

1 **Food Security and the 2015-30 Sustainable Development Goals: From Human to Planetary**
2 **Health**

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13 Abbreviations used:

14 ELCSA: Latin American and Caribbean Food Security Scale; FIES: Food Insecurity Experience

15 Based Scale; FI, food insecurity; HFI, household food insecurity, SDGs; United Nations

16 Sustainable Development Goals; SMART, Specific, Measurable, Achievable, Realistic, Time-

17 bound indicators.

18

19 **Abstract**

20 Food security exists when ‘all people, at all times have physical and economic access to
21 sufficient, safe and nutritious food that meets their dietary needs and food preferences for an
22 active and healthy life’. Close to 800 million individuals do not have access to enough food, over
23 two billion individuals experience key micronutrient deficiencies and about 60% of individuals
24 in low income countries are food insecure. Food insecurity negatively affects human physical,
25 social, emotional, and cognitive development throughout the life course, and is a major social
26 and environmental disruptor with serious repercussions for planetary health (i.e., the health of
27 human civilization and the state of the natural systems on which it depends). Food security is
28 related to all the United Nations Sustainable Development Goals (SDGs). Improved food security
29 governance based on sound, equitable and sustainable food systems that benefit from modern
30 information and sustainable and equitable agricultural technologies is essential for countries to
31 meet the SDGs.

32 **Key words:** Food security, Sustainable Development Goals, Governance, Human Development,
33 Planetary Health

34 **Food Security definition**

35 At the 1996 Food Rome World Food Summit, food security was defined as a condition
36 that exists when ‘all people, at all times have physical and economic access to sufficient, safe
37 and nutritious food that meets their dietary needs and food preferences for an active and healthy
38 life’ (1). Therefore, the key dimensions of the household food security construct are: physical
39 availability of food, economic and physical access to food, and adequate food utilization that is a
40 function of the ability of the body to process/use nutrients as well as of the dietary quality and
41 the safety of the foods consumed. Because of the central role that food security plays in human

42 development it is recognized as a universal human right (1) that is currently unmet for billions of
43 individuals globally (2-5).

44 **Causes of Food Insecurity**

45 Household food insecurity (HFI) is the result of poverty, poor health of household
46 member(s), as well as suboptimal livelihood and household management strategies (6). Food
47 security is closely related to but not synonymous with nutrition security and health. Nutrition
48 security is attained by individuals when the body tissues are exposed to optimal amounts of
49 nutrients and other essential substances. Nutrition security results from the combination of
50 household food security, health care access security as well as access to other basic human needs
51 including adequate sanitation. Food security and the other determinants of nutrition security are
52 linked with each other (6). For example, a household with limited economic access to food may
53 decide to not seek medical care for a child or to not purchase prescribed medications. For food
54 security to be a reality, households need to have unrestricted access to a healthy and nutritious
55 diet. Access to healthy diets in turn depends on having adequate economic resources and for
56 foods to be readily available in the country, region, and communities where the households are
57 located. National food availability is a function of the balance between foods grown in the
58 country plus foods imported minus foods exported, spoiled or fed to animals. Therefore, the
59 maintenance of an affordable and sustainable healthy food supply at the global level is
60 paramount for achieving household food security and nutrition security worldwide. For this
61 reason it is crucial to understand and address climate change, agricultural commodity price
62 policies, armed conflicts, and ultimately the health of our planet from a household food security
63 perspective (6, 7) in the context of the United Nations Sustainable Development Goals (SDGs)

64 that specifically call for ending hunger, achieving food security and improved nutrition, and
65 promoting sustainable agriculture globally (8).

66 **_---- Insert Figure 1 around here ----_**

67 **Consequences of Food Insecurity**

68 HFI represents a strong biological and psycho-social stressor that may increase the risk of poor
69 mental, social, and psycho-emotional development of individuals across the life course through
70 different pathways. A biological pathway involves the potential links between HFI, poorer
71 dietary intakes, nutritional status, and overall well-being. A case in point is a recent study from
72 the U.S. documenting the very poor dietary quality of low income individuals at risk of food
73 insecurity (9). Their diets were characterized by exceedingly low intakes of whole grains, fruits,
74 vegetables, and fish. This indeed is a dietary pattern that has been strongly linked with increased
75 risk of obesity, metabolic syndrome, chronic diseases such as diabetes and premature death (9,
76 10). A psycho-emotional pathway involves the worry/anxiety, feeling of exclusion, deprivation
77 and alienation, distress, and adverse family and social interactions among individuals
78 experiencing food insecurity (11).

79 ***Poor Child Development***

80 HFI is indeed a powerful stressor that has direct and indirect impact on the psycho-emotional,
81 social, behavioral, and intellectual development of children; including problem internalization
82 (e.g., depression) and externalization (e.g. aggressive behaviors) (11). Quantitative studies have
83 shown that HFI affects child development above and beyond the independent effects of typical
84 poverty indicators including household income and parental education (11). The impact of HFI
85 on child development is likely to be influenced by nutritional indicators as well as by psycho-
86 emotional factors affecting the how the family functions. Qualitative research studies have

87 confirmed that HFI leads to strong psycho-emotional responses including being worried, sad, or
88 angry (11-13).

89

90 ***Infectious diseases***

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

95 **Stunting, obesity & chronic diseases**

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

102 ***Poor mental health among children, youth and adults***

103 HFI has been associated with depression and suicidal thoughts among youth in the USA
104 and has been confirmed to be a major source of maternal depression globally (11, 23,24).
105 Maternal depression in turn is a major risk factor for poor child psycho- social, emotional and
106 behavioral development (11,23,25).

107 ***Suboptimal sleep patterns***

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

111 ***Social disruption***

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

116 ***Environmental sustainability***

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

130 **Magnitude of the problem**

131 About 800 million individuals do not have access to enough food (2), over two billion
132 individuals experience key micronutrient deficiencies (such as iron, vitamin A, iodine and zinc)
133 (3) and poor dietary quality in the context of the obesity epidemic has now become a major
134 determinants of the global burden of disease (30). Furthermore, the recent application of the
135 FAO's Food Insecurity Experience Scale (FIES) - that takes into account both the amount of
136 food and dietary quality that individuals have access - in 134 countries has documented that the
137 percentage of individuals living under overall food insecure conditions ranged from 11% in High
138 Income Countries to 56.5% in Low income Countries (Figure 2) (5). The corresponding figures
139 for severe food insecurity were 3.1% and 29.5%, respectively (5). Many food insecure
140 individuals are consuming excessive amount of calories as part of dietary patterns that are
141 heavily based on starches and a high consumption of added sugars as part of ultraprocessed food
142 products including sugar sweetened beverages (30), explaining why both
143 undernutrition/infectious diseases and obesity/chronic diseases are coexisting in low and middle
144 income countries, a phenomenon known as the double burden of malnutrition (16-19).

145 --- Insert Figure 2 around here ---

146 **Food security governance in a globalized world**

147 Sound food security governance is key for ensuring the right for all citizens to food
148 security (31). Food security governance is indeed essential for the stability of stability of nations.
149 According to the FAO 'Food security governance' relates to formal and informal rules and
150 processes through which interests are articulated, and decisions relevant to food security in a
151 country are made, implemented and enforced on behalf of members of society' (32). Adequate
152 food security governance relies heavily on: (a) multisectoral participatory decision making ; (b)
153 transparency and accountability; (c) equity in resource allocation and service delivery; (d) multi

154 sectoral and multilevel policies and corresponding programs. Brazil is highlighted in this
155 commentary because it has been identified as an exemplar country when it comes to food
156 security governance as it has strived to meet all the criteria outlined above at the same time that it
157 has shown major reductions in severe HFI (33,34). Specifically, between 2004 and 2013 severe
158 food insecurity declined in all states (except one) with decline rates ranging from -2.5% to
159 -75.2% (33). It is important to mention however, that even in the case of Brazil there is much
160 more work to do as shown by the very high rates of HFI recently documented in Quilombolas or
161 slave-descendant communities (35).

162 **Monitoring of Household Food Insecurity**

163 Different indicators can and should be used for monitoring food insecurity at different
164 system levels (global-national-state-local-household-individual levels) (Figure 1). However, it is
165 perhaps the global dissemination of HFI experience-based scales that has made the major
166 difference globally with the ability of governments to monitor the impact of their policies on
167 food security at the household level. Brazil has indeed played a very central role in this success
168 story. Experience-based household food security scales assess the perceptions or experience of a
169 household key informant about different dimensions of food insecurity (6,34) including worries
170 of not having access to food, lack of access to sufficient food or to a high quality diet due to a
171 lack of economic resources. Questions can be asked with regards to the whole household,
172 adult(s) or children/youth living in the household. Each household is categorized according to
173 their level of food insecurity based on an additive score (number of affirmative answers to scale
174 questions) and recommended cut-off points (6). The case of Brazil, where the experience-based
175 Escala Brasileira de Insegurança Alimentar (EBIA) (36) has helped improve food security
176 governance, illustrates the strong potential that experience-based food security scales have to

177 influence food security governance from the national to the municipal level (33,34). The pioneer
178 EBIA experience was key for the development of the Latin American and Caribbean Food
179 Security scale (ELCSA) (37) which in turn served as the foundation of FAO's Food Insecurity
180 Experience scale (FIES) that has been applied in over 130 countries and included by FAO (5) as
181 an official metric for assessing one of the Sustainable Development Goals (SDGs) related to
182 reductions in hunger (8). The SDG's are a set of targets and 169 goals that countries have agreed
183 to meet by 2030 based on the fundamental principle of equitable and sustainable economic
184 growth. Food security is indeed paramount for meeting all of the 17 goals that range from
185 reduction in poverty and hunger, to gender equity and planetary sustainability (8) (Table 1).
186 Therefore, the following section provides specific recommendations for policy makers to address
187 the challenge of food insecurity locally and globally.

188 **--- Insert Table1 around here ----**

189 **Conclusions & recommendations**

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

195 ***Reduce income inequality/increase social justice***

196 Wealth inequities, social injustice and social exclusion prevent individuals and societies
197 from developing properly (38). These inequities are major underlying factors driving the very
198 high rates of food insecurity, poor physical and mental health and the environmental destruction
199 of our planet. For this reason it is essential to support the development, implementation and

200 evaluation of economic, social, and cultural policies that close the huge gaps between the
201 wealthiest and the poorest individuals across the globe (8,38).

202 ***Promote sustainable agriculture***

203 Promote sustainable agriculture technologies and practices that minimize agriculture's
204 carbon foot print and its impact on natural resources including soil and water. Agriculture is a
205 major contributor to global warming through massive emission of greenhouse gases (7,39).
206 Specifically, agriculture releases more greenhouse gases than all forms of transportation
207 combined. Methane is a greenhouse gas released in large amounts from large scale commercial
208 cereal agriculture (e.g., rice) and animal husbandry, especially cattle (29). Large scale
209 commercial agriculture that decimates tropical forests also leads to massive release of carbon by
210 destroying a major tree based 'carbon sink' (7,29). Fertilizers that are applied without proper
211 safeguards are also responsible for the release of the greenhouse nitrous oxide. Agriculture can
212 also negatively affect the water supplies as a result of chemicals runoffs and wasteful
213 irrigation systems (29,39). About one third of all food grown is lost or wasted (7,39). Therefore,
214 reducing food loses and waste can significantly reduce the impact of food production on the
215 earth's ecosystems at the same time that we need to plan on making food available to about 2.5
216 billion additional individuals between now and 2050 (7,39).

217 ***Minimize food waste***

218 Support policies that minimize food waste. In developed countries most food waste
219 happens as a result of food left unconsumed at home, restaurants, or supermarkets (7,29,39). This
220 means that in high income nations, consumers have the power to significantly reduce food waste
221 by modifying their own eating behaviors and through their collective power to demand
222 supermarkets and eating venues to disclose and take measures to reduce food losses. By contrast,

223 in low income countries most food losses occur between the farm and the markets as a result of
224 poor agricultural practices, as well as weak food storage and food distribution systems including
225 transportation (29).

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

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

246 In low- and middle-income countries it is key to reduce food losses by improving
247 agricultural, food storage and distribution systems (7,29,39). Consumers need to be educated on
248 sound dietary practices including portion size estimation and control as well to make sure that as
249 their countries' economies grow they don't end up practicing the same eating behaviors currently
250 followed by their counterparts in developed countries. The major obesity and chronic diseases
251 epidemics affecting countries as diverse as Brazil, Mexico, India and China indeed represents the
252 results of a natural experiment as to what happens to dietary quality, excessive body weight and
253 chronic disease outcomes when disposable incomes rise in the context of poverty and an
254 overabundance of low cost highly processed unhealthy energy-dense food products and sugar
255 sweetened beverages in the food supply consumed as part of diets rich in refined starches and
256 added sugars (16-19,30).

257 *Sustainable dietary guidelines*

258 All governments should make a commitment to guide their agriculture, food and nutrition
259 policies through evidence-based dietary guidelines that are predominantly plant based
260 emphasizing variety and the consumption of sustainable animal protein sources including
261 properly managed wild or farmed fish in adequate amounts (29,40,41). Governments should
262 provide fiscal incentives for the development and consumption of a food supply consistent with
263 predominantly plant based dietary patterns that, among other things, include a rich diversity of
264 vegetables, fruits, legumes, nuts, seeds, and whole grains (29,40,41). This is in contrast with the
265 current overwhelming preponderance of processed meats, refined rice, wheat and corn based
266 products in the global food supplies that are often loaded with solid fats, added sugars, and/or
267 salt and leave behind a large carbon foot print (7,29,30).

268 *Nutrition policy*

269 Governments should consider removing subsidies and addressing food price policies that
270 foster the production and consumption of highly energy-dense diets of very low nutritional value
271 as well as sugar sweetened beverages at the expense of healthy nutrient-dense diets based on a
272 variety of fruits, vegetables, legumes, nuts, seeds, whole grains, and healthy animal protein
273 sources including fish (10,40). Governments should specifically consider effective tax policies
274 that provide disincentives for the consumption of sugar sweetened beverages (including sodas)
275 and junk food in general (42). Governments should issue and enforce food labeling legislation
276 (42) that leads to the development of clear, transparent, consumer-friendly labels that provide
277 information on the nutritional value, level of processing, and carbon footprint of foods and
278 beverages purchased at supermarkets or consumed at restaurants and other eating venues. Food
279 labels should also make a clear distinction between ‘best buy’ and ‘expiration’ dates to prevent
280 consumers from discarding products based on ‘best buy date’ which is an indicator of peak
281 “freshness” and not of spoilage of product. Governments should consider policies and programs
282 that optimize the nutrition of their populations throughout the life course including gestation,
283 infancy, early childhood and the adolescent period (43).

284 ***Maternal, Infant and Young Child Feeding***

285 The first 1000 days are the foundation of human development. Governments should
286 support policies that protect, promote, and support optimal maternal, infant and young child
287 feeding behaviors including food security for all pregnant and lactating women, exclusive
288 breastfeeding for six months followed by the introduction of healthy and nutritious
289 complementary foods at that age and continuation of breastfeeding until the child is at least two
290 years old (44). Breastfeeding in particular is considered to be central to sustainable development

291 globally (45) and needs to be better supported through improved policies that include protection
292 for employed women to implement the right they have to breastfeed their children (46).

293 ***Education: Planetary health 2.0***

294 Planetary health is defined as ‘the health of human civilization and the state of the natural
295 systems on which it depends’ (29). In all countries it is key to educate and engage consumers
296 through mass media and other means on the huge impact that choices from government,
297 consumers, farmers, and the restaurant and food processing industry have on the strongly
298 negative environmental impact that food production is currently having in the Earth’s eco-
299 systems threatening the ability of our planet to remain sustainable in the longer term. It is also
300 important to educate consumers on the fact that to a large extent we now know the causes of the
301 problem and that sound practical solutions have been identified. It is also important to increase
302 the awareness among policy makers of the immense threat that climate change poses for food
303 security and world stability globally (7,29).

304 ***Support the plight of refugees***

305 Current humanitarian emergencies largely due to man-made conflicts and disasters
306 (including climate change) have led to an unprecedented exodus of 65 million refugees who are
307 at very high risk of food insecurity (7,29). Governments should support policies that welcome
308 refugees and help me them gain access to education, a gainful employment and to a good quality
309 of life including access to adequate amounts of healthy and nutritious foods.

310 ***Modern information technology for monitoring food insecurity***

311 Support modern information management technology and communication systems with
312 strong potential to help generate SMART (Specific, Measurable, Achievable, Realistic, Time-
313 bound) indicators that are sensible and cost-effective and provide useful information to decision

314 makers to make timely decisions affecting different food security and food systems dimensions
315 from the local to the planetary level (34). Given the multiple dimension of the construct of food
316 security it is key to track all dimensions of food security and food systems including availability,
317 access, consumption and utilization, and supply stability using the suite of indicators endorsed by
318 FAO (47,48).

319 In conclusion, food insecurity is a major social and environmental disruptor with serious
320 repercussion for the health and future sustainability of our planet. Improved food security
321 governance based on sound, equitable and sustainable food systems that benefit from modern
322 information technologies is essential for all countries to be able to meet the United Nations
323 Sustainable Development Goals (49).

324

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Figure Legends

Figure 1. Food insecurity and the SDGs: From human to planetary health. Conceptual framework (references 7,8,10,11,20,28,29,30,38,41,42). FI, food insecurity; SDGs; United Nations Sustainable Development Goals.

Figure 2. Prevalence of food insecure and severely food insecure individuals across 20 low-income countries (LIC), 35 lower-middle-income countries (LMIC), 36 upper-middle-income countries (UMIC), and 43 high income countries (HIC). Food insecurity was measured with FAO's Food Insecurity Experience Scale. Figure developed for this commentary with data from Smith, Rabbitt & Coleman Jensen (5).

Table 1. The 2015-30 United Nations Sustainable Development Goals and their bidirectional relationships with food (in)security (FI)¹

	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 education 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 as families have more disposable income for food. Improving food security reduces 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	Socio-economic 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	Socio-economic inequities are the root cause of FI. FI likely to lead to less innovation and hence prevents sustainable innovation
10	Reduce inequality within and among countries	Socio-economic 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 risk of widespread FI. Consumers' sustainable food consumption reduces risk of unsustainable agriculture. FI 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 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 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, and halt and reverse land degradation and halt biodiversity loss	Sustainability of terrestrial ecosystems reduces 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 likely to strengthen global partnerships

From references 5, 7,8,11,14,15,20,24,28,29,30,34,41,48



