food availability is a function of the balance between foods grown in the country plus foods imported minus foods exported, spoiled, or fed to animals. Therefore, the maintenance of an affordable and sustainable healthy food supply at the global level is paramount for achieving household food security and nutrition security worldwide. For this reason, it is crucial to understand and address climate change, agricultural commodity price policies, armed conflicts, and ultimately, the health of our planet from a household food security perspective (6, 7) in the context of the UN Sustainable Development Goals (SDGs), which specifically call for ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture globally (8).

### Consequences of Food Insecurity

HFI represents a strong biological and psychosocial stressor that may increase the risk of poor mental, social, and psycho-emotional development of individuals across the life course through different pathways. A biological pathway involves the potential links between HFI, poorer dietary intakes, nutritional status, and overall well-being. A case in point is a current study from the United States that documents the very poor dietary quality of low-income individuals at risk of food insecurity (9). Their diets were characterized by exceedingly low intakes of whole grains, fruit, vegetables, and fish. This indeed is a dietary pattern that has been strongly linked to an increased risk of obesity, metabolic syndrome, chronic diseases such as diabetes, and premature death (9, 10). A psycho-emotional pathway involves the worry and anxiety; feeling of exclusion, deprivation, and alienation; distress; and adverse family and social interactions among individuals experiencing food insecurity (11).

#### Poor child development

HFI is indeed a powerful stressor that has a direct and indirect impact on the psycho-emotional, social, behavioral, and intellectual development of children, including problem internalization (e.g., depression) and externalization (e.g., aggressive behaviors) (11). Quantitative studies have shown that HFI affects child development above and beyond the independent effects of typical poverty indicators, including household income and parental education (11). The impact of HFI on child development is likely to be influenced by nutritional indicators as well as by psycho-emotional factors affecting how the family functions. Qualitative research studies have confirmed that HFI leads to strong psycho-emotional responses, including being worried, sad, or angry (11–13).

#### Infectious diseases

HFI has been associated with an increased risk of childhood malaria, diarrhea, upper respiratory infections, and hospitalizations due to severe infectious diseases in countries as diverse as Brazil and Haiti, perhaps as a result of inflammation as well as a depressed immune system (14, 15).

### Stunting, Obesity, and Chronic Diseases

HFI has been associated with the double burden of malnutrition (i.e., the simultaneous presence of stunted children and obese mothers living in the same household) in Brazil, Mexico, and other Latin American countries and world regions (16–19). Furthermore, HFI has been associated with serious noncommunicable diseases, including type 2 diabetes and hypertension in Mexico, Ecuador, and other countries (20–22), which is likely to be connected to poor dietary quality (9, 10) and stress (20) resulting from HFI.

#### Poor mental health among children, youth, and adults

HFI has been associated with depression and suicidal thoughts among youth in the United States and has been confirmed to be a major source of maternal depression globally (11, 23, 24). Maternal depression, in turn, is a major risk factor for poor child psychosocial, emotional, and behavioral development (11, 23, 25).

#### Suboptimal sleep patterns

Poor sleep negatively affects physical and mental health. HFI has been associated with suboptimal sleep patterns among Mexican adults and low-income Latinos with type 2 diabetes in the United States and this relation is modified by stress and anxiety (26, 27).

#### Social disruption

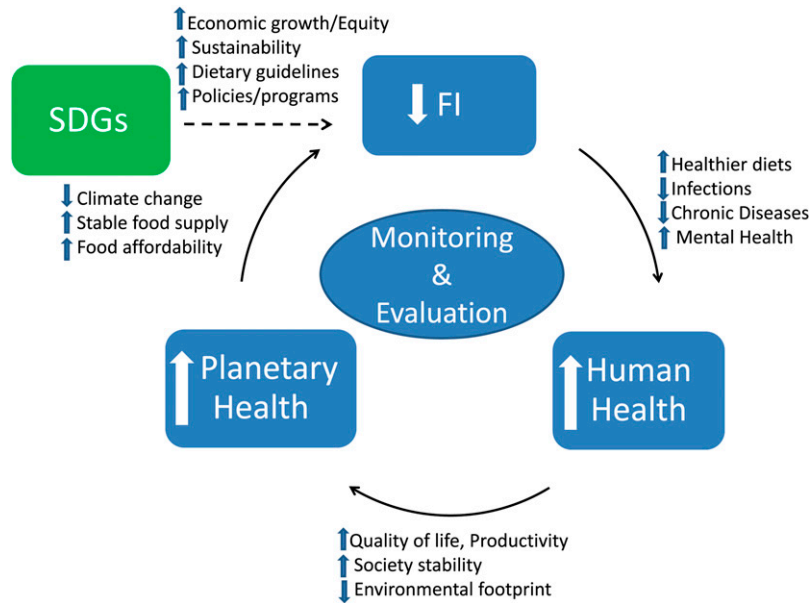
HFI has been identified as a major source of social unrest and internal strife globally as shown by the massive riots and social unrest resulting from the economic crisis and major food inflation observed in 2008 (28). Indeed, food shortages are so disruptive to societies that they are considered to be a major factor in the disintegration of nations.

#### Environmental sustainability

According to the recent *Lancet* Series on Planetary Health (29), the degradation and destruction of natural ecosystems has been identified as a major threat to crop diversity and thus the stability of food systems globally. Climate change, in particular, has been identified as a major determinant of damage to or destruction of ecosystems globally. Thus, maintaining environmental sustainability is an enormous challenge for planetary and human health, making it crucial to take immediate actions. These actions include “nonfood” (i.e., alternatives to fossil fuels), as well as “food-related” strategies (i.e., reducing the raising of cattle and consumption of meats, disseminating affordable sustainable agriculture technologies). Because consumers drive demand and this, in turn, drives decisions by industry, it is crucial for citizens to be educated on the importance of the individual lifestyle choices on the future sustainability and food security of the planet (10) (see **Figure 1** and the section entitled “Education: planetary health 2.0” below). By the same token, it is crucial for governments to implement sustainability policies that provide the conditions needed for consumers to implement these decisions.

### Magnitude of the Problem

Approximately 800 million individuals do not have access to enough food (2), >2 billion individuals experience key micronutrient deficiencies (e.g., iron, vitamin A, iodine, and zinc) (3), and poor dietary



**FIGURE 1** Conceptual framework of FI and the SDGs: from human to planetary health. FI, food insecurity; SDGs; UN Sustainable Development Goals. Data from references 7, 8, 10, 11, 20, 28–34.

quality in the context of the obesity epidemic has now become a major determinant of the global burden of disease (30). Furthermore, the recent application of the FAO's Food Insecurity Experience Scale, which takes into account both the amount of food and dietary quality that individuals have access to, in 134 countries has documented that the percentage of individuals living under overall food-insecure conditions ranged from 10.8% in high-income countries to 56.5% in low-income countries (**Figure 2**) (5). The corresponding values for severe food insecurity were 3.1% and 29.5%, respectively (5). Many food-insecure individuals consume excessive amounts of calories as part of dietary patterns that are heavily based on starches and a high amount of added sugars as part of ultra-processed food products, including sugar-sweetened beverages (30), which explains why both undernutrition and infectious diseases and obesity and chronic diseases coexist in low- and middle-income countries, a phenomenon known as the double burden of malnutrition (16–19).

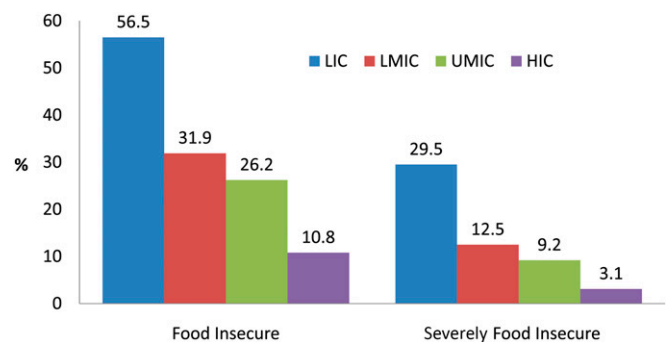
### Food Security Governance in a Globalized World

Sound food security governance is key for ensuring the right of food security for all citizens (34). Food security governance is indeed essential for the stability of nations. According to the FAO “food security governance” relates to formal and informal rules and processes through which interests are articulated and decisions relevant to food security in a country are made, implemented, and enforced on behalf of members of society (35). Adequate food security governance relies heavily on the following: 1) multisectoral participatory decision making, 2) transparency and accountability, 3) equity in resource allocation and service delivery, and 4) multisectoral and multilevel policies and corresponding programs. Brazil is highlighted in this perspective because it has been identified as an exemplary country when it comes

to food security governance, because it has strived to meet all of the criteria outlined above at the same time that it has shown major reductions in severe HFI (36, 37). Specifically, between 2004 and 2013, severe food insecurity declined in all states (except for one), with rates of decline ranging from –2.5% to –75.2% (36). It is important to mention, however, that even in the case of Brazil there is much more work to do as shown by the very high rates of HFI recently documented in Quilombolas or slave-descendant communities (38).

### Monitoring of HFI

Different indicators can and should be used for monitoring food insecurity at different system levels (global, national, state, local,



**FIGURE 2** Prevalence of food-insecure and severely food-insecure individuals across 20 LICs, 35 LMICs, 36 UMICs, and 43 HICs. Food insecurity was measured with FAO's Food Insecurity Experience Scale. HIC, high-income countries; LIC, low-income countries; LMIC, lower- and middle-income countries; UMIC, upper- and middle-income countries. Data from reference 5.

**TABLE 1** The 2015–2030 UN Sustainable Development Goals and their bidirectional relations with FI<sup>1</sup>

	Goal	Association with FI
1	End poverty in all its forms everywhere	Poverty is a major determinant and consequence of FI and FI is a major determinant of poverty.
2	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture	Goal directly calls for ending FI.
3	Ensure healthy lives and promote well-being for all at all ages	FI has been associated with poor physical and mental health throughout the life course.
4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	FI affects the ability of children to learn in school. Lower educational levels increase the risk of FI.
5	Achieve gender equality and empower all women and girls	Eliminating FI among women and girls improves their health and ability to learn. This empowers women to provide better food security to their future families.
6	Ensure availability and sustainable management of water and sanitation for all	Reducing infectious diseases through improved hygiene and sanitation reduces FI because families have more disposable income for food. Improving food security reduces the risk of infection.
7	Ensure access to affordable, reliable, sustainable, and modern energy for all	Access to electricity improves food availability and access to food at home.
8	Promote sustained, inclusive, and sustainable economic growth; full and productive employment; and decent work for all	Socioeconomic inequities are the root cause of FI. Unemployment is a major social determinant of FI. FI leads to less productivity and hence prevents sustainable economic development.
9	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation	Socioeconomic inequities are the root cause of FI. FI is likely to lead to less innovation and hence prevents sustainable innovation.
10	Reduce inequality within and among countries	Socioeconomic inequities are the root cause of FI.
11	Make cities and human settlements inclusive, safe, resilient, and sustainable	Lack of housing security is a strong determinant of FI.
12	Ensure sustainable consumption and production patterns	Environmental sustainability reduces the risk of widespread FI. Consumers' sustainable food consumption reduces the risk of unsustainable agriculture. FI is associated with unsustainable consumption and agricultural practices and environmental degradation.
13	Take urgent action to combat climate change and its impacts	Environmental degradation due to climate change increases the risk of FI. FI leads to social and environmental disruption, accelerating climate change.
14	Conserve and sustainably use the oceans, seas, and marine resources for sustainable development	Sustainability of marine ecosystems reduces the risk of widespread FI. FI leads to unsustainable fishing practices.
15	Protect, restore, and promote sustainable use of terrestrial ecosystems; sustainably manage forests; combat desertification; halt and reverse land degradation; and halt biodiversity loss	Sustainability of terrestrial ecosystems reduces the risk of widespread FI. Sustainable agriculture is likely to slow down climate change, which, in turn, is a major threat to food security.
16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels	Conflict is a major risk factor for FI and is also driven by FI. Proper local-to-global governance is needed to prevent conflict and FI.
17	Strengthen the means of implementation and revitalize the global partnership for sustainable development	Sustainable global partnerships are needed to reduce FI for all. Increased food security is likely to strengthen global partnerships.

<sup>1</sup>Data from references 5, 7, 8, 11, 14, 15, 20, 24, 28–31, 34, 38, 41, and 48. FI, food insecurity.

household, and individual levels) (Figure 1). However, it is perhaps the global dissemination of HFI experience-based scales that has made the major difference globally with the ability of governments to monitor the impact of their policies on food security at the household level. Brazil has indeed played a very central role in this success story. Experience-based household food security scales assess the perceptions or experience of a household key informant about different dimensions of food insecurity (6, 37), including worries about not having access to food and lack of access to sufficient food or to a

high-quality diet due to a lack of economic resources. Questions can be asked with regard to the whole household and adults or children and youth living in the household. Each household is categorized according to their level of food insecurity on the basis of an additive score (number of affirmative answers to scale questions) and recommended cutoffs (6). The case of Brazil, where the experience-based Escala Brasileira de Insegurança Alimentar (39) has helped improve food security governance, shows the strong potential of experience-based food security scales to influence food security governance

from the national to the municipal level (36, 37). The pioneer Escala Brasileira de Insegurança Alimentar experience was key for the development of the Latin American and Caribbean Food Security Scale (40), which, in turn, served as the foundation of FAO's Food Insecurity Experience Scale, which has been applied in >130 countries and was included by FAO as an official metric for assessing one of the SDGs related to reductions in hunger (8, 41). The SDGs are a set of 17 goals with 169 targets that countries have agreed to meet by 2030 based on the fundamental principle of equitable and sustainable economic growth. Food security is indeed paramount for meeting all of the 17 goals, which range from reduction in poverty and hunger to gender equity and planetary sustainability (8) (**Table 1**). The following section therefore provides specific recommendations for policy makers to address the challenge of food insecurity locally and globally.

### Conclusions and Recommendations

There is no doubt that food insecurity is affected by and strongly affects both the health of human beings and also the health and survival of our planet for future generations (7, 29) (Figure 1). Given the enormous magnitude of the problem of food insecurity globally it is important that policy makers and society at large consider engaging strongly with the actions discussed in the following sections.

#### Reduce income inequality and increase social justice

Wealth inequities, social injustice, and social exclusion prevent individuals and societies from developing properly (4, 8). These inequities are major underlying factors that drive the very high rates of food insecurity, poor physical and mental health, and the environmental destruction of our planet. For this reason, it is essential to support the development, implementation, and evaluation of economic, social, and cultural policies that close the huge gaps between the wealthiest and the poorest individuals across the globe (4, 8).

#### Promote sustainable agriculture

Promote sustainable agriculture technologies and practices that minimize agriculture's carbon footprint and its impact on natural resources, including soil and water. Agriculture is a major contributor to global warming through massive emissions of greenhouse gases (7, 29). Specifically, agriculture releases more greenhouse gases than all forms of transportation combined. Methane is a greenhouse gas released in large amounts from large-scale commercial cereal agriculture (e.g., rice) and animal husbandry, especially cattle (29). Large-scale commercial agriculture that decimates tropical forests also leads to massive release of carbon by destroying a major tree-based "carbon sink" (7, 29). Fertilizers that are applied without proper safeguards are also responsible for the release of the greenhouse gas nitrous oxide. Agriculture can also negatively affect the water supplies as a result of chemical runoff and wasteful irrigation systems (29, 31). Approximately one-third of all food grown is lost or wasted (7, 31). Therefore, reducing food losses and waste can significantly reduce the impact of food production on the earth's ecosystems at the same time that we need to plan on making food available to ~2.5 billion additional individuals between now and 2050 (7, 29).

#### Minimize food waste

Support policies that minimize food waste. In developed countries, most food waste happens as a result of food left unconsumed at home, in restaurants, or in supermarkets (7, 29, 31). This means that in high-income nations, consumers have the power to significantly reduce food waste by modifying their own eating behaviors and through their collective power to demand supermarkets and eating venues to disclose and take measures to reduce food losses. In contrast, in low-income countries, most food losses occur between the farm and the markets as a result of poor agricultural practices, as well as poor food storage and food distribution systems, including transportation (29, 31).

Food losses can be substantially reduced by improving the efficiency of agricultural practices through lessons learned from the large-scale commercial and the smaller scale organic farming sectors (7, 29). From the large-scale commercial sector we have learned how to apply fertilizers and pesticides more precisely, taking into account the nature of the local soil to reduce the use of agriculture's toxic chemicals and to prevent them from leaching into the water supplies. The evolution of organic farming offers lessons as to how to improve the nutritional quality of the soil and to conserve water by using cover crops, mulch, and compost. Consumers in high-income countries could play a key role in fostering sustainable agriculture by reducing their demand for foods that depend on crops that follow unsustainable agricultural practices that erode major ecosystems.

A key strategy for preventing food waste in developed countries is to prevent or use leftovers from foods prepared at home, ordered in restaurants, or purchased in supermarkets, and to develop better recycling systems of food waste. Recycled food waste can then be converted into compost for the production of fruit and vegetables in home gardens or in small community farms. Consumers can also reduce substantially the portion sizes of the meals they consume at home or outside of the home and can decide not to buy foods or food ingredients sold in excessive-portion-size presentations. In other words, through the power of their wallets, consumers can apply the pressure needed for the commercial food sector to mitigate the impact of its operations on the environment. On the other hand, by limiting waste and overconsumption, consumers can reduce pressure on producers to supply them with unsustainable food.

In low- and middle-income countries, reducing food losses by improving agricultural, food storage, and distribution systems is key (7, 29, 31). Consumers need to be educated on sound dietary practices, including portion-size estimation and control, as well to ensure that, as their countries' economies grow, they do not end up practicing the same eating behaviors currently followed by their counterparts in developed countries. The major obesity and chronic disease epidemics affecting countries as diverse as Brazil, Mexico, India, and China indeed represent the results of what happens to dietary quality, body weight, and chronic disease outcomes when disposable incomes increase in the context of poverty and an overabundance of low-cost, highly processed, energy-dense food products and sugar-sweetened beverages in the food supply consumed as part of diets rich in refined starches and added sugars (16–19, 30).

## SDGs

All governments should make a commitment to guide their agriculture, food, and nutrition policies through evidence-based dietary guidelines that are predominantly plant based and that emphasize variety and the consumption of sustainable animal protein sources, including properly managed wild or farmed fish in adequate amounts (10, 29, 42, 43). Governments should provide fiscal incentives for the development of a food supply and the consumption of foods consistent with predominantly plant-based dietary patterns that, among other things, include a rich diversity of vegetables, fruit, legumes, nuts, seeds, and whole grains (29, 30, 43). This is in contrast with the current overwhelming preponderance of processed meats, refined rice, and wheat- and corn-based products in global food supplies, which are often loaded with solid fats, added sugars, and salt and leave behind a large carbon footprint (7, 29, 30).

## Nutrition policy

Governments should consider removing subsidies and addressing food price policies that foster the production and consumption of highly energy-dense diets of very low nutritional value and of sugar-sweetened beverages at the expense of healthy, nutrient-dense diets based on a variety of fruit, vegetables, legumes, nuts, seeds, whole grains, and healthy animal protein sources including fish (10, 43). Governments should specifically consider effective tax policies that provide disincentives for the consumption of sugar-sweetened beverages (including sodas) and “junk” food in general (32). Governments should issue and enforce food-labeling legislation (32) that leads to the development of clear, transparent, consumer-friendly labels that provide information on the nutritional value, level of processing, and carbon footprint of foods and beverages purchased at supermarkets or consumed at restaurants and other eating venues. Food labels should also make a clear distinction between “best by” and “expiration” dates to prevent consumers from discarding products on the basis of the “best by” date, which is an indicator of peak freshness and not of spoilage of the product. Governments should consider policies and programs that optimize the nutrition of their populations throughout the life course, including gestation, infancy, early childhood, and the adolescent period (33, 44).

## Maternal, infant, and young child feeding

The first 1000 d are the foundation of human development. Governments should support policies that protect, promote, and support optimal maternal, infant, and young child feeding behaviors, including food security for all pregnant and lactating women, exclusive breastfeeding for 6 mo followed by the introduction of healthy and nutritious complementary foods at that age, and continuation of breastfeeding until the child is  $\geq 2$  y old (44). Breastfeeding, in particular, is considered to be central to sustainable development globally (45) and needs to be better supported through improved policies that include protection for employed women to implement the right to breastfeed their children (46).

## Education: planetary health 2.0

Planetary health is defined as “the health of human civilization and the state of the natural systems on which it depends” (29). In all

countries, it is important to educate and engage consumers through mass media and other means on the huge impact that choices from government, consumers, farmers, and the restaurant and food-processing industry have on the strongly negative environmental impact that food production currently has on the Earth’s ecosystems, which threatens the ability of our planet to remain sustainable over the longer term. It is also important to educate consumers about the fact that, to a large extent, we now know the causes of the problems and that sound practical solutions have been identified. It is also important to increase awareness among policy makers of the immense threat that climate change poses for food security and world stability globally (7, 28, 29).

## Support the plight of refugees

Current humanitarian emergencies largely due to manmade conflicts and disasters (including climate change) have led to an unprecedented exodus of 65 million refugees or internally displaced individuals who are at very high risk of food insecurity (7, 29). Governments should support policies that welcome refugees and help them gain access to education, gainful employment, and to a good quality of life, including access to adequate amounts of nutritious foods.

## Modern information technology for monitoring food insecurity

Support modern information management technology and communication systems with strong potential to help generate SMART (Specific, Measurable, Achievable, Realistic, Time-bound) indicators that are sensible and cost-effective and that provide useful information to decision makers to make timely decisions affecting different food security and food system dimensions from the local to the planetary level (37). Given the multiple dimensions of the construct of food security, it is key to track all dimensions of food security and food systems, including food availability, access, consumption, and utilization, and to promote food systems stability by using the suite of indicators endorsed by FAO (41, 47).

In conclusion, food insecurity is a major social and environmental disruptor with serious repercussions for the health and future sustainability of our planet. Improved food security governance based on sound, equitable, and sustainable food systems that benefit from modern information technologies is essential for all countries to be able to meet the SDGs (48).

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