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Could measuring factors other than a lack of financial resources help in achieving the zero hunger goal

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The second Sustainable Development Goal of Zero Hunger, defined by the United Nations, broadly focuses on several dimensions of food access and availability, including measures of hunger and undernourishment, food insecurity, and malnutrition. Progress toward the Zero Hunger goal is monitored using indicators like the Prevalence of Undernourishment and the prevalence of moderate or severe food insecurity. These indicators are widely regarded as accurately portraying the underlying phenomena of concern. There are, however, other considerations one may want to include when considering the broader food system, including the role of food access and sovereignty in the rural areas of low-income countries. This paper reviews measurements of food insecurity and reflects on how food access and sovereignty may improve food security and, conversely, how it may impede advances toward alleviating food insecurity. These considerations can be helpful in tracking the need and progress toward the Sustainable Development Goal of Zero Hunger.

KEYWORDS

sustainable development goals, food insecurity experience scale, household food security survey module, food security, food sovereignty, food insecurity

1 Introduction

The 17 Sustainable Development Goals (SDGs) defined by the United Nations (UN) aim to promote global prosperity and partnership through specific calls to action (United Nations, 2022). “Zero Hunger” is the second SDG (SDG2) and aims to achieve food security and improve nutritional outcomes, as an estimated 2.4 billion people, nearly 30% of the population, experienced moderate or severe food insecurity in 2022 (FAO, 2023a). The Zero Hunger goal broadly focuses on several dimensions of food access and availability, including measures of hunger and undernourishment, food insecurity, and malnutrition. Specifically, Target 2.1 states,

“By 2030, end hunger and ensure access by all people, in particular, the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.”

Progress toward this target is primarily measured using two statistical indicators: (1) the Prevalence of Undernourishment (PoU), and (2) the prevalence of moderate or severe food insecurity.

The PoU indicator measures the proportion of a country's population that does not meet the energy intake threshold necessary to sustain a healthy and active life. The proportion of undernourished households in a country considers household survey data on food consumption and secondary country-level data on food availability (Naiken, 2002). PoU estimates are expressed as a percentage of households, generalizing the energy intake of entire countries. PoU has fallen from around 13% in the early 2000s to about 8% in 2019; however, PoU increased by 1% in 2020 due to the Covid-19 pandemic (Food and Agriculture Organization of the United Nations, 2023). The prevalence of moderate or severe food insecurity is measured using the Food Insecurity Experience Scale (FIES), created by the Food and Agriculture Organization of the UN. The FIES measures a household's ability to acquire adequate food given its financial or other resource constraints, calibrated to a global standard so that countries can be easily compared (Cafiero et al., 2018). An estimated 30% of the global population is classified as moderately or severely food insecure as of 2022, compared to about 22% in 2015 (FAO, 2023b).

The primary impediment to food security is the lack of financial resources needed to be food secure. These resources are not the sole determinant of food insecurity. For example, in the U.S., the majority of low-income households – who are often assumed not to have sufficient income to be food secure – are food secure (Rabbitt et al., 2023). Beyond income, other factors that contribute to food security include food prices (Rachidi and Gundersen, 2024) and disability status (Henly et al., 2023). Another contributing factor that often emerges, especially in low-income countries, is access to a diverse variety of foods. This lack of access to food – even when financial resources may be sufficient – can contribute to high levels of micronutrient deficiency due to the inability to consume a diverse diet (Bailey et al., 2015). This is especially a problem in certain regions like Sub-Saharan Africa, which still generally lack the availability of diverse nutrient-rich foods and struggle with malnutrition (Beal et al., 2017). Including indicators beyond “lack of money” may help when measuring national, community, or household/individual prevalence of hunger. For example, an understanding of barriers to accessing a sufficient and diverse diet, like infrastructural barriers, may provide valuable information when creating solutions to achieve the Zero Hunger goal.

In high-income countries, lack of access to food stores – so-called food deserts – has received much attention in the 1990s and early 2000s. The term “food desert” was developed by the Scottish Nutrition Task Force in 1995 to describe a geographic area lacking access to affordable and healthy food (Beaulac et al., 2009). In the U.S., attention toward food deserts at this time led to policy interventions such as the Healthy Food Financing Initiative in 2014, designed to help develop new food retailers in underserved communities. While food deserts have garnered attention from the public and policymakers, more recent research has shown that the direct linkage between food deserts and dietary inequality is low (Allcott et al., 2019; Zhen, 2021). However, a similar conceptual framework could be more effectively used to describe challenges faced in lower-income countries (LICs), particularly in rural areas, where a lack of efficient distribution or infrastructure may impede food access.

One concept that can either enhance or impede food access is food sovereignty. The concept was established by La Via Campesina, an international organization for farmers, and introduced globally in 1996 (Wittman, 2009). The Declaration of Nyéléni (2007) was drafted at the first Global Forum on Food Sovereignty and defined food sovereignty as “the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems”. The concept of food sovereignty has since gained political and economic consideration as a potential descriptive measure of the underlying social factors that contribute to a community's food security status. However, the measurement of food sovereignty remains vague, and specific interventions to develop small-scale food production may be ultimately counterproductive to providing communities with an affordable local food supply. Food sovereignty initiatives are, therefore, highly location-specific and must meet the unique needs of individual communities. Nevertheless, initiatives like Feed the Future (USAID, 2024) that provide resources to smallholder farmers seeking to improve food sovereignty within a community could effectively increase food security and resiliency when food access is an issue.

This paper adds to the literature by discussing the nuances associated with the various indicators used to measure food security, focusing on access and sovereignty. The quality of the methods used to examine a community's food environment is critical for policy formation and strategic action, so it is important to identify best practices, recognize the limitations of indicators and the measurements used, and adapt and revise methods and instruments as needed to provide accurate assessments. Knowledge gained from indicators not currently used by the UN could provide insight into the progress, or lack of progress, toward the goal of Zero Hunger. The following sections provide background on indicators used to measure food security, food access, and food sovereignty, including a discussion about how these intersect.

2 Food security

FAO defines food security as “a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO, 2006). When examining and measuring food security, four main dimensions are generally considered: (1) availability of food, (2) access to food, (3) utilization of food, and stability of the first three dimensions over time (Leroy et al., 2015). According to the FAO (2006), “for food security to be realized, all four dimensions must be fulfilled simultaneously.” Following an initiative from Voices of the Hungry, the FAO began administering an 8-question survey called the Food Insecurity Experience Scale (FIES) in 2014 to track global food insecurity rates. Each FIES question corresponds to a severity category, which places respondents on an experience-based scale for the different levels of food insecurity. FIES was intentionally designed to facilitate the ease of global comparison and monitor hunger across countries. It now serves as one of the primary measurements of progress toward the Zero Hunger goal.

Accurate food security measurement is also of interest to high-income countries. While the magnitude, severity, and associated

consequences are far less in the U.S. than in low-income countries, the determinants are similar in some dimensions. In addition, the U.S. invests heavily in alleviating food insecurity, with over \$183 billion spent on food assistance programs in the fiscal year 2022 (USDA, 2023a). To monitor the impact of that investment, the Household Food Security Survey Module (HFSS) was developed by the USDA in 1995 to measure food security in the U.S. The HFSS is administered annually as a supplement to the Current Population Survey facilitated by the U.S. Census Bureau and includes 10 questions, with an 8-question supplement for households that include children under the age of 17.

Table 1 displays the questions included in the FIES and HFSS, separated by category, and Supplementary Appendix Table 1 shows

the HFSS supplement for households with children. As the FIES was modeled after the HFSS, the instruments have strong similarities. Both surveys also ask respondents to recall issues with food insecurity during the previous 12 months, though a 30-day recall time has also been used. The unit of measurement for HFSS is households exclusively, while FIES can be adapted for either households or individuals.

The HFSS places respondents into severity categories based on the sum of affirmative responses on a scale from 1 to 10 (or 1 to 18 for households with children), which include “yes,” “often,” “sometimes,” “almost every month,” and “some months but not all months.” Table 2 shows the criteria and definitions for the four HFSS categories, which include high, marginal, low, and very low food security. Before 2006, the

TABLE 1 Food security survey questions, response options, and source.

Category	Question format	Response choices	Source
Types	Which of these statements best describes the food eaten in your household in the last 12 months?	Enough of the kinds of food I want to eat; Enough, but not always the kinds of food I want; Sometimes not enough to eat; Often not enough to eat; Do not know or Refused	USDA/ERS
Worried	During the last 12 months, was there a time when you were worried you would not have enough food to eat because of a lack of money or other resources? “We worried whether our food would run out before we got money to buy more.” Was that often, sometimes, or never true for you in the last 12 months?	Yes/No Often; Sometimes; Never true; Do not know or Refused	FAO USDA/ERS
Healthy	During the last 12 months, was there a time when you were unable to eat healthy and nutritious food because of lack of money or other resources? “We could not afford to eat balanced meals.” Was that often, sometimes, or never true for you in the last 12 months?	Y/N Often; Sometimes; Never true, Do not know or Refused	FAO USDA/ERS
Fewfoods	During the last 12 months, was there a time when you only ate a few kinds of foods because of lack of money or other resources?	Yes/No	FAO
Skipped	During the last 12 months, was there a time when you had to skip a meal because there was not enough money or other resources to get food? In the last 12 months, did you or other adults in the household ever cut the size of your meals or skip meals because there wasn't enough money for food? (If yes to previous question) How often did this happen?	Yes/No Yes/No Almost every month; Some months but not every month; Only 1 or 2 months; Do not know or Refused	FAO USDA/ERS
Ateless	During the last 12 months, was there a time when you ate less than you thought you should because of a lack of money or other resources? In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?	Yes/No Yes/No	FAO USDA/ERS
Ranout	During the last 12 months, was there a time when your household ran out of food because of a lack of money or other resources? “The food that we bought just did not last and we did not have money to get more.” Was that often, sometimes, or never true for you in the last 12 months?	Yes/No Often; Sometimes; Never true, Do not know or Refused	FAO USDA/ERS
Hungry	During the last 12 months, was there a time when you were hungry but did not eat because there was not enough money or other resources for food? In the last 12 months, were you ever hungry, but did not eat, because there wasn't enough money for food?	Yes/No Yes/No	FAO USDA/ERS
Wholeday	During the last 12 months, was there a time when you went without eating for a whole day because of a lack of money or other resources? In the last 12 months did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food? (If yes to previous question) How often did this happen?	Yes/No Yes/No Almost every month; Some months but not every month; Only 1 or 2 months; Do not know or Refused	FAO USDA/ERS
Weight	In the last 12 months, did you lose weight because there wasn't enough money for food?	Yes/No	USDA/ERS

TABLE 2 USDA food security distinctions.

	Definition	Number of affirmative responses (HFSS)
High food security	Households had no problems, or anxiety about, consistently accessing adequate food.	0 for both groups
Marginal food security	Households had problems at times, or anxiety about, accessing adequate food, but the quality, variety, and quantity of their food intake were not substantially reduced.	1–2 for both groups
Low food security	Households reduced the quality, variety, and desirability of their diets, but the quantity of food intake and normal eating patterns were not substantially disrupted.	3–5 if no children; 3–7 if one or more children
Very low food security	At times during the year, eating patterns of one or more household members were disrupted and food intake reduced because the household lacked money and other resources for food.	6–10 if no children; 8–18 if one or more children

Source: USDA.

four categories used hunger as a metric. An update in 2006 addressed the concern that hunger is technically a separate phenomenon from food insecurity involving a more subjective range of severity. As a result, “food insecurity with hunger” was replaced by “very low food security.”

The FIES also considers the sum of affirmative responses and is analyzed using the Rasch model as a theoretical base for respondents, an individual severity parameter along a continuous experience-based scale. Each question corresponds with a severity level if answered affirmatively, which places the individuals along a scale ranging from mild to severe food insecurity. These results are then used to calculate a population’s probability of being moderately or severely food insecure. To allow for international comparisons, FIES results are calibrated to a global standard, including a set of parameter values estimated from 140 countries between 2014 and 2016 (Cafiero et al., 2018). The prevalences of moderate and severe food insecurity are used to monitor the Zero Hunger Goal.

Despite the similarity between the FIES and HFSS, FAO and the USDA Economic Research Service (ERS) report slightly different food insecurity rates in the United States. As of 2021, the prevalence of food insecurity and very low food security estimated by ERS was 10.2%, while the prevalence of moderate or severe food insecurity estimated by FAO was 7.8% (UNSTAT, 2023; USDA, 2023b). This difference of 2.4 percentage points highlights inconsistencies between these scales, due to differences in sample construction and administration of the surveys. These differences could be significant to policymakers and those affected by food insecurity.

The focus of both surveys is analyzing the impact of a lack of sufficient income or financial resources to buy food. While it is unrealistic to include other dimensions of food access in this condensed, standardized survey, traditional food security measurement does not include any report of diet quality, food literacy, cooking skills, or social networks, which are all relevant to the four pillars of food security (Begley et al., 2019; Nosratabadi et al., 2020). In LICs, other studies have also found that access to household infrastructure like electricity, cooking fuels, and running water significantly associated with a greater likelihood of food security and a stable annual food supply (Frayne and McCordic, 2015).

It is also important to note that there are some contextual limitations to using aggregate food insecurity rates as an indicator to track global progress toward the Zero Hunger goal. For example, in the U.S., food insecurity rates have decreased overall since 2010, but the rate has increased for some particularly vulnerable groups, including American Indians, households with an individual with a disability, and very low-income households (Gundersen, 2023). The

same phenomenon has been observed in other countries where overall food insecurity rates fall, while the food insecurity rates for specific groups rise, remain the same, or do not fall at the same rate as the rest of the country (Smith et al., 2017). Given the inconsistencies in causes of food insecurity across populations, it may be beneficial to consider additional indicators and food access frameworks to evaluate progress toward the Zero Hunger goal, particularly in individual contexts where financial constraints do not fully summarize barriers to obtaining food.

3 Food availability

Food availability, one of the four dimensions necessary to achieve food security, refers to food supply and is “determined by production, net trade, and stock levels” (FAO, 2006). Table 3 reports the daily supply of calories available to the average person in each continent, highlighting the magnitude of the gap in regional food supplies, for example between North America and Africa. The amount of food available within a country depends on many factors, including the ability of countries to produce enough food and import food as needed. Accordingly, a comprehensive overview of a state’s policies toward agricultural production and agricultural trade is needed to understand the availability of food. Countries that impede agricultural production and/or impose trade restrictions on agricultural trade have less food available and higher prices than countries that encourage production and trade. Multiple targets of SDG2 acknowledge the importance of food production and trade, including Target 2.4 aiming to ensure sustainable and resilient production systems; Target 2.B aiming to intervene in trade distortions; and Target 2.C which encourages policy measures to protect the functioning of commodity markets and preventing food price volatility.

In high-income countries, national-level food availability issues are not as much of a concern, but there has been concern that local-level food availability may compound the food insecurity challenges faced by vulnerable households. While the national food supply may be adequate, it is possible that some populations may face challenges to accessing this supply due to economic and other constraints. This concern motivated a focus on food deserts, which are characterized by several quantitative indicators, including distance to food stores, individual-level resource access such as vehicle availability, and neighborhood-level resource access such as public transportation or income estimates (USDA, 2022). Definitions of food desert indicators identified by the USDA are shown in Table 4.

Multiple policies in the U.S. have aimed to eliminate urban and rural food deserts by assisting retailers to open new locations in the identified affected areas, primarily via the Healthy Food Financing Initiative. Though the development of new food retailers has decreased the number of census tracts defined by “low access” criteria, declines in income levels have kept the number of Americans residing in food deserts essentially the same despite the level of investment in these policies (Karpyn et al., 2020). Rural communities also face different challenges than urban food desert residents, as the growth in dollar store locations has outpaced supermarkets, and the quality of products offered at these retailers may lead to increased diet-related health issues over time (Feng et al., 2023).

Given the attention on food deserts in the U.S., multiple studies have examined their impact on various health and nutrition outcomes.

Many studies have been conducted to examine the connection between food deserts and poor nutritional outcomes, but these studies ultimately lack any statistically significant causal interpretations, especially in urban areas (Zhen, 2021). While there is some evidence that physical distance from food retailers could have an impact on nutrition outcomes in high-income countries (Gregory and Coleman-Jensen, 2013; Jewell et al., 2019), other analyses have contradicted the common sentiment that supermarket distances are associated with lower consumption of fruits and vegetables, highlighting that supply factors and individual preferences and demand may be more impactful (Rodier et al., 2017; Allcott et al., 2019; Silva et al., 2023). It is difficult to ascertain the impact of food availability on nutritional outcomes, even in high-income countries, because a firm understanding of how to measure lack of access is not well-established and there is disagreement about the quality of available measurements (Ver Ploeg et al., 2015).

While physical distance from food retailers has little to no impact on nutrition outcomes in high-income countries, there is extensive evidence that food prices in low-income countries do have a significant impact on food insecurity (Rosen and Shapouri, 2008; Choudhury et al., 2020). Exploring the use of food availability metrics that account for multifactorial contributors to availability, rather than simple distance metrics used by food desert models, may be helpful in assessing and monitoring progress toward SDG2. Particularly if exploring factors associated with lack of access in low-income countries provides insight into barriers (e.g., infrastructural)

TABLE 3 Daily per capita calorie supply (2021).

Continent	Calories per day
Africa	2,573
Asia	2,931
Europe	3,458
North America	3,878
Oceania	3,086
South America	3,108

Source: FAO.

TABLE 4 Food access indicators.

Category	Criteria
General tract characteristics	Population, low income, poverty rate, urban/rural status, median income, housing units
Low-income and low-access distance measures	The tract’s poverty rate is 20 percent or greater; or The tract’s median family income is less than or equal to 80 percent of the State-wide median family income; or The tract is in a metropolitan area and has a median family income less than or equal to 80 percent of the metropolitan area’s median family income.
Low-access and distance measures	Low-income census tracts where a significant number (at least 500 people) or share (at least 33 percent) of the population is greater than one-half mile from the nearest supermarket, supercenter, or large grocery store for an urban area or greater than 10 miles for a rural area. Using this measure, an estimated 53.6 million people, or 17.4 percent of the U.S. population, live in tracts that are low-income and low access and are more than one-half mile or 10 miles from the nearest supermarket. Low-income census tracts where a significant number (at least 500 people) or share (at least 33 percent) of the population is greater than 1 mile from the nearest supermarket, supercenter, or large grocery store for an urban area or greater than 10 miles for a rural area. This measure shows that an estimated 18.8 million people, or 6.1 percent of the U.S. population, live in low-income and low access tracts and are more than 1 mile or 10 miles from a supermarket. Low-income census tracts where a significant number (at least 500 people) or share (at least 33 percent) of the population is greater than 1 mile from the nearest supermarket, supercenter, or large grocery store for an urban area or greater than 20 miles for a rural area. Under this measure, an estimated 17.1 million people, or 5.6 percent of the U.S. population, live in low-income and low access tracts and are more than 1 mile or 20 miles from a supermarket.
Vehicle availability	A tract is identified as having low-vehicle availability if more than 100 households in the tract report having no vehicle available and are more than one-half mile from the nearest supermarket.
Group quarters	A tract in which at least 67 percent of the population live in group quarters such as dormitories, military bases, assisted living or skilled nursing facilities, and other large institutions.
Low-income and low-access measures	Number of low-income individuals living more than 1 mile (urban areas) or more than 10 miles (rural areas) from the nearest supermarket, supercenter, or large grocery store in a tract. Low income is defined as annual family income at or below 200 percent of the Federal poverty threshold for family size.
Low-access and population subgroups	Number of individuals who are age 0–17 living more than one-half mile from the nearest supermarket, supercenter, or large grocery store.

hindering food security. For example, there is evidence that market accessibility road networks have a positive association with household security in LICs (Ahmed et al., 2017; Namubiru et al., 2022). Target 2A of SDG2 includes investment in rural infrastructure, including road networks linking producers and consumers to markets. However, expanding infrastructure does not guarantee improved nutritional outcomes. Even with expanded access to markets, some populations have reported persistent micronutrient deficiencies after infrastructure expansion, as accessible foods were relatively nutrient-poor, despite having access to a greater food supply overall (Grocke and McKay, 2018).

4 Food sovereignty

Food sovereignty refers to the opportunity for local democratic control of food systems, ensuring resilient and culturally appropriate food access in historically marginalized or underserved communities. Coined by La Via Campesina (1996), the pillars of food sovereignty prioritize (1) the right to sufficient, healthy, and culturally appropriate food, (2) the value of all those in the production process (food providers), (3) localization of food systems, including increased connections between producers and consumers, (4) control of providers over their land, seeds, and water and rejects the privatization of natural resources, (5) the sharing of local knowledge and skills and traditional ecological knowledge, (6) and producing and harvesting food in a way that improves food system resilience to climate change and maximizes ecosystem contribution.

While the SDGs do not explicitly use the terminology of food sovereignty, the FAO definition of food security includes meeting the “dietary needs and food preferences for an active and healthy life” for all people. The reference to food preferences could be linked to the framework of food sovereignty, where individuals have access to foods that meet their cultural preferences and the necessary resources to grow those foods themselves if desired. Despite the periodic adaptation of the definition of food security, food preferences are not considered in traditional food security measurement. There are aspects of SDG Target 2.3 that can be framed in food sovereignty terms, for example:

“By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.”

The focus on smallholder producers, notably the mention of indigenous peoples, and ensuring access to the resources needed to produce food if desired closely relates to the concept of food sovereignty. In high-income countries, food sovereignty is often discussed in the context of indigenous populations, with consideration for historical injustices regarding colonization of native agricultural lands, high food prices, challenges to access, and a lack of culturally appropriate foods included in nutrition assistance programs (Grey and Patel, 2015; First Nations Development Institute, 2018; Mucioki et al., 2018; Sowerwine et al., 2019). The emphasis on increasing productivity among these producers in Target 2.3 is consistent with an attempt to improve food security, as a recent systematic review concluded that

addressing inequities in land access and promoting equity have a positive influence on food security outcomes (Sampson et al., 2021).

In high-income countries (HICs), there is no connection between food sovereignty and food availability insofar as food access is excellent in HICs. In some limited instances, though, food sovereignty and food availability challenges can often be related. As an example, consider areas with low food access due to transportation constraints preventing the distribution of imported foods. In these areas, local food production plays a critical role and efforts to increase agricultural productivity should be pursued. This is part of a broader set of efforts to increase agricultural productivity in LICs.

Building effective policy interventions to improve food security requires an understanding of the specific needs and challenges faced by the population of interest. Food sovereignty can be a useful framework to inform policy efforts, though it is unlikely for any singular policy to fully address an entire community’s food access barriers. Brazil’s Fome Zero (Zero Hunger) policy beginning in 2001 is an example of a comprehensive program tailored to the specific needs of a country. This program involves a combination of federal and local actions aiming to address hunger and poverty by increasing access to food, raising income, supporting family farming, and expanding social security (Berchin et al., 2019). Several pieces of this program can be related to food sovereignty, though they are not specified this way. The focus on providing financial, technical, and infrastructural assistance to family farms, especially those with low incomes, is designed to ensure an economically sustainable system of domestic food production, aligns with the definition of food sovereignty.

Other locally implemented policies associated with Fome Zero share these goals, such as the school meal program, which aims to increase the caloric and nutritional contribution of school meals by facilitating the procurement of fresh produce from local farmers (FAO, 2006). Fome Zero also identifies groups as priorities for emergency actions, which largely includes indigenous populations. The food baskets provided as emergency interventions for Indigenous households were intentionally adapted to ethnic traditions (FAO, 2006). As food sovereignty principles emphasize the importance of the cultural appropriateness of a community’s food supply, this is another example of how Brazil’s food policies can be viewed through a food sovereignty framework.

However, like food availability, food sovereignty is a difficult concept to measure. The First Nations Development Institute created a question scale designed for measuring food sovereignty called the Food Sovereignty Assessment tool in 2004. The questionnaire includes several categories of questions intended to build a comprehensive community profile of available resources (First Nations Development Institute, 2014). A summary of the question categories and the included criteria is shown in Supplementary Appendix Table 2. Though this questionnaire has been used to evaluate and describe the food sovereignty of a community, it currently lacks the potential for statistical analysis. There is currently no documentation of how to use the Food Sovereignty Assessment tool for quantitative analysis, which raises challenges for evaluating policy efforts targeting food sovereignty and comparing the degree of food sovereignty experienced across different communities with varying cultural, political, and geographic contexts. In spite of its use in Indigenous community interventions, there is a lack of use of the Food Sovereignty Assessment tool in research projects. It is possible that evaluating the progress toward

UN SDGs could benefit from this type of community-based participatory tool, but further research is needed to validate the usefulness of these assessments (Abdul et al., 2024). Other emerging frameworks for measuring food sovereignty have involved national-level indicators such as a population's food policies, resource availability, and production models (Binimelis et al., 2014; Ruiz-Almeida and Rivera-Ferre, 2019; Jernigan et al., 2023). While these questionnaires and indicators currently lack a standardized empirical component, they can still be useful in evaluating the effectiveness of a population's food system and identifying the most urgent challenges.

While some countries may use food sovereignty as a framework to advocate for more self-sufficiency in food production, environmental and geographic constraints can make self-sufficiency an unrealistic target (Agarwal, 2014). It is important to note that the role of food sovereignty is context-specific because some efforts to promote food sovereignty could raise the price of food and thereby increase food insecurity. Often, the global food system provides products at the lowest price possible, and it is possible that government interference, including the promotion of food sovereignty, could raise food prices. For example, one of the reasons given for the recent ban on genetically engineered corn in Mexico is to bolster domestic production of corn; however, it is estimated that this policy will result in a 25% increase in corn prices and a 6% increase in other agricultural products (Beckman et al., 2024). In addition to higher prices, it is estimated that the ban in Mexico will require 3.3 million additional hectares of corn to be planted to replace the imports lost (Beckman et al., 2024). Thus, in some instances, food sovereignty can divert scarce resources, like land area, that could be used toward other resources to alleviate food insecurity.

Food sovereignty can be framed as a means to achieving long-term food security, which involves different institutional contexts and scales based on the challenges faced by individual populations (Leventon and Laudan, 2017; Noll and Murdock, 2020; Byaruhanga and Isgren, 2023). In this sense, food sovereignty can be used as a framework for smaller-scale food system transformations that uniquely contribute to achieving food security in low-income countries. However, a great deal of caution must be used when promoting food sovereignty, and the nuances associated with context-specific situations must be considered.

5 Conclusion

Reliable measurement methods are essential when tracking the progress of hunger initiatives such as the UN Sustainable Development Goal of Zero Hunger by 2030, which is why food security currently serves as the most widespread and statistically standardized measurement. Ultimately, the price of healthy food at existing retailers remains one of the most significant obstacles in lower-income countries, given that earners may still select more energy-dense, less nutritious options due to affordability even when healthier substitutes exist, which furthers the connection between poverty and chronic disease (Drewnowski, 2009; Lee et al., 2011). However, as solutions to food insecurity may be as varied and unique as the factors that contribute to the progress toward the Zero Hunger goal may benefit from supplementation of other indicators that describe the unique food environments of certain countries or individual populations.

Attention toward food availability and food sovereignty measures can provide important context for populations that face additional social and economic challenges associated with higher rates of food insecurity. However, alternative indicators of food access remain more ambiguous in practice because the levels are not clearly defined and, therefore, also lack the ability to make statistical comparisons between populations. Therefore, improving, supplemental instruments like the Food Sovereignty Assessment tool may be helpful when analyzing the food environment of vulnerable populations globally or even within high-income countries to get a more complete picture of the factors contributing to Food Insecurity in specific areas including the structural challenges underlying food security, such as political instability or environmental degradation. By acknowledging the multifaceted and intersecting nature of food availability, food sovereignty, and food security, policymakers can better tailor interventions to meet the diverse needs of communities worldwide, ultimately advancing progress toward the goal of Zero Hunger by 2030.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2024.1412401/full#supplementary-material>

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