

Reshaping the Agrifood Sector for Healthier Diets

Exploring the Links between Agrifood Public Support and Diet Quality

Knowledge Note



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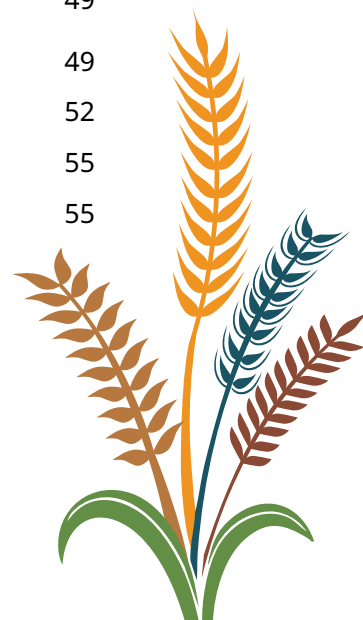
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Table of Contents

Acknowledgments	vii
Abbreviations and Acronyms	viii
Executive Summary	x
1 Failing to Tackle Malnutrition	1
1.1. The growing triple burden of malnutrition	1
1.2. The high costs of malnutrition	6
1.3. Poor diets are a crucial part of malnutrition	9
References	17
2 An Opportunity to Leverage Agrifood Public Support	27
2.1. The problem with current agrifood support	27
2.2. An opportunity to repurpose agrifood support	36
Notes	44
References	45
3 Global-Level Analysis: Agrifood Support and Food Consumption	49
3.1. Existing research on agrifood support and food consumption	49
3.2. Different types of agrifood public support	52
3.3. Different types of food commodities	55
3.4. Methodology: Cross-country estimations	55



3.5. Results: Support to the agrifood sector	56
3.6. Results: Support to specific agrifood commodities	59
Notes	68
References	68
4 Country-Level Cases: Comparing Different Interventions	71
4.1. Input subsidies, roads, and cash transfers in Bangladesh	71
4.2. Input subsidies, irrigation, and cash transfers in Malawi	81
Data and methods	83
Notes	92
References	93
5 Future Directions	99
Appendix A: OECD Database on Agrifood Support	101
Appendix B: Global Dietary Database on Food Consumption	105
Appendix C: Cross-Country Regression Estimations	107

Tables

Table 3.1	Top Producers and Consumers of Grains	60
Table 3.2	Top Producers and Consumers of Meats	63
Table 3.3	Top Producers and Consumers of Sugar	65
Table 4.1	Basic Descriptive Statistics of Selected Variables	73
Table 4.2	Basic Descriptive Statistics of Different Food Security Variables	74
Table 4.3	Average Value of Different Food Security Variables for the Beneficiaries and Nonbeneficiaries of the OAA Social Security Program	75
Table 4.4	Average Impact (Treatment Effect) of Social Protection Program on the Food Security of Households	76
Table 4.5	Average of Food Security Variables by the Presence of Improved Roads	77
Table 4.6	Average Impact (Treatment Effect) of Improved Rural Infrastructure on the Food Security of Households	78
Table 4.7	Average of Food Security Variables by Input Subsidy Card Status	79
Table 4.8	Average Impact (Treatment Effect) of Input Subsidy on the Food Security of Households	80
Table 4.9	Food and Nutrition Variables and Program Participation	84
Table 4.10	Pairwise Correlation of Program Participation	85

Table 4.11	Mean Differences in Food and Nutrition Security Measures by Program	86
Table 4.12	Descriptive Statistics for Pooled Sample	86
Table 4.13	Effects of Interventions on Household Dietary Diversity	87
Table 4.14	Effects of Interventions on Food Consumption Score	88
Table 4.15	Effects of Interventions on Coping with Food Insecurity	89
Table B.1	List of Countries in the Analysis (<i>N</i> = 44)	106
Table C.1	Specifications on the Choice of Support Variables	107
Table C.2	Descriptive Statistics: Overall Support Variables	108
Table C.3	Descriptive Statistics: Grain Consumption and Single Commodity Support Variables	109
Table C.4	Descriptive Statistics: Meat Consumption and Single Commodity Support Variables	110
Table C.5	Descriptive Statistics: Sugar Consumption and Single Commodity Support Variables	111
Table C.6	Regression: Grain Consumption and Overall Support	112
Table C.7	Regression: Grain Consumption and Single Commodity Support	113
Table C.8	Regression: Meat Consumption and Overall Support	114
Table C.9	Regression: Meat Consumption and Single Commodity Support	115
Table C.10	Regression: Sugar Consumption and Overall Support	116
Table C.11	Regression: Sugar Consumption and Single Commodity Support	117

Figures

Figure 1.1	Trends in the Prevalence of Stunting, Wasting, and Overweight in Children under Five	2
Figure 1.2	Global Trends in Adult BMI	4
Figure 1.3	Regional Trends in Obesity	5
Figure 1.4	Diet-Related NCDs	5
Figure 1.5	Composition of Cause of Death, WHO Regions and Global, 2000-2048	6
Figure 1.6	Hidden Costs of Food and Land Uses	7
Figure 1.7	Global Food Intake (grams/day per adult) and Global Dietary Recommendations, 2018	10
Figure 1.8	Global and Regional Mean Absolute Differences in Alternative Healthy Eating Index (AHEI) Component Scores in Adults between 1990 and 2018	11
Figure 1.9	Drivers of Undernutrition	13
Figure 1.10	Ultra-Processed Foods and Adverse Health Outcomes	14
Figure B1.2.1	Pathways by Which Sugar Impacts Health	15
Figure 2.1	Public Support to Agrifood Sector, by Type of Support	28
Figure B2.1.1	Change in Productivity Due to Use of Nitrogen Fertilizer	29
Figure 2.2	Food Groups Based on Per Capita Consumption Relative to Dietary Guidelines	30

Figure 2.3	Agrifood Support by Food Commodity.....	31
Figure B2.2.1	Differences between Recommended and Current Intake, by Food Group in Africa.....	33
Figure 2.4	Sugar Consumption, Taxes on SSBs, and Support to Sugar Producers.....	34
Figure 2.5	Greenhouse Gas Emissions of Food Commodities across the Supply Chain (per kg of food product), 2018.....	37
Figure 2.6	Repurposing Simulations at the Global Level: Potential Win-Win Scenarios.....	39
Figure 3.1	Composition of Agrifood Public Support.....	53
Figure 3.2	PSE vs CSE, 2020–22.....	58
Figure 3.3	MPS, Non-MPS, GSSE, and CSE, 1986–2022.....	58
Figure 3.4	Composition of Support to Grains, and PSCT and CSCT by Country, 2020–22.....	61
Figure 3.5	Grains: Daily Intake, MPS, and non-MPS, 1990–2018.....	62
Figure 3.6	Composition of Support to Meats and PSCT and CSCT by Country, 2020–22.....	64
Figure 3.7	Meats: Daily Intake, MPS, and non-MPS, 1990–2018.....	65
Figure 3.8	Composition of Support to Sugar, and PSCT and CSCT by Country, 2020–22.....	66
Figure 3.9	Sugar: Daily intake, MPS, and non-MPS, 1990–2020.....	67

Maps

Map B1.3.1	Geographical Density of the Number of Dietary Surveys in the GDD 2017 by Country (A), including publicly available surveys (B), and non-public surveys submitted by data owners (C) GGD, Global Dietary Database.....	16
Map B2.3.1	Taxes on SSBs, as of August 2023.....	35
Map 3.1	Total Support and PSE across Countries.....	57

Boxes

Box 1.1	Negative Externality Costs of the Food System.....	7
Box 1.2	Guidelines on the Consumption of Sugar, Sodium, Fats, and Alcohol.....	15
Box 2.1	A Closer Look at Fertilizer Use.....	29
Box 2.2	Differences between Recommended Intake and Current Intake, by Food Groups in Africa.....	33
Box 2.3	Global Implementation of Sugar-Sweetened Beverage Taxes.....	34
Box 2.4	Lessons in Transitioning Farmers away from Tobacco Farming.....	41
Box 3.1	Trade Policy and Obesity.....	49
Box 3.2	Indicator Definitions for Public Support Variables.....	53
Box A.1	Producer Support Estimate Categories and Subcategories.....	101

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Abbreviations and Acronyms

1M5R	One Must Five Reductions
AHEI	Alternative Healthy Eating Index
AIP	Affordable Inputs Program (Malawi)
AMR	anti-microbial resistance
ASF	animal source foods
ATT	Average Treatment Effect on the Treated
AWD	alternate wetting and drying
BDT	Bangladeshi taka (currency)
BIHS	Bangladesh Integrated Household Survey
BMI	body mass index
BOT	budgetary and other transfers
BTs	budgetary transfers
CNPC	Consumer Nominal Protection Coefficient
CO₂eq	carbon dioxide equivalent
CRD	chronic respiratory disease
CSCT	Consumer Single Commodity Transfers
CSE	Consumer Support Estimate
CVD	cardiovascular disease
DALYs	disability-adjusted life years
EFC	excess feed costs
FAO	Food and Agriculture Organization of the United Nations
FBDGs	food-based dietary guidelines
FCS	Food Consumption Score
FIES	Food Insecurity Experience Scale
FISP	Farm Input Subsidy Program (Malawi)
FOLU	Food and Land Use Coalition
GDD	Global Dietary Database
GDP	gross domestic product
GFR	gross farm receipts
GHG	greenhouse gas
GIFT	FAO/WHO Global Individual Food Consumption Data Tool
GLOPAN	Global Panel on Agriculture and Food Systems for Nutrition
GMM	generalized method of moments
GSS	General Services Support
GSSE	General Services Support Estimate
HDDS	household dietary diversity score
HFCS	high-fructose corn syrup

HIV	human immunodeficiency virus
IAT	inclusive agriculture transformation
IDB	Inter-American Development Bank
IDD	iodine-deficiency disorders
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IV Poisson	instrumental variable Poisson
LMICs	low- and middle-income countries
LSMS	Living Standards and Measurement Studies
LV	price levies
MK	Malawian kwacha (currency)
MPS	Market Price Support
MVAC	Malawi Vulnerability Assessment Committee
NAFTA	North American Free Trade Agreement
NCDs	noncommunicable diseases
NRA	nominal rate of assistance
NPP	net primary productivity
OECD	Organisation for Economic Co-operation and Development
OOA	Old Age Allowance (Bangladesh)
OR	odds ratio
PPP	purchasing power parity
PSCT	Producer Single Commodity Transfers
PSE	Producer Support Estimate
PSM	propensity score matching
SCTP	Social Cash Transfer Program (Malawi)
SDD	Sustainable Development Goals
SOFI	State of Food Security and Nutrition in the World
SSB	sugar-sweetened beverages
TCT	Transfers to Consumers from Taxpayers
TSE	Total Support Estimate
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
VAD	vitamin A deficiency
WASH	water sanitation and hygiene
WFP	World Food Programme
WHO	World Health Organization
WRA	women of reproductive age

All dollar amounts are US dollars unless otherwise indicated.

Executive Summary

The world is off track in meeting Sustainable Development Goal 2 (SDG2)— progress in curbing the various forms of malnutrition has slowed. Undernutrition in children, including stunting and wasting, has multifaceted causes. The health and economic consequences of undernutrition are also complex and can have intergenerational consequences that result in undernutrition and poverty in future generations. In recent years, the decline in undernutrition has plateaued. Most children under five affected by stunting and wasting live in Asia (52 percent and 70 percent, respectively) or Africa (43 percent and 27 percent, respectively). Globally, the prevalence of stunting and wasting in children under five has decreased from 33.0 and 8.7 percent in 2000 to 22.3 and 6.8 percent in 2022. This decrease is inadequate to meet the 2030 SDG2 target of halving the number of children affected by stunting; only about one-third of all countries are expected to meet this goal. The prevalence of underweight in adolescent girls (ages 10 to 19 years) has remained the same, at 8 percent, since 2000. In 1990, underweight was more prevalent than obesity, when 14.5 percent of females and 13.7 percent of males were underweight. This prevalence has steadily declined over the past three decades. In 2022, 7.0 percent of females and 6.2 percent of males were underweight. Underweight and thinness among adults are associated with increased morbidity and mortality from infectious diseases and lower work productivity and wages. In pregnant women, a low body mass index is associated with intrauterine growth restriction and stunting and wasting in early childhood.

Women and children continue to be the most vulnerable to micronutrient deficiencies. Women of reproductive age (WRA) are at a high risk of undernutrition, including underweight and thinness in pregnant women. This undernutrition can result in adverse birth outcomes. Children and WRA are at a higher risk of micronutrient

deficiencies, including those of iron, vitamin A, and iodine. Across all age groups, females have nearly twice the prevalence of anemia (31.2 percent) as males. Pregnant women and children under five are at a higher risk of vitamin A deficiency. During pregnancy, iodine-deficiency disorders can result in stillbirth, spontaneous abortions, and congenital abnormalities such as cretinism.

The prevalence of overweight and obesity is steadily increasing among children and adults. Overweight and obesity are a main risk factor for many noncommunicable diseases (NCDs). The increase in NCDs has significant economic effects because of their high health care costs and associated loss of income. Once considered a high-income country problem, overweight and obesity are on the rise in low- and middle-income countries (LMICs). Obesity has negative health and economic consequences throughout the lifespan. The largest proportion of children affected by overweight live in Asia (48 percent) or Africa (28 percent). It is projected that, by 2030, 18 percent of all adults will be living with obesity. Dietary factors account for 6 of the top 11 risk factors for NCDs.

Failing to tackle malnutrition poses huge costs to society. These health costs are the largest hidden costs that come from our food systems. The global food industry accounts for more than 10 percent of global gross domestic product (GDP), with an estimated market value of \$10 trillion. However, the current food system has significant hidden health, environmental, and economic costs that exceed its market value by an estimated \$2 trillion. The hidden health costs, which include obesity and undernutrition, are the highest among these costs. The cost that the food systems impose on health is \$6.6 trillion dollars; on the environment it is \$3.1 trillion; and on the global economy it is \$2.1 trillion. Globally, stunting is estimated to result in an annual per capita income penalty of 5 percent. The global cost of overweight and obesity was estimated to be \$1.96 trillion in 2020.

Unhealthy diets are a core driver of this malnutrition problem. On average, diets are currently poor. People are overconsuming sugar, red meat, and processed meat while underconsuming whole grains, fruits, and vegetables. Improvements in diets have been slow, in part because of the rise of the consumption of less healthy food such as sugar, red meat, and processed meat. Poor diet quality and high food prices drive malnutrition—including undernutrition, stunting, wasting, micronutrient deficiencies, overweight, obesity, and the resulting rise in NCDs such as diabetes, hypertension, cardiovascular disease, kidney disease, cancer, osteoarthritis, depression, asthma, and Alzheimer’s disease. In many LMICs, consumption of animal sourced foods (ASFs) is limited and those who need their nutritional benefits (for example, high-quality proteins and bioavailable micronutrients) the most (that is, WRA and children) have the least access. This contrasts with many people in high-income countries, where ASFs are over-consumed thereby increasing the risk of NCDs. A country’s unique situation needs to be taken into account when making recommendations about ASF consumption. Such recommendations can include adjusting prices to include environmental costs and public awareness campaigns in high-income countries as well as making ASFs more affordable in LMICs by increasing farm productivity, improving market efficiency, and raising household incomes.

Food system shifts have precipitated a major dietary transition toward increasingly ultra-processed foods and away from more traditional dietary patterns. These changes have occurred over the past half-century, first in high-income countries and then in LMICs such as countries in Sub-Saharan Africa, South and East Asia, and Latin America. Ultra-processed foods are high in added sugar, sodium, and saturated fats, with sugar-sweetened beverages (SSBs) being the primary source of added sugar consumed in most countries. Food system shifts in tandem with increased consumption of ultra-processed foods have worsened diets globally, especially in LMICs; these shifts are associated with

numerous adverse health outcomes, including cardiometabolic and mental disorders as well as mortality. In response to the increasing burden of diet-related diseases, the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) have created dietary guidelines—also known as food-based dietary guidelines—that set recommendations for which foods to limit and which to consume in greater quantities. These guidelines recommend eliminating or significantly limiting the consumption of free sugar, sodium (salt), trans fats, and alcohol. In addition to limitations, they recommend increasing the intake of healthy foods such as fruits, vegetables, legumes, seeds and nuts, and whole grains. These guidelines serve as crucial goalposts of what does and does not constitute a healthy diet.

Public support to the agrifood sector is large, distortionary, and inefficient. Globally, support to the agrifood sector comes to \$854 billion per year. Most of this support is focused on producers and comes largely in the form of trade and market policies that distort prices. Out of the total support to agrifood, 74 percent was targeted toward producers; most of these measures are market distortive. Over 50 percent of producer support is in the form of trade and market policies, which impact the market prices of agrifood commodities, or Market Price Support (MPS). Smaller shares of support are allocated to General Services Support (GSS, 12 percent). These are investments in private or public services—such as institutions and infrastructure. And even smaller shares are also allocated to consumer subsidies (13 percent)—which can improve the consumption of nutritious food if targeted effectively. Support is also often regressive, benefiting wealthier farmers, who use more inputs and produce more output. Notably, farmer subsidies are leading to excessive use of fertilizers, particularly in East Asia and the Pacific and in South Asia.

Public support to the agrifood sector is not geared toward promoting healthier diets, making it potentially misaligned with public health policies. Public support to the

agrifood sector is focused much more on food commodities that are already high in consumption such as grains and meats, and much less on underconsumed, healthier food commodities such as fruits, vegetables, and dairy products. Between 2020 and 2022, in terms of the dollar value of support, the most supported commodities were maize, rice, pork, poultry meat, and beef and veal. In terms of the share of this support to gross farm receipts, the most supported commodities were sugar, with around 24 percent of farmers' incomes from sugar deriving from public support, followed by maize, rice, and poultry meat and beef and veal. For this reason, the current set of agrifood policies is probably not aligned with policies in other sectors, such as in public health. For example, some countries tax the consumption of SSBs while at the same time they provide significant support to domestic sugar production. In several of these countries with seemingly inconsistent policies around sugar consumption and production, levels of sugar consumption exceed the WHO recommendations.

However, the scale and the composition of agrifood public support varies largely across regions and across countries. In Africa, for example, support to the agrifood sector is generally low and support to this sector would require simultaneously increasing and rebalancing support. In 2015, countries in Sub-Saharan Africa provided only \$680 million in agriculture subsidies. This number is extremely low, considering that agriculture constitutes 23 percent of GDP in Sub-Saharan Africa and employs 60 percent of people in the region. Some countries in Sub-Saharan Africa allocate only 6 percent of their expenditure to food and agriculture, which is well below the African Union's target of 10 percent. Many countries in Sub-Saharan Africa prioritize inputs (for example, fertilizers), allocating 88 percent of the total agriculture support to inputs.

Recent simulation analyses show that there are windows of opportunity to repurpose public support to the agrifood sector for healthier diets and better nutrition, while supporting poverty alleviation and emissions

reductions. Because agrifood support is biased toward less healthy and nutritious commodities, it potentially fuels the high costs of malnutrition. There is an imperative to rethink and repurpose agrifood support in a way that better promotes healthy diets. While there are often tradeoffs to repurposing, global simulation exercises have demonstrated that there are some windows of opportunity for multiple wins across different outcomes—such as climate, nutrition, and poverty alleviation. In a World Bank–International Food Policy Research Institute (IFPRI) report, one simulation scenario from 2020 to 2040 shows that redirecting public support toward research and development and other technological investments could lead to a 1.6 percent increase in real national income, a 1 percent reduction in extreme poverty, an 18 percent reduction in the cost of healthy diet, a 16 percent increase in crop production, an 11 percent increase in livestock, and a 41 percent reduction in emissions from agriculture and land use. In the 2022 State of Food Security and Nutrition in the World (SOFI) Report, one simulation scenario from 2017 to 2030 shows that repurposing agrifood support (fiscal subsidies) from producers to consumers and for healthier foods can reduce extreme poverty by 0.06 percent globally (and by 0.22 percent among low-income countries), reduce greenhouse gas emissions by 0.18 percent, and decrease the cost of a healthy diet by 3.34 percent globally.

But repurposing agrifood support requires a set of complementary interventions across various sectors, including agrifood systems, health systems, social protection, and the environment. It also requires a careful consideration of the political economy in terms of what is feasible and how to overcome political economy constraints. Moreover, assessing options for repurposing requires leveraging better data and techniques to assess the links between agrifood policy and support, food consumption, and healthy diets; it will require a rich set of country-level deep dives that investigate policy reform simulations and their impacts on health and environmental outcomes.

This Knowledge Note presents two sets of analytical work to further our understanding of the links between public support in the agrifood sector and healthy diets. While the analytical work here is mostly suggestive, it paves the way for more in-depth research to unpack the relationship of agrifood support with healthy diets. The first set of analytics uses cross-country estimations to assess the potential correlation of agrifood public support with healthy diets for an average country. The second set of analytics uses within-country estimations to assess the correlation of agrifood public support with healthy diets in the context of a particular country. The overall principles that underpin these analyses are: (1) that not all types of agrifood public support are the same, (2) that not all types of food commodities are the same, (3) that the impacts of a given type of support can vary depending on the type of food commodity, and (4) that the impacts of various policy options on healthy diets will vary across countries. These analytics help to foster more dialogue and a deeper exploration of the links between agrifood support and healthy diets.

The cross-country analysis finds that GSS (that is, public goods) increases the consumption of food commodities, while distortionary MPS reduces consumption, particularly for more easily traded and less perishable commodities such as grains and sugar.

The global cross-country analysis makes use of a database that merges detailed agrifood public support data with consumption of various commodities across years and countries. The data are being made publicly available to encourage further research.¹ The analysis explores the correlation of the levels of different types of agrifood support with the consumption of different types of food commodities. Building on the global simulation work on repurposing, this work unpacks some key assumptions of how repurposing public support could impact healthy diets by estimating the actual correlations between public support and

food consumption. The level of total non-market price support (non-MPS) has been growing quickly over time, while growth in total GSS has been slow. In contrast, it is precisely GSS that is found to increase overall productivity and translate into increased consumption of all food commodities. There were no clear impacts of total non-MPS and MPS on consumption. But across all types of non-commodity-specific support, the impact of GSS is found to be positive on the consumption of all commodities assessed. A 10 percent increase in GSS leads to a 0.14 percent increase in consumption of grains, a 0.22 percent increase in the consumption of meats, and a 0.35 percent increase in the consumption of sugars. Looking at commodity-specific support, an increase in commodity-specific MPS is seen to decrease the consumption of grains and sugar, which are often more easily traded than perishable meat products, for example. A 10 percent increase in grain-specific MPS reduces consumption of grains by 0.35 percent and a 10 percent increase in sugar-specific MPS reduces consumption of sugar by 0.60 percent. These distortionary commodity-specific MPS measures increase domestic prices and reduce consumption. Thus, policies to remove commodity-specific MPS must be accompanied by complementary measures to curb consumption of less healthy and already-overconsumed commodities.

Two within-country case studies look at the impacts of various public interventions on healthy diets, one in Bangladesh and one in Malawi. For both countries, the work compares the impacts of input subsidies, rural agriculture infrastructure, and social protection programs. The cross-country analysis indicates that while there are correlations between MPS policies and consumption, there were no clear correlations between agrifood subsidies and consumption, on average. This could suggest that country context varies significantly and that the impact of various policy and intervention options are largely country-specific. The goal of these case studies is to look at the country-level impacts of various types of agrifood sector support (that is, input subsidies, irrigation, infrastructure, and social protection) on measures of food security and healthy diets.

¹ The data are available here: https://datacatalog.worldbank.org/search/dataset/0066597/agrifood_public_support_and_food_consumption.

In the case of Bangladesh, contrary to the impact of social protection programs and farmer input subsidies, there is a positive impact of rural infrastructure development on various measures of healthy diets. Looking into the impact of the social protection program as proxied by the country's Old Age Allowance program, there are no significant impacts of the program on the food consumption score, dietary diversity score, the food insecurity experience scale, or the household hunger scale. Previous literature confirms that the impact depends on the size of the benefits as well as the duration of the support. The benefits of the Old Age Allowance program are very small, and they might fall short of diversifying the food basket of the beneficiary households. The impact of input subsidies on food security and nutrition is also insignificant, consistent with other studies. Although the input subsidy helps farmers increase production, the size of the benefits as well as their duration might be inadequate to improve food security. In contrast, households having access to improved roads have a significantly higher per capita food expenditure and diversified food basket than those having no access to such roads. In this analysis, direct transfer programs, such as social protection and input subsidies, are less effective than indirect support programs such as rural infrastructure development. There are important efforts to rethink the effectiveness of fertilizer subsidies in Bangladesh, including piloting an e-voucher system with support from the World Bank.

In the case of Malawi, farmer input subsidies and food and cash transfers have different impacts on food and nutrition security, while access to irrigation schemes does not have an impact on diets. *Input subsidies*, which typically support maize production, reduce the likelihood of undertaking negative coping strategies, but do not improve diet diversity or the food consumption score. Households that receive input subsidies undertake negative coping strategies for food insecurity between 13 and 16 percent less on average. This implies that food availability through own-food production makes it less likely for households to use negative coping mechanisms.

On the other hand, subsidies are mainly used for growing maize, which increases monotony rather than diversity of production. In other words, the input subsidy program increases the quantity and not the quality of food. In contrast, *food and cash transfers* increase the likelihood of undertaking negative coping strategies, but they lead to improved diet diversity and a higher food consumption score. Households that receive food and cash transfers undertake negative coping strategies for food insecurity between 22 and 26 percent more on average, which could be a manifestation of the characteristics of the beneficiaries who are often poorer. However, receiving food and cash transfers increases household dietary diversity by at least two food groups and raises the food consumption score above acceptable levels of food security. This implies that food and cash transfers support market purchases and consumption of a wider variety of foods, but it does not support the quantity of food consumption. Cash transfers can be used to purchase food and non-food items, in contrast to input subsidies, which are only used to produce food crops. Finally, in the Malawi case study, *irrigation infrastructure* does not impact food and nutrition security, potentially because of its low coverage and capacity. But other studies suggest positive effects of improved irrigation. Large-scale irrigation investments, such as the Shire Valley Transformation Project, could transform food systems as well as enhance food and nutrition security and household resilience in Malawi.

Looking at the various interventions together in Malawi, there are no positive impacts of a *combination* of input subsidies, food and cash transfers, and irrigation infrastructure. Nevertheless, households receiving food and cash transfers alone showed improvements in food consumption and dietary diversity scores; and households receiving input subsidies alone helped reduce negative coping strategies with food insecurity, but an over-reliance on agriculture input subsidies leads to reduced variety in consumption. The findings suggest that the current standalone implementation strategy may

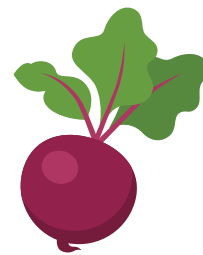
not offer opportunities to build synergies between investments in irrigation infrastructure and social assistance. A coordinated strategy across these programs may be necessary to support both food quantity and food quality. Like in Bangladesh, the World Bank is supporting efforts to rethink input subsidies in Malawi, by promoting efficient usage of fertilizer subsidies and incentivizing diversification of crop production.

It is important that we continue to build on this knowledge agenda to demonstrate the value of repurposing agrifood public policies and support for healthy diets. Cross-country analysis globally or regionally can shed light on trade policy for healthy diets. Moreover, a deeper dive into political economy analysis can elucidate lessons from successful cases. Within-country analyses can include better articulations of the hidden health and nutrition costs of food systems and the impact of various policy options to mitigate these costs. Similarly, within-country analyses can also assess the climate and nutrition tradeoffs and win-wins across various policy options.

This Note is organized as follows. Chapter 1 establishes that the costs of malnutrition are high, that progress toward curbing malnutrition has slowed, and that the promotion of healthy diets is a cornerstone to tackling malnutrition. Chapter 2 demonstrates that current public support to the agrifood sector does not promote healthy diets, and that there are windows of opportunity to repurpose public support to the agrifood sector in a way that better supports diets. Chapter 3 presents the cross-country analytical work, while chapter 4 presents the case studies for Bangladesh and Malawi. Chapter 5 provides some future directions. Appendix A defines the terms of the Organisation for Economic Co-operation and Development (OECD)'s database on agrifood support with examples, appendix B provides information on the Global Dietary Database (GDD) on Food Consumption, and appendix C provides cross-country regression estimations.







1 Failing to Tackle Malnutrition

1.1. The growing triple burden of malnutrition

Undernutrition in children, including stunting and wasting, have multifaceted causes. Its health and economic consequences can have intergenerational significance, resulting in undernutrition and poverty in future generations. In recent years, the decline in undernutrition has plateaued.

The lifelong consequences of stunting in childhood increase the risk of stunting in the next generation, contributing to intergenerational cycles of poverty and malnutrition. *Stunting*, a measure of chronic undernutrition for children, has serious short- and long-term consequences. It can begin in utero due to poor maternal nutrition and/or recurrent infections and can continue through childhood (Christian, Afful-Dadzie, and Marquis 2023; de Onis and Branca 2016). Stunting can occur concurrently with wasting and overweight/obesity (Steyn and Nel 2022; Thurstans et al. 2022). In childhood, stunting is associated with increased morbidity and mortality from infection. In school-age children, stunting is associated with lower educational attainment (including both lower grades and fewer years of educational attainment) (Hoddinott et al. 2013; Martorell et al. 2010). In adulthood, stunting during childhood is associated with economic losses through a loss of physical growth potential, cognitive impairments, and a higher risk of chronic diseases (Hoddinott et al. 2013; Huxley, Shiell, and Law 2000; Whincup et al. 2008).

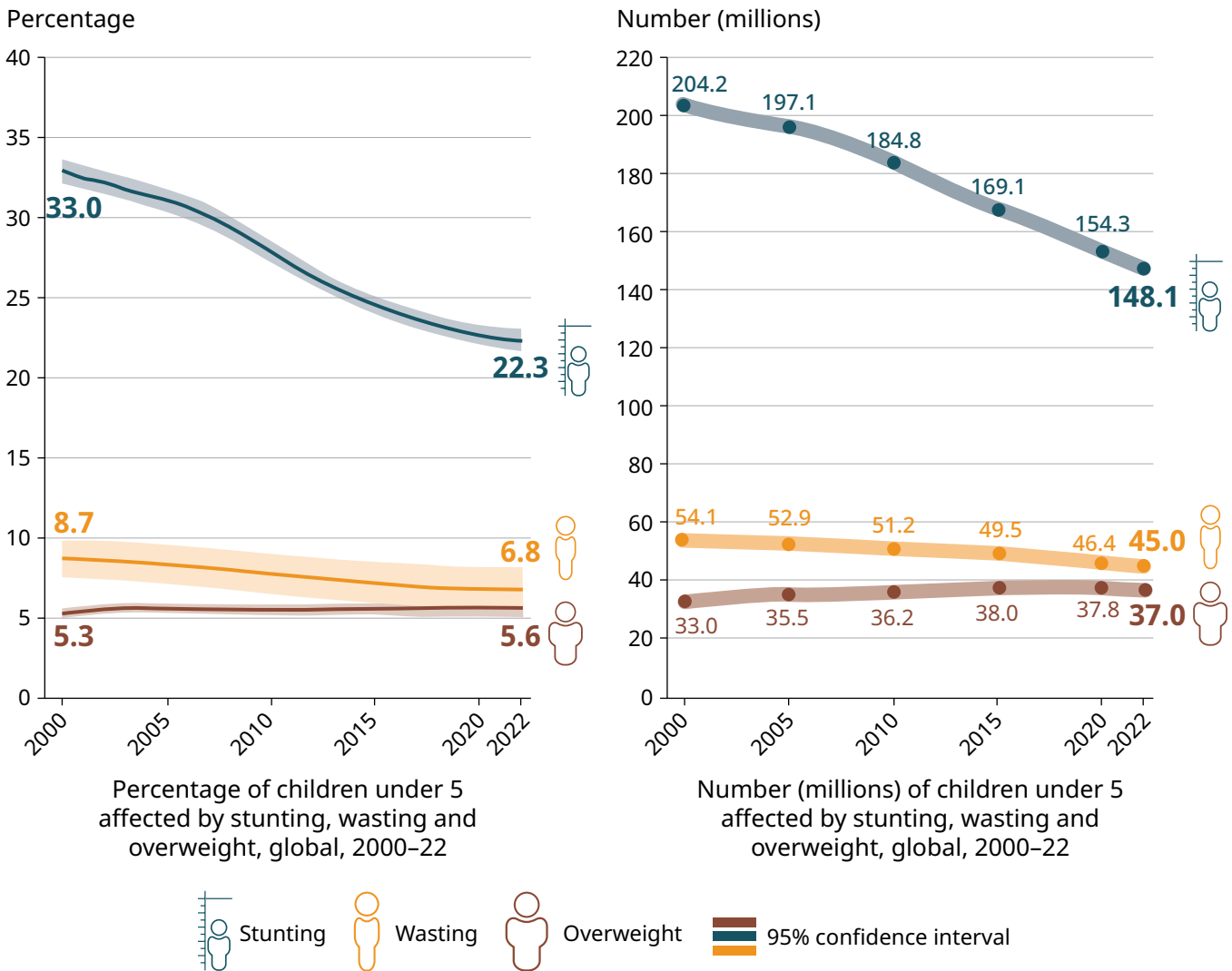
Most children under five affected by stunting live in Asia (52 percent) and Africa (43 percent). Globally,

the prevalence of stunting in children under five has decreased from 33.0 percent (204.2 million cases) in 2000 to 22.3 percent (148.1 million cases) in 2022 (figure 1.1). This decrease is inadequate to meet the 2030 Sustainable Development Goal (SDG) target of halving the number of children affected by stunting; only about one-third of all countries are expected to meet this goal. In Asia, the prevalence of stunting decreased from 28.2 percent (106.8 million) in 2012 to 21.3 percent (76.6 million) in 2022. In Africa, while the prevalence of stunting has decreased, the total number of children affected by stunting has increased from 61.3 million (34.4 percent) in 2012 to 63.1 million (30.0 percent) in 2022 (UNICEF/WHO/World Bank Group 2023).

Wasting causes developmental delays, disease, and death (UNICEF 2021). Wasting is characterized by low weight-for-height as a measure of acute malnutrition. Children affected by wasting have weakened immune systems, increasing their risk of infection and worsening their nutritional status (UNICEF/WHO/World Bank Group 2023). Over time, wasting can lead to stunting if acute malnutrition persists (Thurstans et al. 2022).

The majority of children affected by wasting live in Asia (70 percent) and Africa (27 percent). Globally, the prevalence of wasting has decreased from 8.7 percent (54.1 million cases) in 2000 to 6.8 percent (45.0 million cases) in 2022 (figure 1.1). The prevalence of wasting is highest in Southern Asia, where 14.3 percent of children are affected. Five countries—India, South Sudan, Sri Lanka, Sudan, and Yemen—had a prevalence of wasting that exceeded 15.0 percent (UNICEF/WHO/World Bank Group 2023)

Figure 1.1 Trends in the Prevalence of Stunting, Wasting, and Overweight in Children under Five



Source: UNICEF/WHO/World Bank Group 2023.

Women and children are the most vulnerable. Women of reproductive age are at high risk of undernutrition, including underweight and thinness in pregnant women, and undernutrition can result in adverse birth outcomes. Children and women of reproductive age are at a higher risk of micronutrient deficiencies, including those of iron, vitamin A, and iodine.

The prevalence of underweight in adolescent girls (ages 10 to 19 years) has remained the same, at 8 percent, since 2000 (UNICEF 2023). In 1990,

underweight was more prevalent than obesity (NCD-RisC 2024), when 14.5 percent of females and 13.7 percent of males were underweight. The prevalence has steadily declined over the past three decades. In 2022, 7.0 percent of females and 6.2 percent of males were underweight (NCD-RisC 2023; NCD-RisC 2024). Underweight and thinness among adults are associated with increased morbidity and mortality from infectious diseases and lower work productivity and wages. In pregnant women, a low body mass index (BMI) is associated with intrauterine growth restriction and stunting and wasting in early childhood (UNICEF 2023).

Short height is associated with a higher risk of adverse birth outcomes, including preterm birth and small-for-gestational-age infants (Kozuki et al. 2015; Özaltın, Hill, and Subramanian 2010; Victora et al. 2021). Short height is an indicator of intergenerational chronic undernutrition. It is both a cause and consequence of childhood stunting. In 2020, in South Asia, 69 percent of adolescent girls and women were shorter than 155 centimeters, 35 percent were shorter than 150 centimeters, and 11 percent were shorter than 145 centimeters (UNICEF 2023).

Across all age groups, females have nearly twice the prevalence of anemia (31.2 percent) as males (GBD 2021 Anaemia Collaborators 2023). Since 1990, the global prevalence of anemia has decreased by only about 4 percent (24.3 percent in 2021) and in children under five, the prevalence of anemia was highest in Africa (60.2 percent) (WHO GHO 2024a). Inadequate dietary iron intake is a leading cause of anemia (WHO 2023a). Children and women of reproductive age are at higher risk of anemia. Anemia has been associated with increased morbidity and mortality across the life course (Chaparro and Suchdev 2019), during pregnancy with poor birth outcomes (Haider et al. 2013), during childhood with impaired cognitive and behavioral development (Walker et al. 2007), and during adulthood with decreased work productivity and lower income (Haas and Brownlie IV 2001).

Pregnant women and children under five are at a higher risk of vitamin A deficiency (VAD). VAD can cause vision problems and is associated with a higher risk of infectious diseases, including measles, diarrhea, respiratory diseases, and death. In 2019, the global prevalence of VAD was 6.8 percent; among children one through four years old, the prevalence was more than twice that (16.0 percent) (Hess et al. 2022), with the

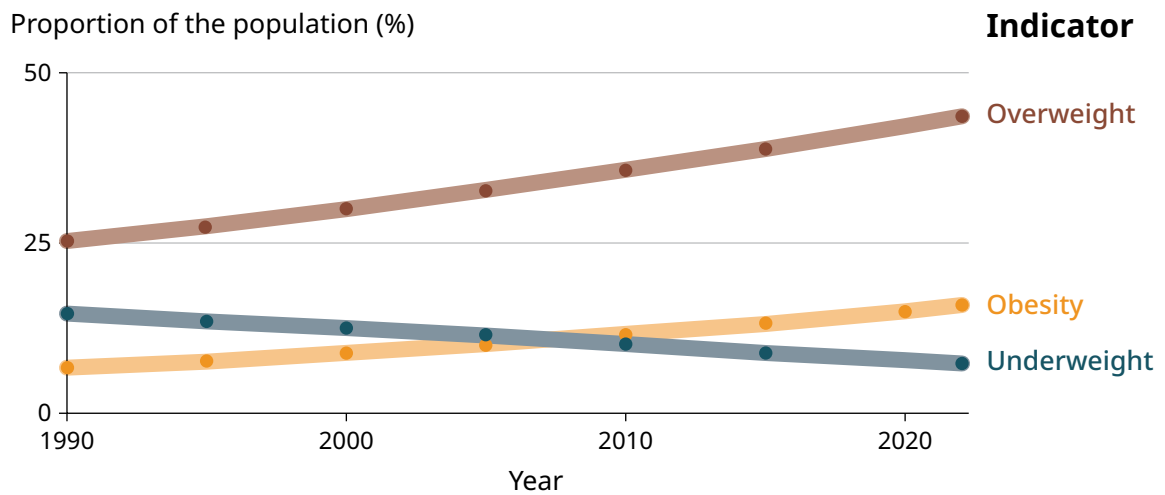
highest prevalence in South Asia and Sub-Saharan Africa.

During pregnancy, iodine-deficiency disorders (IDD) can result in stillbirth, spontaneous abortions, and congenital abnormalities such as cretinism. During infancy, childhood, and adolescence, IDD can impair skeletal and central nervous system development and can lead to hypothyroidism or hyperthyroidism (Zimmermann and Andersson 2021). Since 2003, the number of countries with adequate iodine intake has nearly doubled, reaching 118 in 2020. However, 21 countries remained iodine deficient, including Burkina Faso, Burundi, Cambodia, Finland, Germany, Haiti, Israel, Iraq, the Republic of Korea, Lebanon, Madagascar, Mali, Mozambique, Nicaragua, Norway, the Russian Federation, Samoa, South Sudan, Tajikistan, Vanuatu, and Viet Nam (Zimmermann and Andersson 2021).

The prevalence of overweight and obesity has continued to increase in children and adults. Overweight and obesity are a main risk factor for many noncommunicable diseases. The increase in noncommunicable diseases has significant economic effects as a result of the associated high health care costs and loss of income.

Once considered a high-income country problem, overweight and obesity are on the rise in low- and middle-income countries (figure 1.2). It is one of the few indicators of malnutrition that has increased over the past 20 years. Overweight and obesity occur when there is an imbalance of energy intake and energy requirements. In most cases, it is a multifactorial disease due to psychosocial factors, genetics, and obesogenic environments (WHO 2024a), which promote high energy intake and sedentary behavior (WHO 2016).

Figure 1.2 Global Trends in Adult BMI



Source: Original figure for this publication based on data from WHO GHO 2024b.

Note: BMI = body mass index.

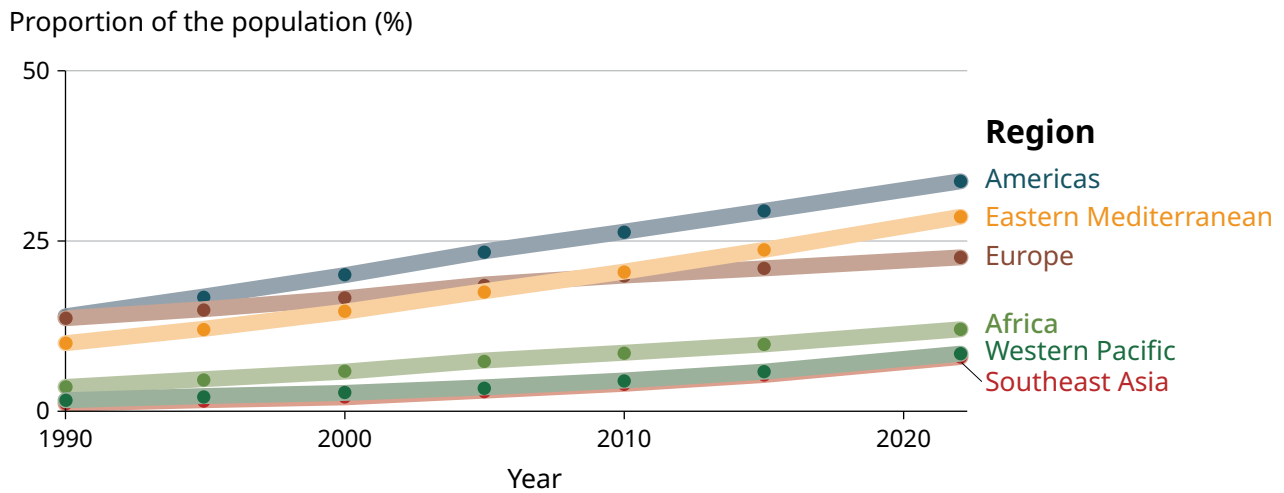
Obesity has negative health and economic consequences throughout the lifespan. During childhood and adolescence, overweight and obesity are associated with a greater risk and earlier onset of several NCDs, including type 2 diabetes and cardiovascular diseases along with adverse psychosocial consequences, which affect school performance and quality of life. Children with obesity are most likely to continue to live with obesity in adulthood (WHO 2024a), which further increases the risk of NCDs, including cardiovascular diseases, diabetes, cancers, neurological disorders, chronic respiratory diseases, and digestive disorders (GBD 2019 Risk Factors Collaborators 2020). It also has significant economic impacts through higher health care costs and decreased income (Okunogbe et al. 2022).

The largest proportion of children affected by overweight live in Asia (48 percent) and Africa (28 percent). In children and adolescents, overweight rose from 8 percent in 1990 to 20 percent in 2022 and from 25.2 percent to 42.8 percent among adults during the same time. Among adults who are living with overweight, the highest percentage

live in the Americas (66.9 percent) and the lowest in Southeast Asia (30.2 percent) and Africa (30.7 percent). Low- and middle-income countries are catching up to the high prevalence of overweight in high-income countries, but its prevalence is still rising in high-income countries. In high-income, upper-middle-income, lower-middle-income, and low-income countries the prevalence of overweight increased from 1990 to 2022 by 42.4 percent to 56.2 percent, 23.6 percent to 45.9 percent, 13.7 percent to 35.4 percent, and 10.5 percent to 26.4 percent, respectively (WHO GHO 2024b).

It is projected that, by 2030, 18 percent of all adults will be living with obesity (Lobstein et al. 2023). Globally, the prevalence of obesity in adults more than doubled from 6.6 percent in 1990 to 15.8 percent in 2022 (WHO GHO 2024b). The bulk of this growth occurred in high-income countries (16.9 percent in 2000 to 25.9 percent in 2022); however, obesity prevalence increased in low- and middle-income countries too, ranging from 3.6 percent in 2000 to 15.8 percent in 2022 (figure 1.3), with the Americas seeing the largest increase—from 12.9 percent to 33.8 percent (WHO GHO 2024b).

Figure 1.3 Regional Trends in Obesity

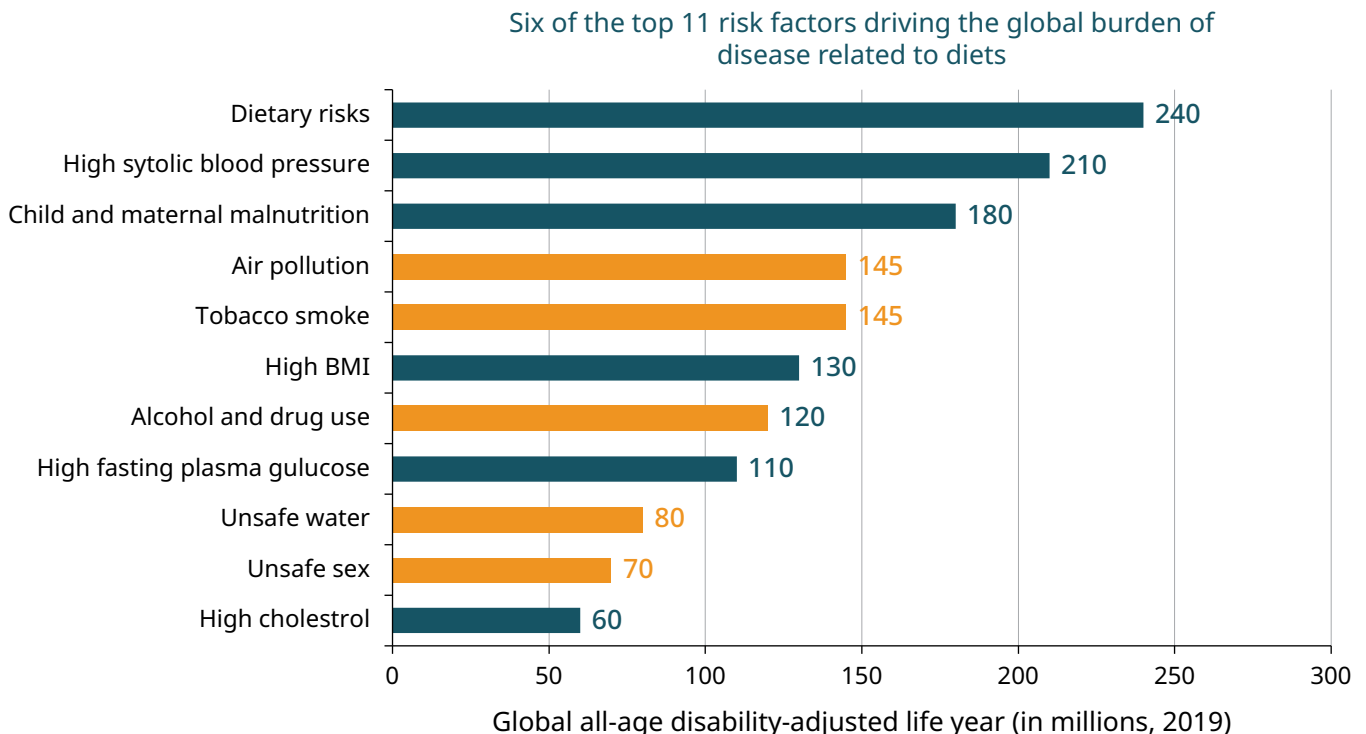


Source: Original figure for this publication based on data from WHO GHO 2024b and World Obesity Federation 2023.

Dietary factors account for 6 of the top 11 risk factors for NCDs (figure 1.4) (WHO 2023c). The major diet-related risk factors for NCDs are alcohol consumption, obesity, hypertension, child and maternal malnutrition, high cholesterol, and high fasting plasma glucose. NCDs caused 74 percent of global deaths in 2019, an increase from 61 percent

in 2000. Four NCDs—cardiovascular disease (CVD), cancer, chronic respiratory disease (CRD), and diabetes—killed about 33.3 million people in 2019, a 28 percent increase from 2000 (WHO 2023c). It is expected that NCDs will account for 86 percent of global deaths by 2048 (figure 1.5).

Figure 1.4 Diet-Related NCDs

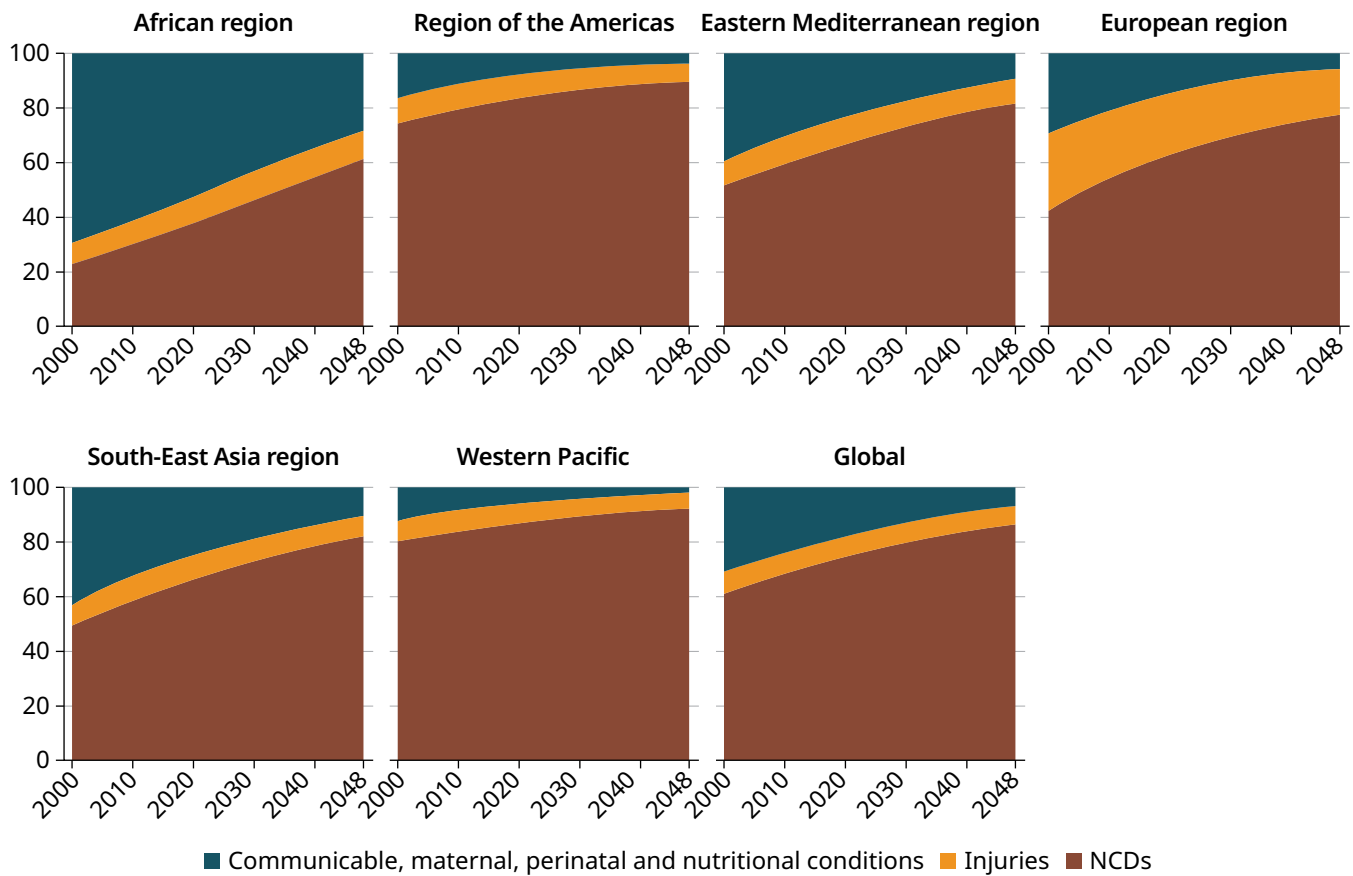


Source: IHME 2019.

Note: NCDs = noncommunicable diseases.

Figure 1.5 Composition of Cause of Death, WHO Regions and Global, 2000-2048

Percentage (%)



Source: WHO 2023c.

Note: NCDs = noncommunicable diseases.

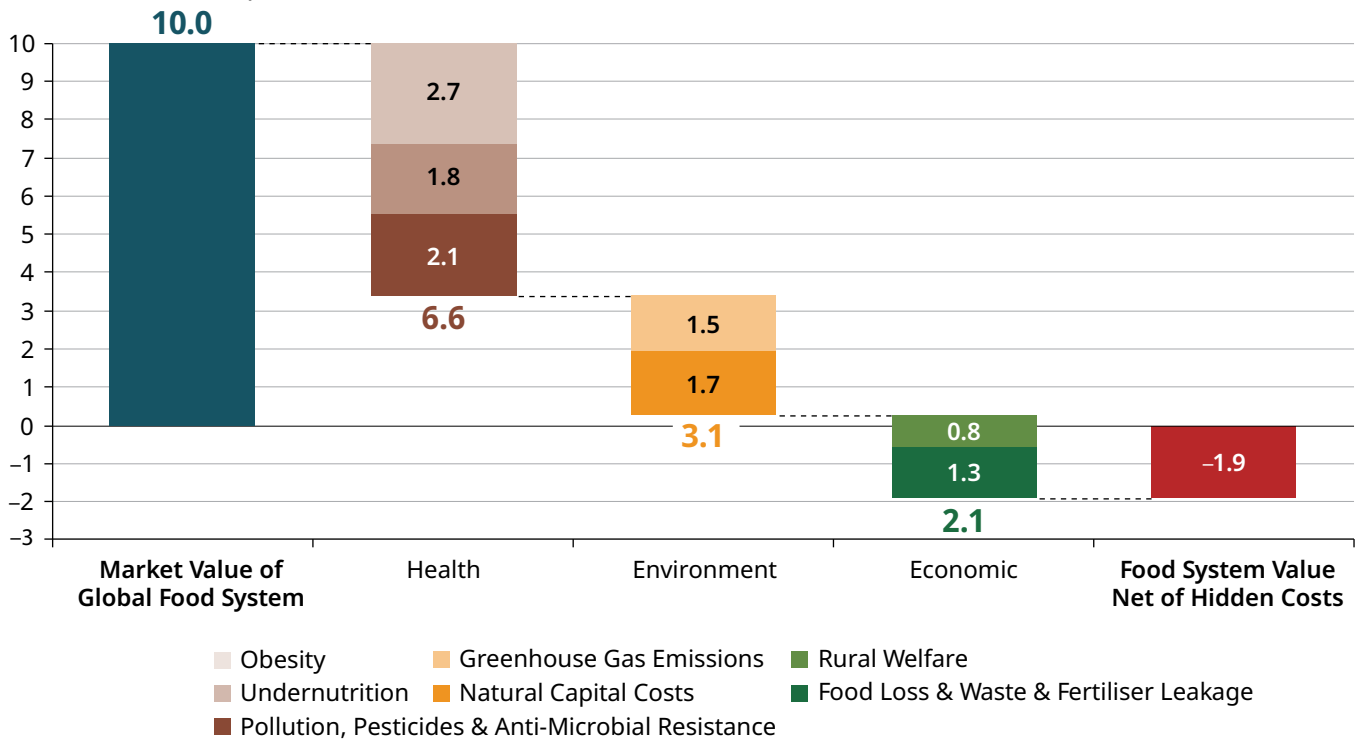
1.2. The high costs of malnutrition

The hidden costs of food systems exceed its market value by an estimated \$2 trillion in negative externalities; hidden health costs are the highest of these. The global food industry accounts for more than 10 percent of global gross domestic product (GDP), with an estimated market value of \$10 trillion. However, the current food system has significant negative externalities of \$12 trillion—such as hidden health, environmental, and economic costs—exceeding its market value. The highest cost is to health at \$6.6 trillion dollars, then to the environment at \$3.1 trillion, and economic costs at \$2.1 trillion (FOLU 2019a;

see figure 1.6). Human capital losses have been quantified through the Human Capital Index which is a measure of both the expected education and health of a child born today (World Bank 2018). The index has three components: (1) survival (under-five mortality rate), (2) expected years of school, and (3) health (the rate of stunting of children under age five and the adult survival rate, defined as the proportion of fifteen-year-olds who will survive until age sixty). Those most affected by the hidden costs to health live in Asia and Sub-Saharan Africa (Burgess et al. 2019; FOLU 2019a). Negative externalities for the hidden health costs of the food system can be quantified for malnutrition, including undernutrition, overweight, and obesity (see box 1.1).

Figure 1.6 Hidden Costs of Food and Land Uses

Trillions USD, 2018 prices



Source: FOLU 2019a.

Note: FOLU = Food and Land Use Coalition.

Box 1.1 Negative Externality Costs of the Food System

The hidden health costs for the food system were estimated by multiplying the gross domestic product (GDP) per capita by relevant disability-adjusted life years (DALYs). The GDP per capita, purchasing power parity (2018 international \$), was the average output per capita for different regions of the world in 2018 international dollars. DALYs are the sum of years of life lost due to premature mortality and the years lived with a disability. For obesity, DALYs related to high body mass index (BMI) risk factors were included. Undernutrition included DALYs related to child growth failure, including child stunting, wasting, and underweight. Air pollution included DALYs related to ambient particulate matter and

ozone pollution and caused by pollution from household solid cooking fuels. The cost of air pollution also considered the total global greenhouse gas (GHG) emissions from food and land use systems and the proportion of solid cooking fuels from biomass. Pesticide exposure included DALYs per kilogram of insecticide, herbicide, fungicide, and bactericide multiplied by the metric tons of annual pesticides applied. Anti-microbial resistance (AMR) did not use GDP per capita. Instead, this was estimated by multiplying the percentage of AMR related to food systems by the total annual GDP loss attributed to AMR associated with human immunodeficiency virus (HIV), tuberculosis, malaria, E. coli, S. aureus, and K.

pneumoniae. It is likely that this methodology missed additional hidden costs that the food and land use system have on health.

The costs of the food and land use system were estimated through GHG and natural capital costs, including land degradation, water scarcity, biodiversity loss, and overexploitation of land. The cost of GHG emissions was estimated using the total annual GHG emissions from food and land use systems, the production of nitrogen fertilizer, the GHG emissions from the production of nitrogen fertilizer, and the marginal abatement costs for GHG emissions. The cost of land degradation was estimated using the total area of degraded land, the annual value of crop production per hectare of cropland, the annual value of livestock production per hectare of grassland, the economic value of soil ecosystem services per hectare, and the percent loss of soil biodiversity from land degradation. Water scarcity was estimated by the total annual freshwater withdrawals for agriculture, the scarcity cost of water, and the percent of freshwater withdrawal for agriculture that

Source: FOLU 2019b.

are unsustainable or at risk of becoming unsustainable. Biodiversity loss was estimated using the economic value of ecosystem services from tropical forests and mangroves and the annual rate of deforestation and mangrove loss caused by agriculture and aquaculture. The cost of overexploitation was estimated using the value of crop production reliant on pollinator services, the yield reduction from the loss of pollinators, and the economic cost of overfishing beyond the maximum sustainable yield.

The hidden economic costs include rural welfare, food loss and waste, and fertilizer leakage. The costs from rural welfare were estimated using the respective region's poverty line, the average rural poverty gap, and the total population living below the poverty line. Food loss and waste were estimated using the share of the total food production that is lost or wasted and the annual value of agricultural production. Fertilizer leakage was estimated using the average leakage rate, total annual application, and global average price nutrients for nitrate and phosphate fertilizers.

Malnutrition—including undernutrition, overweight, and obesity—has huge negative externality costs through high health care costs and loss of income. These costs are incurred throughout the lifespan and have national consequences beyond the individual.

Globally, stunting is estimated to result in an annual per capita income penalty of 5 percent. The highest impact was in South Asia, which was estimated to have a 9 percent decrease in per capita income. Sub-Saharan Africa was estimated to have a 6 percent decrease in per capita income. North America had the lowest decrease in per capita income at 2 percent. The estimates

considered the loss of income due to education, height, and cognition as a result of stunting in childhood (Galasso and Wagstaff 2019). Additional economic impacts due to health care costs throughout the lifespan have not been estimated. (Note: The hidden costs of stunting have been estimated quite differently than the estimates of the hidden costs of negative externalities from the food system.)

The global cost of overweight and obesity in 2020 is estimated to be \$1.96 trillion. This is expected to rise to \$4.32 trillion in 2035 (Lobstein et al. 2023; Okunogbe et al. 2022). Obesity has significant health and economic costs.

Overweight and obesity are significant risk factors of NCDs, which increase health care costs. In addition to increasing mortality, obesity reduces productivity, increases disabilities, increases health care costs, results in early retirement, and reduces the length of disability-free healthy living across the life cycle, which impacts human capital outcomes (Shekar and Popkin 2020). The estimated health care cost of obesity includes the cost of 38 disease conditions that are associated with a high BMI (GBD 2016 Risk Factors Collaborators 2017; Lobstein et al. 2023). There are likely to be additional health care costs from additional comorbidities, including mental health and neurological conditions, endocrine disorders, respiratory conditions, and dental caries. The economic costs included the impact of high BMI on economic productivity, including absenteeism, reduced productivity at work, and premature retirement or death. There may be additional economic costs from lower educational attainment, unemployment, long-term disability, and early retirement (Lobstein et al. 2023). (Note: The hidden costs of overweight and obesity have been estimated quite differently than those of the negative externalities from the food system.)

Estimating the diet-related hidden health costs of the food systems at the country level is an emerging and important piece of work. Such analysis enables better policy dialogue framed around a more accurate view of the magnitude of the problem and an outline of possible food systems solutions, tailored to a specific country. A new method jointly developed by FAO and the World Bank was tested in the Philippines and Ethiopia. That work found that unhealthy diets contribute significantly to child stunting and adult NCDs. For instance, child stunting costs in the Philippines and Ethiopia amounted to 1.5 percent and 16.5 percent of GDP, respectively. Moreover, the economic costs (including treatment and premature mortality) of diet-related NCDs amounted to 4.4 percent of GDP in the Philippines and 1.9 percent of GDP in Ethiopia (FAO and World Bank, forthcoming).

1.3. Poor diets are a crucial part of malnutrition

Diets are currently poor, with people overconsuming sugar, red meat, and processed meat while underconsuming whole grains, fruits, and vegetables. Improvements in diets have been slow in part because of the rise in the consumption of unhealthy foods such as sugar, red meat, and processed meat.

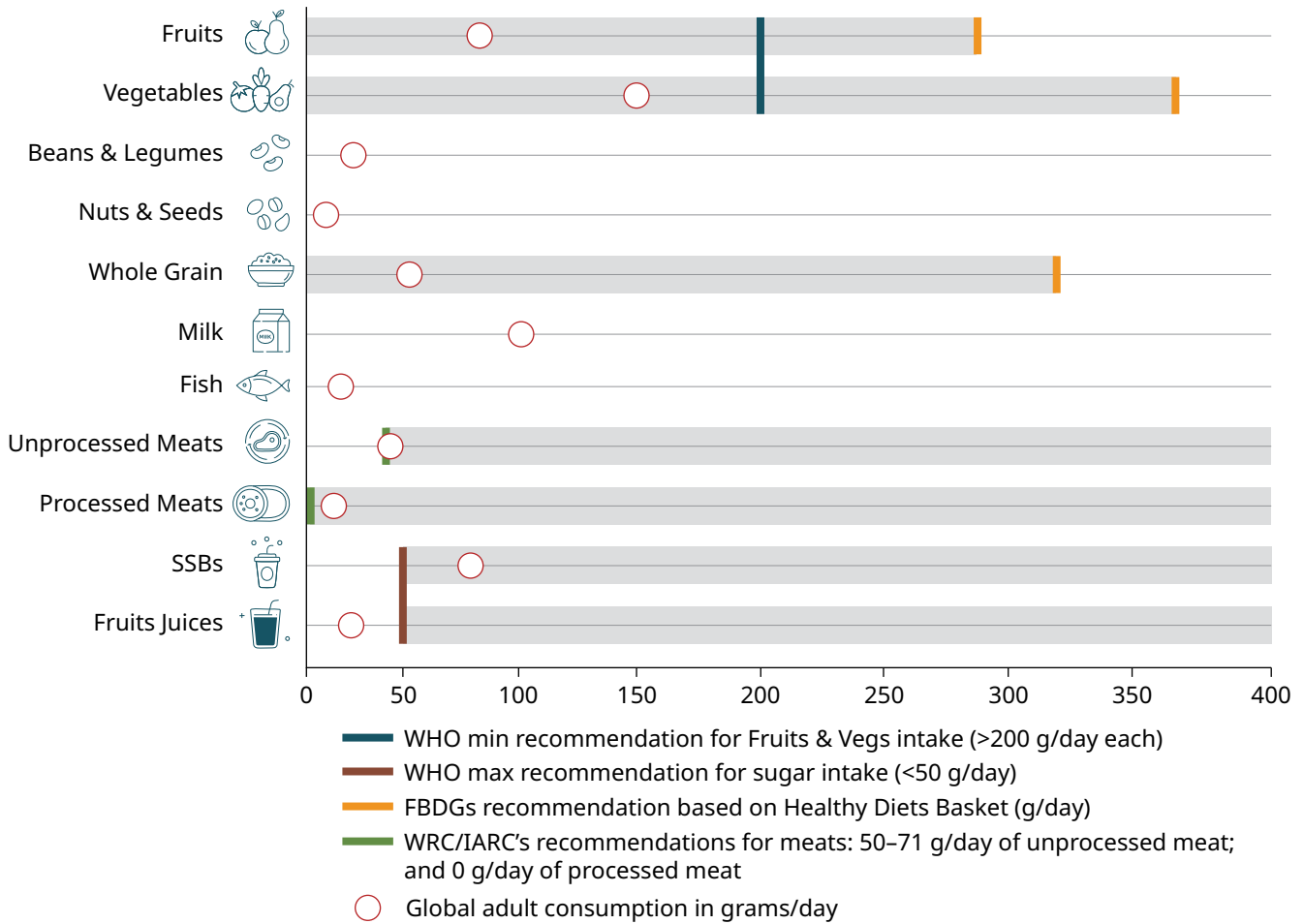
Globally, diets fall short of meeting dietary recommendations. The World Health Organization (WHO) recommendations and food-based dietary guidelines (FBDGs) show that adults' dietary intake falls far short of meeting the recommended consumption of fruits, vegetables, and whole grains while exceeding recommendations for sugar, mainly in the form of sugar-sweetened beverages (SSBs), and both processed and unprocessed meats (figure 1.7) (FAO et al. 2023). The WHO recommends a minimum intake of 200 grams per day for fruits and vegetables while the FBDGs recommend just shy of 300 grams per day of fruit and more than 350 grams per day of vegetables. In 2018, adults globally ate less than 100 grams of fruit per day and about 150 grams of vegetables per day. Adults consumed only around 50 grams of whole grains in comparison to the more than 300 grams per day recommended by the FBDGs. The WHO recommends less than 50 grams of sugar consumed per day and global consumption on SSBs alone far exceeds the 50 grams per day (FAO et al. 2023).

Improvements to diets have been slow over time in part because of the rise in unhealthy food consumption such as sugar, red meat, and processed meat (figure 1.8). The global overall diet quality has improved modestly since 1990, as measured by the Alternative Healthy Eating Index (AHEI) in figure 1.8 (Miller et al. 2022). Some of these gains were due to increased fruit consumption, by about 5.3 grams per day, and increased nut and seed consumption, by about

2.3 grams per day. The gains were countered by losses from decreased consumption of whole grains by 8.5 grams per day along with increased red meat and SSB consumption by 1.5 grams per day and 0.37 servings (8 ounces = 248 grams) per week, respectively (Lara-Castor et al. 2023; Micha

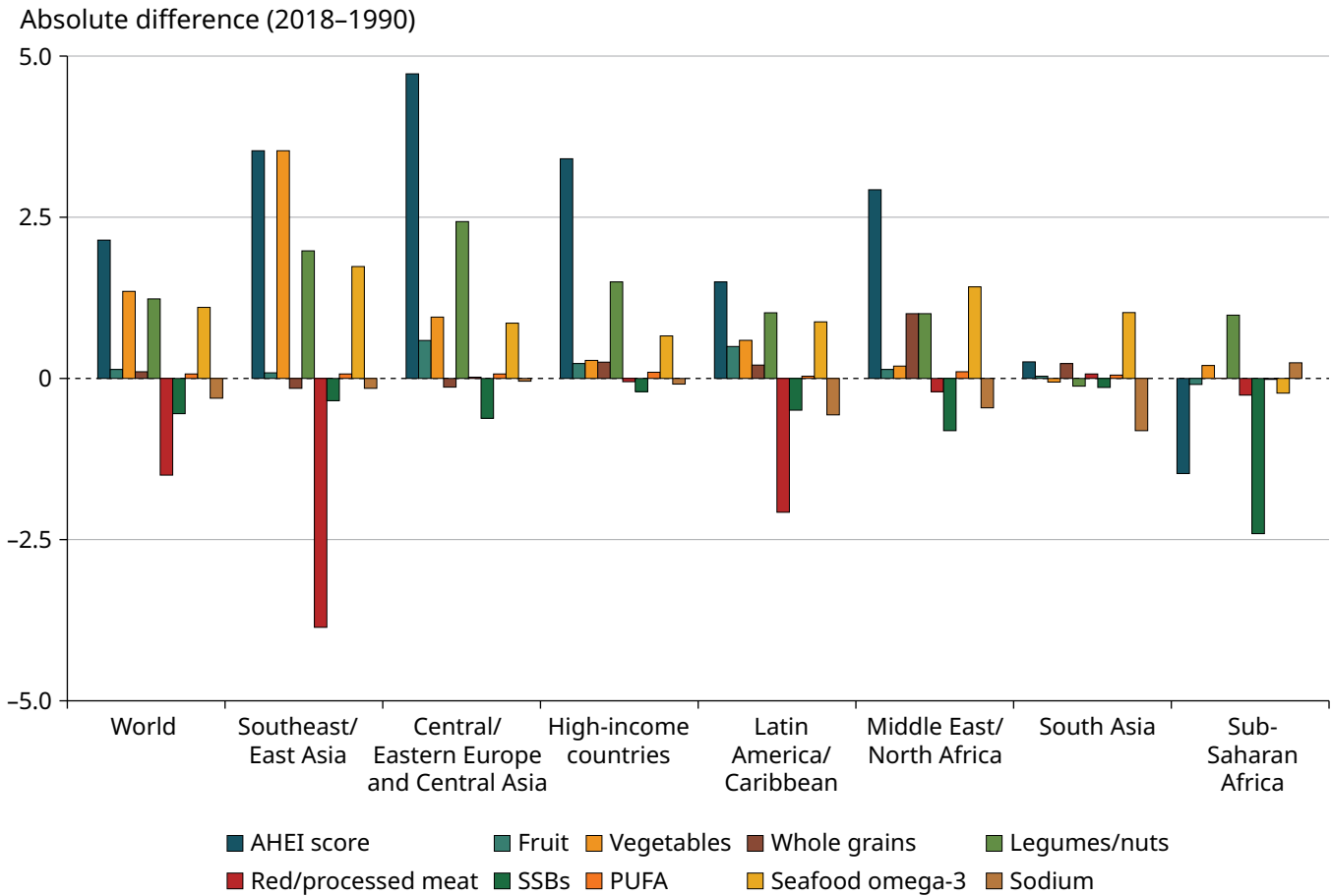
et al. 2015). The AHEI did not improve in every region, though; in South Asia it stayed roughly the same and in Sub-Saharan Africa it declined, largely because of increased SSB consumption (Miller et al. 2022).

Figure 1.7 Global Food Intake (grams/day per adult) and Global Dietary Recommendations, 2018



Source: Original figure for this publication based on World Bank data. Data for global food intake are from the Global Dietary Database (GDD) 2023.

Figure 1.8 Global and Regional Mean Absolute Differences in Alternative Healthy Eating Index (AHEI) Component Scores in Adults between 1990 and 2018



Source: Miller et al. 2022. <http://creativecommons.org/licenses/by/4.0/>

Poor diet quality and high food prices drive poor malnutrition—including undernutrition, stunting, wasting, micronutrient deficiencies, overweight, obesity, and the consequent noncommunicable diseases. Food system shifts are part of the problem because they have precipitated a major dietary transition toward increasingly ultra-processed foods away from more traditional dietary patterns.

Poor diets drive undernutrition, such as stunting, wasting, and micronutrient deficiencies. Poor diets that lack diversity, quality, and sufficient quantity are associated with micronutrient deficiencies (such as deficiencies of iodine, vitamin A, and iron)

and add to the burden of wasting and stunting (Skoufias, Vinha, and Sato 2019). A scoping literature review on the health and nutrition costs of poor diets in low- and middle-income countries was conducted in 2024 and helped quantify the association between poor diets and stunting (Siekmans et al., 2024). A meta-analysis found that children five- to eighteen-years old living in low- and middle-income countries who had a low diet diversity score were associated with an increased risk of stunting, with a stunting odds ratio (OR) = 1.43 ($n = 14$ studies) and wasting OR = 2.18 ($n = 2$ studies) (Zeinalabedini et al. 2023). The results are similar for children under five (Abdulahi et al. 2017). This research helps underscore the integral nature poor diets play in contributing to the burden of stunting globally,

along with highlighting healthy diets as a critical component in mitigation strategies. In 2019, Skoufias, Vinha, and Sato conducted an analysis of 33 Demographic Health Surveys from Sub-Saharan Africa to quantify the marginal effects on the probability of stunting based on children's access to the three determinants of nutrition: (1) food and care; (2) water, sanitation and hygiene (WASH); and (3) health. Their study found that a child's access to all three determinants of nutrition was associated with a 5.4 percent decrease in the probability of stunting, while the independent effect of a child's access to food and care decreased the probability of stunting by 0.3 percent (Skoufias, Vinha, and Sato 2019).

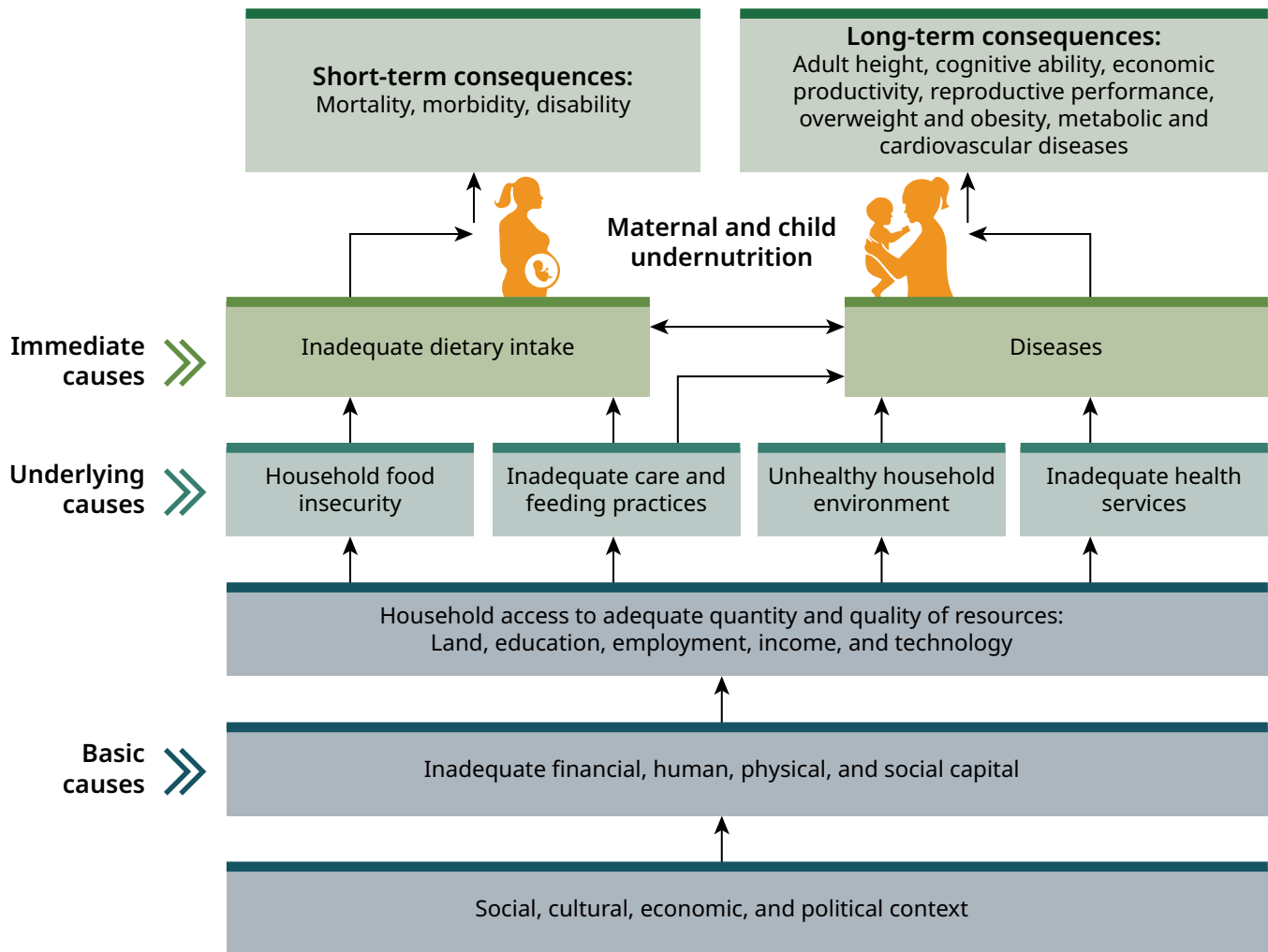
In many LMICs consumption of animal sourced foods (ASFs) is limited and those who need their nutritional benefits (high-quality proteins and bioavailable micronutrients) the most (women of reproductive age and children) have the least access (International Food Policy Research Institute 2024). This contrasts with many people in HICs, where ASFs are over-consumed increasing the risk of NCDs. The country's unique situation needs to be taken into account when making recommendations about ASF consumption and can include adjusting prices to include environmental costs and public awareness campaigns in HICs and making ASFs more affordable in LMICs through increased farm productivity, improved market efficiency, and raising household incomes.

High food prices are also known to drive undernutrition. Food prices are integral to the burden of nutrition-related diseases as they impact the accessibility of a diverse, high-quality, and sufficient quantity of food. This is especially true for people of low socioeconomic status in low- and middle-income countries, as these people spend a larger proportion of their budget on food than those of higher socioeconomic status (Skoufias, Vinha, and Sato 2019). Headey and Ruel recently assessed the impact of food inflation on wasting and stunting in 44 low- and

middle-income countries. Their research found that a 5 percent increase in the real price of food increased the risk of wasting by 9 percent and severe wasting by 14 percent. The risk of moderate and severe stunting for children two through five years old was increased if food inflation occurred during pregnancy by 1.6 percent and 2.4 percent and if it occurred during the first year after birth by 1.8 percent and 3.4 percent, respectively. These effects were more severe for children from poor and rural households. Wasting, an acute measure of malnutrition, was more severely impacted following a 5 percent increase in food prices. However, increased food prices went beyond increasing acute malnutrition to affect chronic malnutrition as well, by increasing the risk of stunting (Headey and Ruel 2023). It is evident that poor diets are exacerbated as food prices increase, further driving increased undernutrition and stunting (figure 1.9 shows a conceptual framework). Increased food prices make nutritious foods less accessible to households by making them less affordable (Skoufias, Vinha, and Sato 2019).

Food system shifts have precipitated a major dietary transition toward increasingly ultra-processed foods and away from more traditional dietary patterns. These changes have occurred over the past half-century, first in high-income countries and then in low- and middle-income countries such as Sub-Saharan Africa, South and East Asia, and Latin America (Gill et al. 2023; Lane et al. 2024). Ultra-processed foods are high in added sugar, sodium, and saturated fats, with SSBs being the primary source of added sugar consumed in most countries (Baker and Friel 2014; Baker et al. 2020; Monteiro et al. 2013, 2018; Popkin and Hawkes 2016; Popkin and Reardon 2018; Reardon et al. 2021). Food system shifts in tandem with increased ultra-processed foods have worsened diets globally, especially in low- and middle-income countries, and are associated with numerous adverse health outcomes including cardiometabolic and mental disorders as well as mortality (figure 1.10).

Figure 1.9 Drivers of Undernutrition

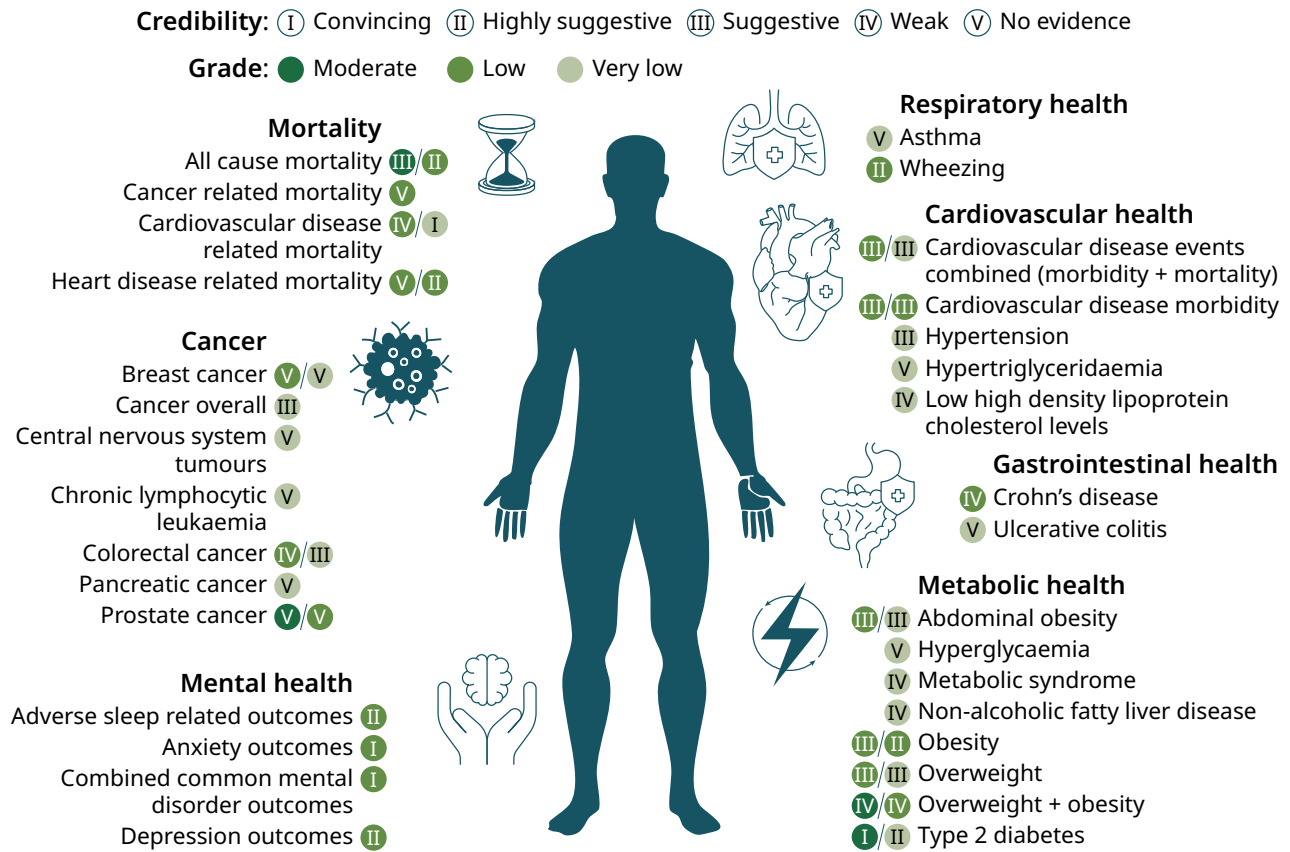


Source: Skoufias, Vinha, and Sato 2019. Adapted from UNICEF 1990. <http://creativecommons.org/licenses/by/3.0/igo>

Poor diets drive overweight and obesity, along with other NCDs (see figure 1.10) (Siekmans et al., 2024). Overweight and obesity further drive NCDs such as asthma, Alzheimer’s disease, cancer, cardiovascular disease, depression, diabetes, hypertension, kidney disease, and osteoarthritis (Siekmans et al., 2024; WHO 2024b). A scoping literature review of the health and nutrition costs of unhealthy diets in low- and middle-income countries conducted in 2024 found that a healthy dietary pattern, vegetarian and vegan diets, higher consumption of fruits and vegetables, and higher consumption of dairy

were associated with reduced risk of overweight, obesity, diabetes, and hypertension. Conversely, risk factors for overweight, obesity, diabetes, and hypertension were greater consumption of fried foods, SSBs, ultra-processed foods, and red and processed meats (Siekmans et al., 2024). In 2022, a Lancet study showed that one in eight people are living with obesity (1 billion) (NCD-RisC 2024), and every year more than 5 million lives are lost from overweight- and obesity-attributable diseases (GBD Collaborative Network 2021; Kontis et al. 2014).

Figure 1.10 Ultra-Processed Foods and Adverse Health Outcomes



Source: Lane et al. 2024. <http://creativecommons.org/licenses/by/4.0/>

In response to the increasing burden of diet-related diseases, the WHO and the FAO have created dietary guidelines, also known as food-based dietary guidelines, that set recommendations for which foods to limit and which to consume in greater quantities. They recommended eliminating or significantly limiting the consumption of free sugar, sodium (salt), trans fats, and alcohol. In addition to the limitations, they recommend increasing intake of healthy foods such as fruits, vegetables, legumes, seeds and nuts, and whole grains.

Global recommendations by the WHO and the FAO encourage limiting the consumption of sugar, sodium, fats, and alcohol (box 1.2) and increasing fruits, vegetables, legumes, seeds and nuts, and whole grains (see Figure B1.2.2). In response to the increasing burden of diet-related diseases, the WHO and the FAO have created dietary

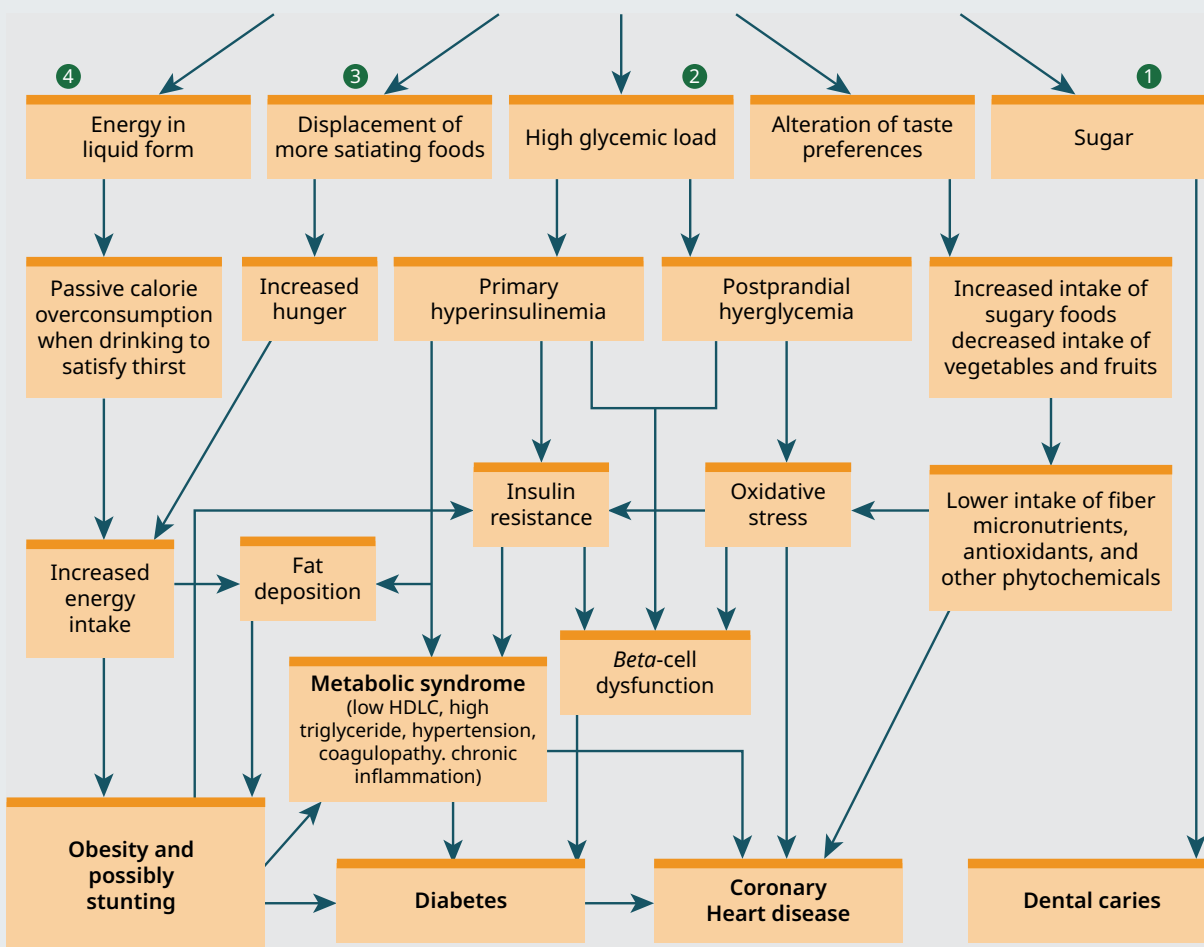
guidelines, also known as *food-based dietary guidelines*, that set recommendations for which foods to limit and which to consume in greater quantities (FAO 2021; World Cancer Research Fund International 2015; WHO 1998, 2003, 2015). They recommended eliminating or significantly limiting the consumption of free sugar, sodium (salt), trans fats, and alcohol (Nishida et al. 2004). In addition to all of the limitations, the WHO also recommends increasing the intake of healthy foods such as fruits, vegetables, legumes, seeds and nuts, and whole grains. To meet these FBDGs and mitigate obesity and its associated NCDs, the WHO recommends a suite of interventions that includes fiscal policies to promote healthy diets, nutrition labeling policies, regulations on harmful marketing of food and beverages to children, breastfeeding promotion and support, and school food and nutrition policies that include regulations on the sale of products close to schools that are high in fats, sugars, and salt (WHO 2024a).

Box 1.2 Guidelines on the Consumption of Sugar, Sodium, Fats, and Alcohol

Free sugar has been strongly associated with increased weight gain, obesity, diabetes, hypertension, fatty liver disease, kidney dysfunction, cancers, and dental caries (figure B1.2.1) (Huang et al. 2023; WHO 2015; World Cancer Research Fund International 2015); research has shown that these effects are especially pronounced for free sugar in sugar-sweetened beverages (SSBs) (Singh et al. 2015). As a result, the Food and Agriculture

Organization of the United Nations (FAO), UNICEF, the World Bank, the World Cancer Research Fund International, and the World Health Organization (WHO) all strongly advise against free sugar consumption (UN-Nutrition 2022; World Bank 2020; World Cancer Research Fund International 2015). The WHO recommends consuming not more than 5 percent of total kilocalories per day from free sugar (World Bank 2015).

Figure B1.2.1 Pathways by Which Sugar Impacts Health



Source: Popkin and Hawkes 2016.

Increased sodium consumption is a risk factor for hypertension, cardiovascular disease, stroke, and other NCDs (Afshin et al. 2019; Bibbins-Domingo et al. 2010; WHF 2021; WHO

2018). The WHO recommends limiting the consumption of sodium to less than 2 grams per day (5 grams per day of salt) for adults. In tandem, the WHO advises processed food

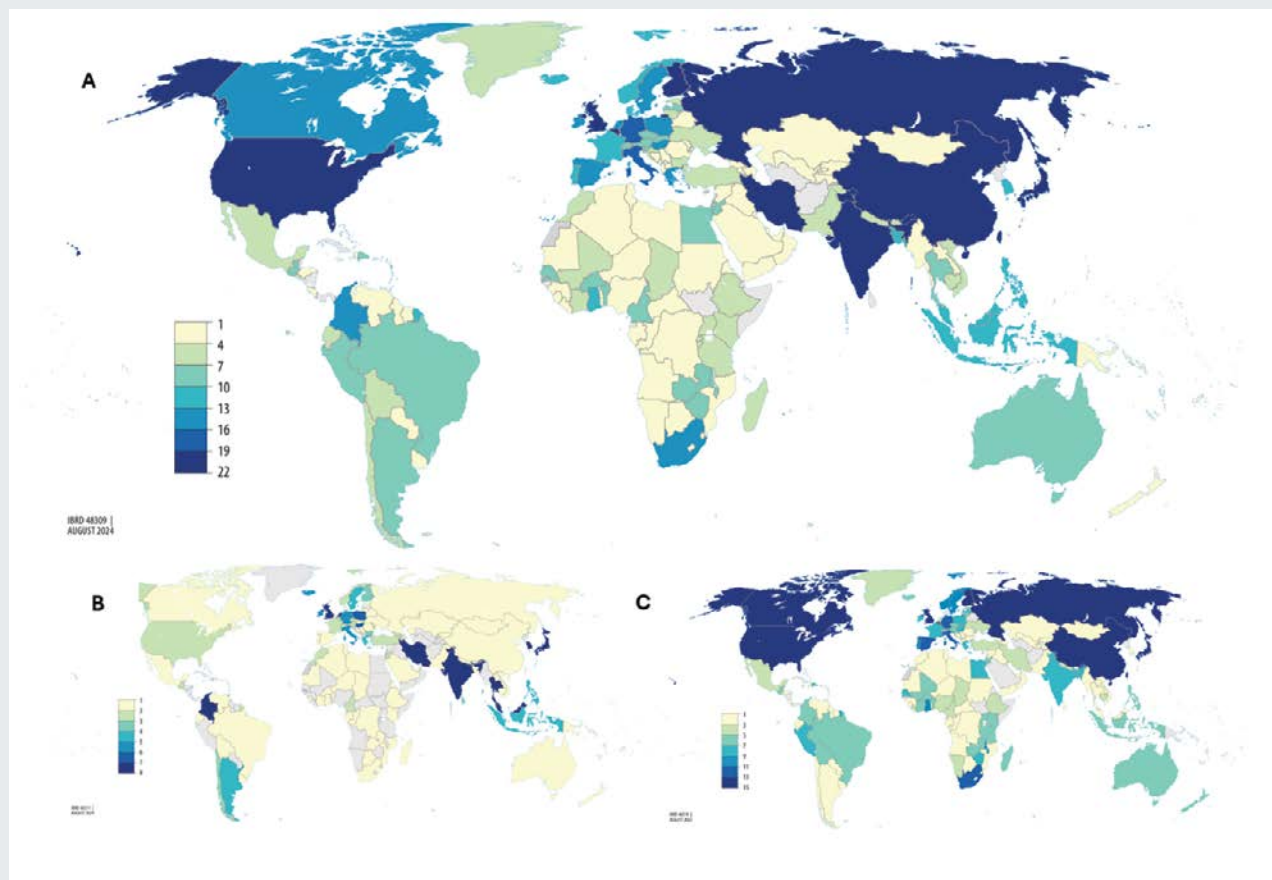
companies to eliminate as much sodium as possible from their recipes and consider potassium salt as a substitute for sodium salt (World Bank 2022).

Trans fats should make up no more than 1 percent of kilocalories per day and the WHO recommends eliminating them as much as possible to governments and policy makers (World Bank 2022). Trans fats are linked to a large increased risk of death primarily through coronary heart disease, with high consumption increasing the risk of hospitalization and death by more than 50 percent (Afshin et al. 2019;

Amico et al. 2021; WHO 2018; Willett and Ascherio 1994).

Heavy alcohol consumption is a major cause of preventable death and injuries, violence, and abuse. More than 3 million deaths and more than 120 disability-adjusted life years (DALYs) lost are due to heavy drinking (Afshin et al. 2019; Cao et al. 2015; Kloner and Rezkalla 2007; O’Keefe et al. 2014; Stampfer et al. 1988; USDA 2015). Recommendations on how much alcohol can be consumed safely vary widely by country—the WHO suggests consuming no more than 14 drinks per week spread out over three or more days (World Bank 2022).

Map B1.3.1 Geographical Density of the Number of Dietary Surveys in the GDD 2017 by Country (A), including publicly available surveys (B), and non-public surveys submitted by data owners (C) GGD, Global Dietary Database



Source: Miller et al. 2021. <https://creativecommons.org/licenses/by/4.0/>. Slight changes have been made to the original image.

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2 An Opportunity to Leverage Agrifood Public Support



2.1. The problem with current agrifood support

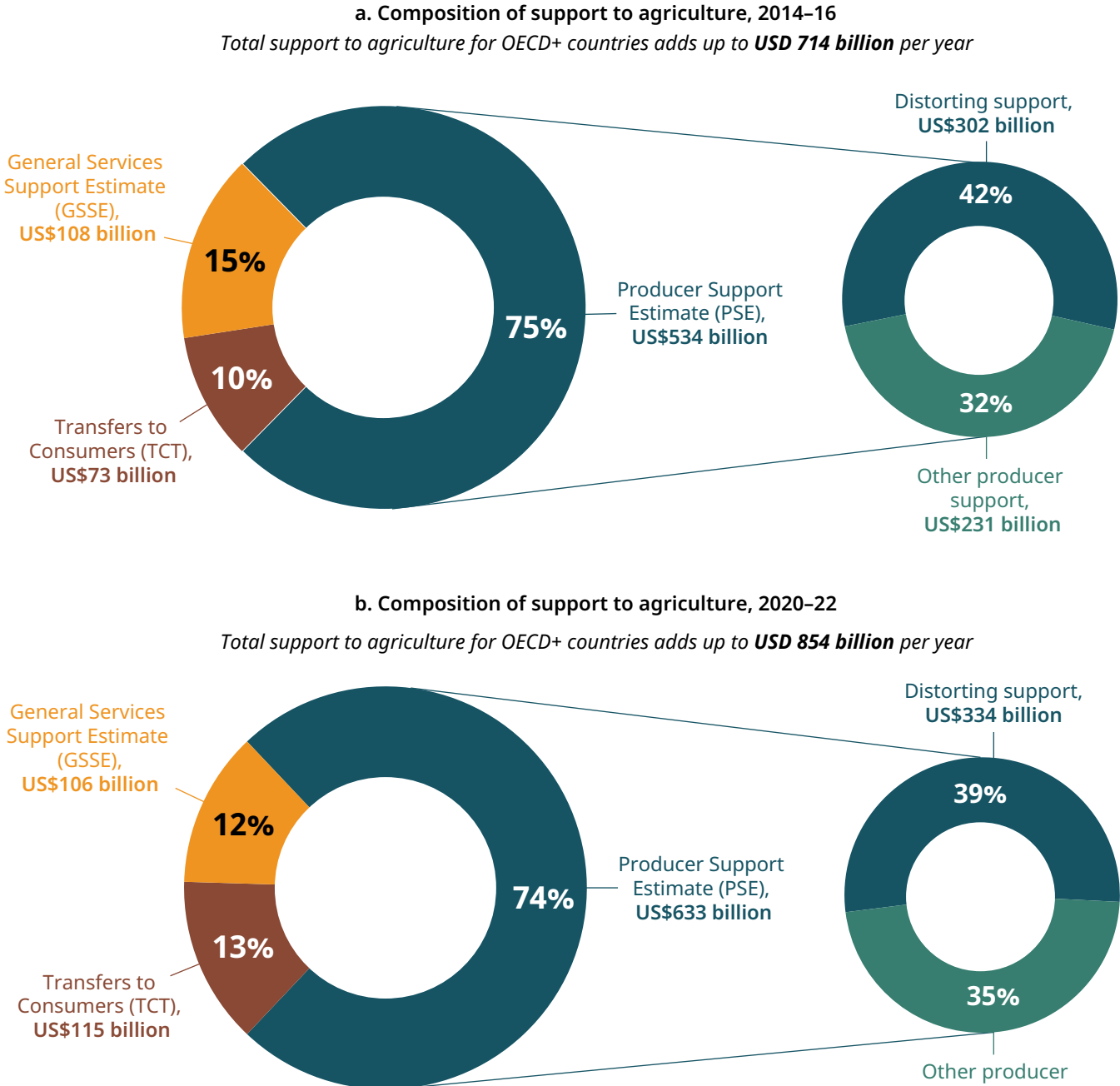
Public support to the agrifood sector is large, distortionary, and inefficient. Globally, support to the agrifood sector comes to at least \$854 billion per year. Most of this support is focused on producers, not on consumers, and comes largely in the form of trade and market policies that distort prices. Public support to the sector is also often regressive, benefiting wealthier farmers.

Agrifood support is sizeable, but it is also largely distortionary and inefficient, particularly in low- and middle-income countries. Total support to the agrifood sector averaged \$854 billion from 2020 to 2022 (see figure 2.1) in the 54 countries combined that include Organisation of Economic Co-operation and Development (OECD) members and other major agrifood producers.¹ This number is an increase from the total support to agrifood of \$714 billion annually for the years between 2014 and 2016 (OECD 2023a). This considerable growth in the sectoral support to agrifood, despite increasing global agrifood production, is also highly distortive to the markets. Out of the total support to agrifood, 74 percent was targeted toward producers; most of these measures are market distortive. Over 50 percent of producer support is in the form of trade/market policies, which impact the market prices of agrifood commodities. Smaller shares of support are allocated to General Services Support (GSS, 12 percent). These are investments in private or public services—such as institutions and infrastructure. Smaller shares are also allocated to consumer subsidies (13 percent)—which can improve the consumption of nutritious food if targeted effectively. Agrifood public support is concentrated in a few jurisdictions: China, India, the United States, and the European Union together

make up well over 75 percent of the total support (OECD 2023a). Furthermore, agrifood support measures in low- and middle-income countries often lead to the most distorting outcomes, since they tend to prioritize coupled subsidies—unlike in high-income countries, where subsidies are commonly uncoupled and have a less distortive impact. In addition, agrifood subsidies in high-income countries focus more on research and infrastructure development than those in low- and middle-income countries, which leads to more market harm in the latter (Damania et al. 2023).

Agrifood support is also producer-focused and regressive. Between 2020 and 2022, agrifood consumers and GSS together received \$221 billion, while producers received \$633 billion on average per year. Aggregate support to producers in all 54 countries represented 9.8 percent of gross farm receipts (GFR) on average in 2020–22. This is 13.7 percent of GFR in positive support and 3.9 percent in negative Market Price Support (MPS) (OECD 2023a). Large producer support, however, does not aid all recipients equally. The OECD notes that producer support reforms have stagnated over the last 10 years. Agrifood subsidies that governments allocate to their agriculture producers often regressively benefit wealthier farmers, since they, compared to poorer farmers, “use more inputs and produce more outputs,” and the subsidies rarely have a positive effect on the efficiency of the agricultural production. For example, subsidies are leading to excessive use of fertilizers, particularly in East Asia and the Pacific and in South Asia (see box 2.1). Even targeting subsidies to the poorer farmers often fails to address the regressivity of a policy and, ultimately, those with stronger political or market connections end up having better access to subsidies (Damania et al. 2023). The issue, however, is not only how governments support their agrifood sectors, but also what commodities these funds are aimed at. Chapter 4 also discusses the fertilizer subsidies in more detail in the cases of Bangladesh and Malawi.

Figure 2.1 Public Support to Agrifood Sector, by Type of Support



Source: Original figure for this publication based on data from OECD 2023b.

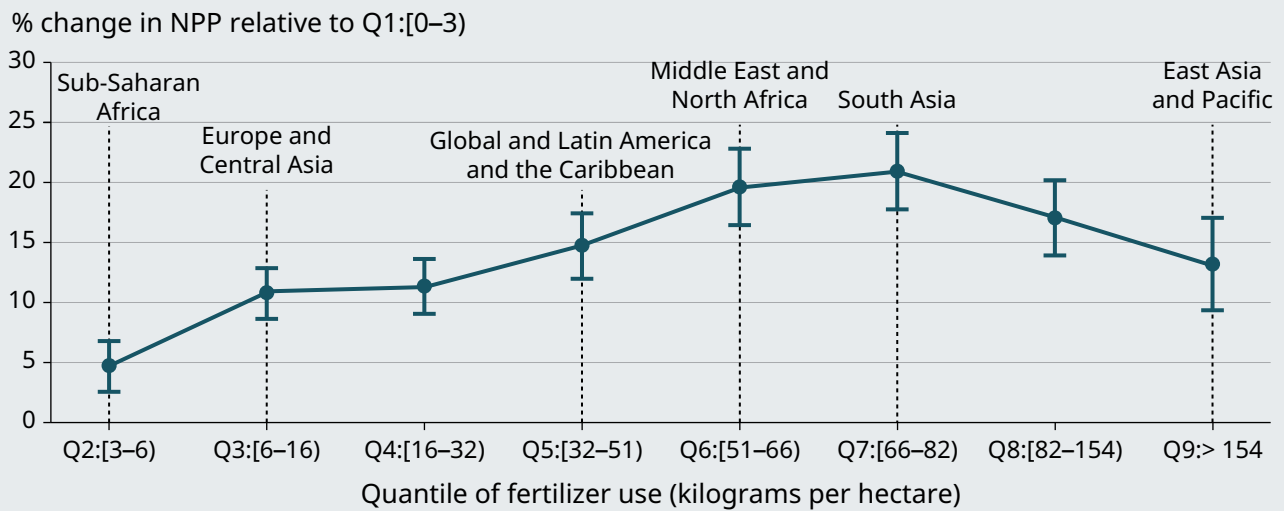
Note: Total support to agriculture indicates positive transfers to the agricultural sector, computed as the sum of transfers to consumers (that is, Transfers to Consumers from Taxpayers) (TCT), General Services Support Estimates (GSSE), and Producer Support Estimates (PSE). To consider implicit taxation of producers in some emerging economies, PSE is combined with transfers away from producers (negative Market Price Support, or negative MPS). Distorting support includes MPS, transfers away from producers (negative MPS), payments based on output, and payments based on unconstrained variable input use. This covers 54 OECD+ countries, which refers to the 38 OECD countries, the 5 non-OECD EU Member States, and 11 emerging economies.

Box 2.1 A Closer Look at Fertilizer Use

According to a 2023 World Bank report, in East Asia and Pacific, excessive fertilizer use is contributing to a decline in agricultural productivity, with South Asia expected to face the same challenge in the near future. In these two regions, nitrogen fertilizer use, promoted by agriculture subsidies, is reaching or has reached the diminishing returns to net primary productivity (NPP) (Damania et al. 2023; see figure B2.1.1). On the other hand, countries in Sub-Saharan Africa and some in Europe and Central Asia exhibit a lack of fertilizer application, which is preventing the growth in agriculture productivity, measured by NPP.

Strikingly, around 50 percent of global caloric production occurs in areas that also overuse fertilizer, making the reduction of fertilizer use there an opportunity that is unlikely to negatively impact agriculture yields. The overconsumption of fertilizers is also leading to the deterioration of water quality, which is yet another reason to bring the use down to optimal levels (Damania et al. 2023). Since the price of fertilizers has risen in recent years, reducing its use in overconsumed areas might positively support the increase in fertilizer use in underconsuming geographies as a result of the lower global price of those inputs.

Figure B2.1.1 Change in Productivity Due to Use of Nitrogen Fertilizer



Source: Damania et al. 2023.

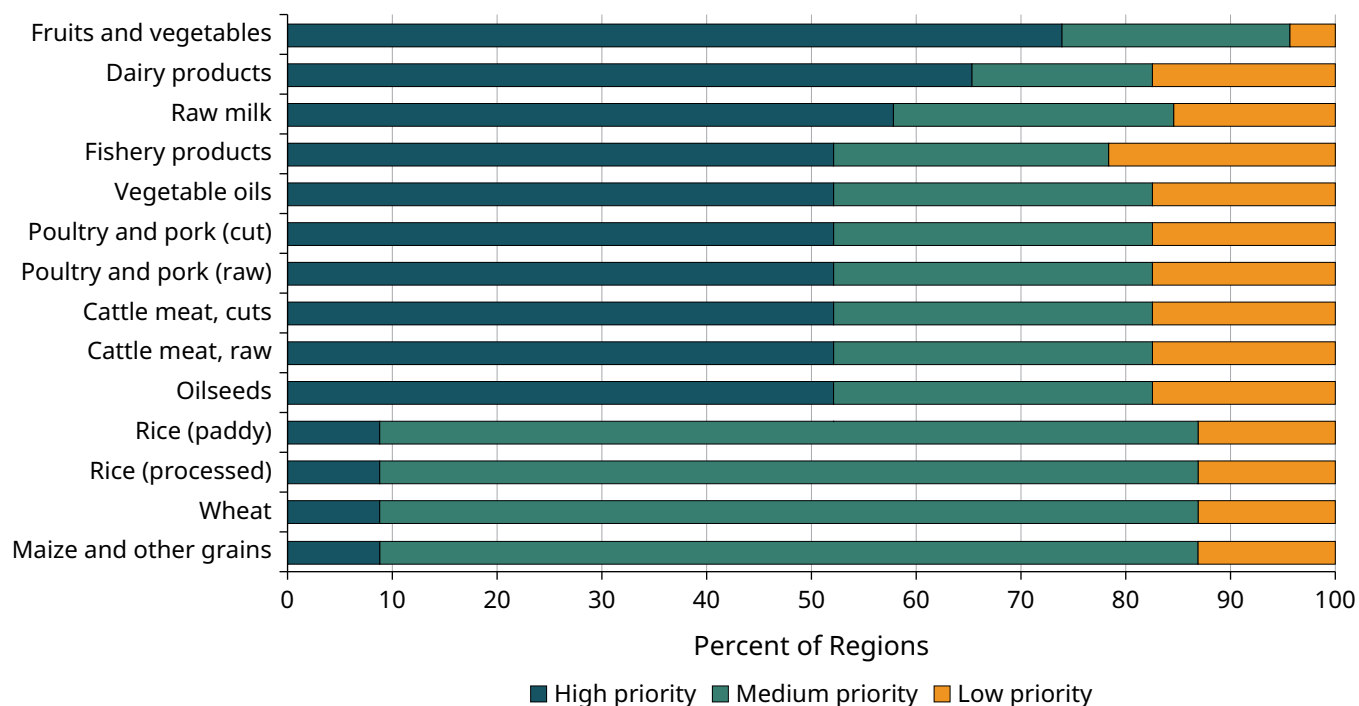
Note: NPP = net primary productivity.

Public support to the agrifood sector is focused much more on food commodities that are already high in consumption such as grains and meats, and much less on underconsumed, healthier food commodities such as fruits, vegetables, and dairy.

Many regions fall short of the recommended consumption of fruits, vegetables, and dairy; very few regions fall short in rice, wheat, and maize. Glauber and Laborde (2023) have classified agriculture commodities based on their level of per capita consumption and the recommended dietary guidance for that geography, which derives from the Food and Agriculture Organization of the United Nations (FAO)'s food-based dietary guidelines (see figure 2.2). "Products whose average actual consumption level was less than 80 percent of the recommended level, were

classified as high priority. Products whose actual level of consumption exceeded 120 percent of the recommended level of consumption, were characterized as low priority. And products with a per capita consumption of 80 and 120 percent of the recommended level, were characterized as medium priority" (Glauber and Laborde 2023, p. 17). Fruits and vegetables are among the least supported agricultural commodities and have the highest priority. In 95 percent of regions, fruits and vegetables are identified as either high- or medium-priority products, pointing to their overwhelming underconsumption (Glauber and Laborde 2023). On the other hand, wheat, maize, and rice are generally overconsumed, since in fewer than 10 percent of regions globally these commodities are identified as high priority. It is worth noting that sugar is not present in this exercise.

Figure 2.2 Food Groups Based on Per Capita Consumption Relative to Dietary Guidelines



Source: Glauber and Laborde 2023.

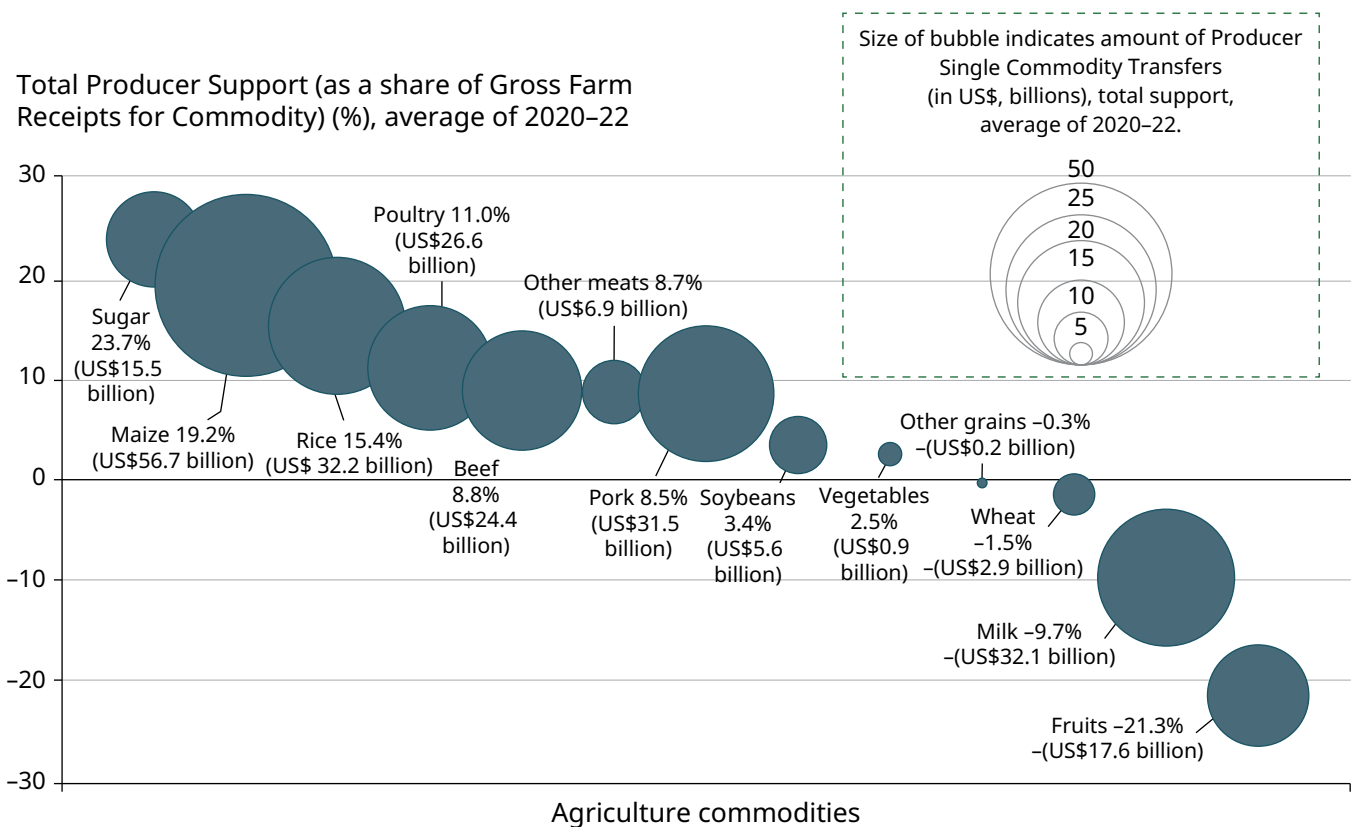
Agrifood support is imbalanced—it is higher for agrifood commodities that are already sufficiently consumed, while lower for much healthier, underconsumed foods (see figure 2.3). Commodity-specific support to the agrifood sector is concentrated among a few products.

Between 2020 and 2022, in terms of the dollar value, the most-supported commodity among the 54 countries studied by the OECD was maize, with over \$56 billion in total support. The second most supported commodity in dollar terms was rice, with \$32.2 billion; third was pork, with \$31.5

billion; fourth and fifth were poultry meat as well as beef and veal, which received \$26.6 billion and \$24.4 billion in agrifood support. Figure 2.3 also ranks the commodities, based on another support measurement, which is the Producer Single Commodity Transfers (PSCT) as a share of the total Gross Farm Receipts, meaning how much income a single-commodity farmer gets from PSCT as a share of their total income. The most-supported commodity as a share of GFR was sugar, with around 24 percent of farmers' incomes from sugar deriving from public support. The second most-supported was maize with around 20 percent, third was rice with approximately 15 percent, and fourth was poultry meat with 11 percent of GFR coming from public support (OECD

2023a). Alternatively, vegetables, dairy, and fruit are located to the far right of figure 2.3 because of their very low (or negative) levels of producer support. As shown in chapter 1, globally, fruit and vegetable consumption fall short of World Health Organization (WHO) or food-based dietary guideline (FBDG) recommendations, while meat consumption exceeds International Agency for Research on Cancer recommendations and sugar-sweetened beverage (SSB) consumption exceeds WHO recommendations. There is thus a disconnect between which agrifood commodities receive public support and which ones are healthier, indicating a need to rethink agrifood support in a way to ensure that it is better guided by health and nutrition outcomes.

Figure 2.3 Agrifood Support by Food Commodity



Source: Original figure for this publication based on data from OECD 2023b.

Note: The OECD indicator database includes a total of 60 food groups. A full list of commodities can be found at <https://www.oecd.org/agriculture/topics/agricultural-policy-monitoring-and-evaluation/documents/producer-support-estimates-manual.pdf>. The full list of the OECD database includes 54 countries, including the 38 OECD countries, five non-OECD EU Member States, and 11 emerging economies. The measure of total public support, percentage of Producer Single Commodity Transfers (%PSCT) of the gross receipts for the single commodity (GR), is defined as the value of gross transfers from consumers and taxpayers to agricultural producers, measured at the farm gate level, arising from policies linked to the production of a single commodity. Other meats include sheep meat. Other grains include alfalfa, oats, sorghum, and barley.

The nature of agrifood public support varies across regions and across countries. In Sub-Saharan Africa, support to the agrifood sector is generally low. Agriculture subsidies in the region amounted to only \$680 million per year, with public spending in the sector at 6 percent of national budgetary resources, well below the 10 percent target from the Maputo Declaration. Thus, there is a need to simultaneously increase agrifood public support and rebalance the support away from a heavy focus on input subsidies and toward more research and development.

Not all regions are the same. In Africa, support to the agrifood sector is low. Globally, agriculture receives significant public support, which (as noted earlier) is often regressive, distortionary, leads to inefficiencies, and supports low-priority foods. These trends, however, are not universal. The African continent is spending considerably less than other parts of the world. According to the Global Panel on Agriculture and Food Systems for Nutrition (GLOPAN) 2022 report, in 2015, countries in Sub-Saharan Africa provided only \$680 million in agriculture subsidies. This number is extremely low, considering that agriculture constitutes 23 percent of gross domestic product (GDP) in Sub-Saharan Africa and employs 60 percent of people in the region. A recent report by the FAO, the United Nations Development Programme (UNDP), and United Nations Environment Programme (UNEP) (FAO et al. 2022) shows that the trend of low agriculture expenditure in Africa continues, particularly citing the negative agriculture producer support, which suppresses prices, favoring consumers for whom food affordability plays a vital role. In addition, Pernechele et al. (2021) affirm that some countries in Sub-Saharan Africa allocate only 6 percent of their expenditure to food and agriculture, which is well below the African Union's target of 10 percent. Per GLOPAN, when it comes to the components of public support, countries in Sub-Saharan Africa prioritize inputs (for example, fertilizers), allocating 88

percent of the total agriculture support to inputs, 4 percent was given to farms directly, 3 percent in a form of coupled support; the rest was directed at producers in other ways. Low levels of agriculture support in Africa and the importance of the sector for the livelihoods of people on the continent have already pushed members of the African Union, which includes all countries in Africa, to commit to increase their spending on rural development and agriculture to 10 percent of budgets back in 2003 as part of the Maputo Declaration (GLOPAN 2022). Further complicating the issue are differences both in diets across regions and between recommended and current intake of various food groups (box 2.2).

The current set of agrifood policies can be disconnected from public policies in other sectors, such as those in the health sector. For example, some countries tax the consumption of sugar-sweetened beverages while providing significant support to domestic sugar production. For several of these countries with seemingly inconsistent policies around sugar consumption and production, the levels of sugar consumption exceed the WHO recommendations.

The nature of agrifood support can point to a lack of policy coherence. In certain cases, agrifood public policy and support might be at odds with public policy in other sectors, such as in the health sector. For example, the production of sugar is one of the most publicly supported. However, many governments around the world are also taxing the consumption of SSBs in recognition of the harmful effects of a final product with high sugar content (see box 2.3). This demonstrates potential inconsistencies in the commodities that governments support production of and the commodities that they curb consumption of. Figure 2.4 presents a scatterplot of various countries, with grams of sugar consumption per day in 2020 in the y-axis, and public support to sugar producers as a share of gross receipts from sugar averaged

between 2020 and 2022 in the x-axis. Countries marked as green triangles have implemented some form of SSB tax, while countries marked as red have not. Countries such as Costa Rica, India, Mexico, the Philippines, South Africa, and the United States

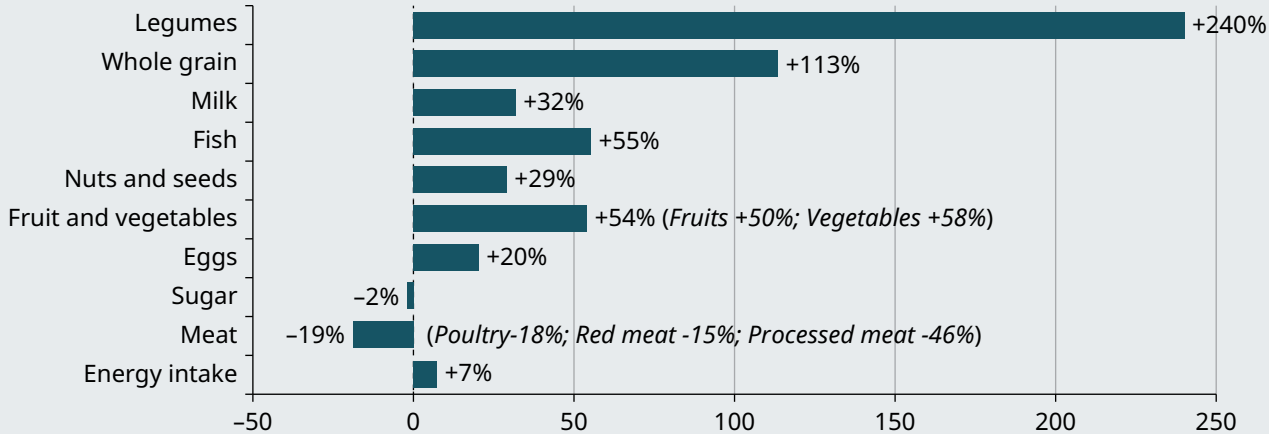
have provided relatively significant support to their sugar producers but have also imposed an SSB taxes on their consumers. These countries are close to or have exceeded the WHO maximum threshold of 50 grams/day of sugar consumption.

Box 2.2 Differences between Recommended Intake and Current Intake, by Food Groups in Africa

Diets differ across regions, making the recommended intakes of foods vary throughout the globe. In Africa, the consumption of high-priority agricultural commodities remains an issue. Figure B2.2.1 shows the deviation of consumption in selected African countries from the recommended local food-based dietary guidelines (FBDGs). The positive percentage indicates by how much the consumption of selected food groups needs to increase to meet the FBDGs. For example, people in Africa, in order to meet the dietary guidelines, need to consume 240 percent more legumes, 113

percent more whole grain, 32 percent more milk, 55 percent more fish, 54 percent more fruits and vegetables, and 19 percent less meat to bring the consumption levels to meet the FBDGs. Meeting FBDGs has been shown to have the ability to reduce premature mortality by 15 percent while also reducing greenhouse gas (GHG) emissions by 13 percent on average (GLOPAN 2022). To meet the FBDGs or at least initiate a positive switch in diets in Africa, repurposing current subsidies could be an effective tool to impact people’s consumption habits.

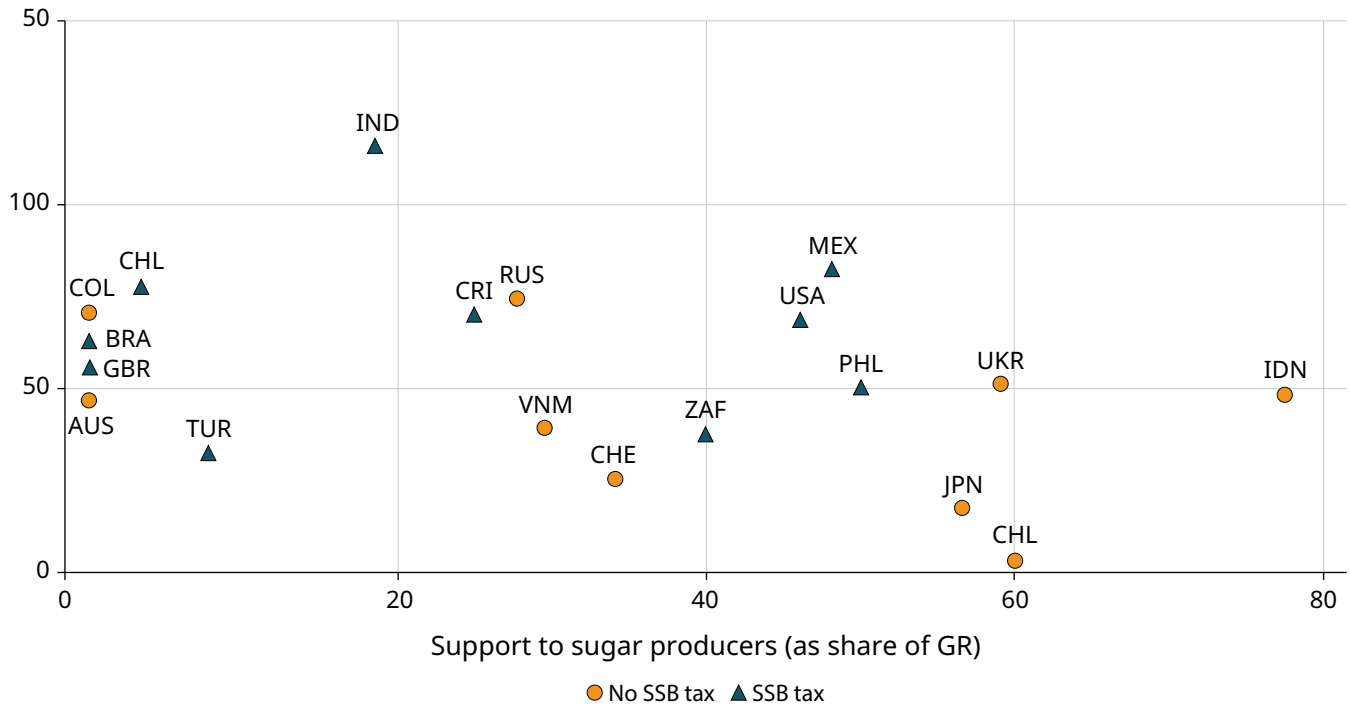
Figure B2.2.1 Differences between Recommended and Current Intake, by Food Group in Africa



Source: This figure has been amended from Springmann et al. 2020.
 Note: The data presented in the figure relate to a subset of African countries that have implemented food-based dietary guidelines. These are Benin, Kenya, Namibia, Nigeria, Seychelles, Sierra Leone, and South Africa.

Figure 2.4 Sugar Consumption, Taxes on SSBs, and Support to Sugar Producers

Sugar consumption (grams per day)



Source: Authors' calculations using data from the OECD (2023). OECD Agriculture statistics (database), IDB (2023). IDB Agrimonitor - PSE Agricultural Policy Monitoring System (data), The Global Nutrition and Policy Consortium (2022). Global Dietary Database, and The World Bank (2023). Global SSB Tax Database, August 2023.

Note: The measure of support to sugar producer—the percentage of Producer Single Commodity Transfers (%PSCT) of the gross farm receipts (GR) for sugar—is defined as the total gross transfers from consumers and taxpayers to agricultural producers, measured at the farm gate level, arising from policies linked to the production of sugar. Countries are indicated by their three-letter ISO codes, available at <https://www.iban.com/country-codes/>. SSB = sugar-sweetened beverages.

Box 2.3 Global Implementation of Sugar-Sweetened Beverage Taxes

Sugar-sweetened beverage (SSB) taxation is a fiscal policy tool primarily aimed at reducing the health burden associated with consuming unhealthy drinks,¹ which can also raise additional revenue. SSBs are a key contributor to excess sugar and energy intakes around the world; they are strongly linked to long-term weight gain, obesity, and a range of noncommunicable diseases (NCDs) including type 2 diabetes, dental caries, cardiovascular diseases, and at least 12 cancers (World Bank 2020). Taxes on SSBs should raise retail prices, which can be viewed as increasing the tax burden on poorer groups. However,

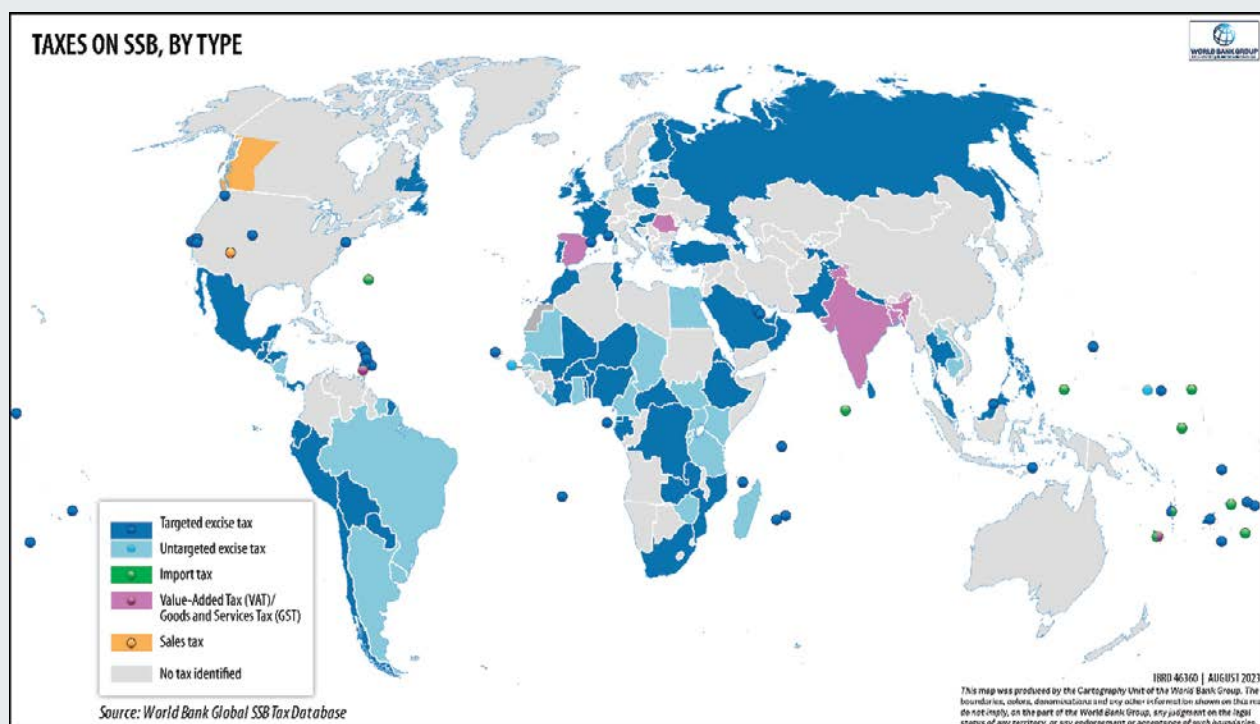
analysis that considers costs and benefits in the longer term suggests that SSB taxes can have a progressive impact, with lower-income households expected to benefit from a disproportionate share of improved health outcomes, reduced health care costs, extended working lives, and reduced years of life lost (Fuchs, Mandeville, and Alonso-Soria 2020). As SSBs are generally cheaper than other unhealthy goods such as cigarettes and tobacco, their revenue potential is smaller—an average of 0.07 percent of gross domestic product in countries for which data are available (World Bank 2023b).

Evidence demonstrating the effectiveness of SSB taxes is expanding rapidly (Andreyeva et al. 2022). There is strong evidence that SSB taxes raise prices and reduce sales of taxed products and can encourage substitution with healthier alternatives. Certain tax designs can also create supply-side incentives to reduce the volume of sugar sold through SSBs. Given that many SSB taxes have been recently implemented, evidence of impacts on population health outcomes remains more limited, though early improvements in oral health and obesity indicators have been observed in Mexico (Gracner, Marquesz-Padilla,

and Hernandez-Cortes 2022; Hernández-F, Cantoral, and Arantxa Colchero 2021) and the United Kingdom (Rogers, Conway et al. 2023; Rogers, Cummins et al. 2023).

SSB taxation is not a novel or untested policy tool, although only a few existing taxes are optimized for health outcomes. More than 100 economies applied national-level taxes on SSBs as of 2023, covering more than half (57 percent) of the world's population and more than four in five people (82 percent) in low- and lower-middle-income economies (map B2.3.1).

Map B2.3.1 Taxes on SSBs, as of August 2023



Source: World Bank 2023a.

Note: Targeted excise tax: Unsweetened bottled water is exempt or taxed at a lower rate than SSBs.

Untargeted excise tax: Unsweetened bottled water is taxed at the same or higher rate as SSBs.

However, one-third of low- and middle-income economies that tax SSBs also tax unsweetened bottled water—a key healthy substitute—at the same or higher rate. These untargeted excise taxes on nonalcoholic beverages more broadly

represent a missed opportunity to reduce sugar consumption by shifting demand.

As with other health taxes, tax design is crucial to achieving health and equity objectives. Fewer than one in five SSB taxes worldwide

(19 percent) target sugar content (either including a component based on absolute sugar content or with sugar content tiers), with these taxes concentrated in high-income economies (World Bank 2023a).² Fewer than

half of SSB taxes worldwide cover sweetened milk-based drinks (42 percent) and only one in three (36 percent) cover 100 percent juices, undermining potential health gains.

Notes

1. SSBs are all beverages containing free sugars, including caloric carbonated soft drinks (sodas), energy drinks, concentrates, and syrups that are diluted to make drinks, as well as sweetened and unsweetened juices, sweetened (flavored) milk-based drinks, sweetened (flavored) waters, sports drinks, and sweetened ready-to-drink teas and coffees. Free sugars include monosaccharides (such as glucose and fructose) and disaccharides (such as sucrose or table sugar) that are added to foods and beverages by the manufacturer, cook, or consumer, as well as those naturally present in honey, syrups, fruit juices, and fruit juice concentrates.
2. See the World Bank Global SSB Tax Database, August 2023 version (World Bank 2023a).

2.2. An opportunity to repurpose agrifood support

Given that agrifood support is biased toward less healthy and nutritious commodities, this support potentially fuels the high costs of malnutrition. There is an imperative to rethink and repurpose agrifood support in a way that better promotes healthy diets. While there are often tradeoffs to repurposing, there are some windows of opportunity for multiple wins across different outcomes—such as climate, nutrition, and poverty alleviation. In Sub-Saharan Africa, some scenarios indicate that simultaneously increasing and rebalancing agrifood support can yield important benefits.

We know that the costs of malnutrition are high, that progress to curb malnutrition has slowed, and that the promotion of healthy diets is a cornerstone to regaining the moment to address malnutrition. At the same time, public support to the agrifood sector is not geared toward promoting healthier diets and better nutrition. There is, however, a growing body of work both across and within countries, largely leveraging simulation methods, which explores the options for repurposing agrifood support. While there are often tradeoffs between climate and nutrition

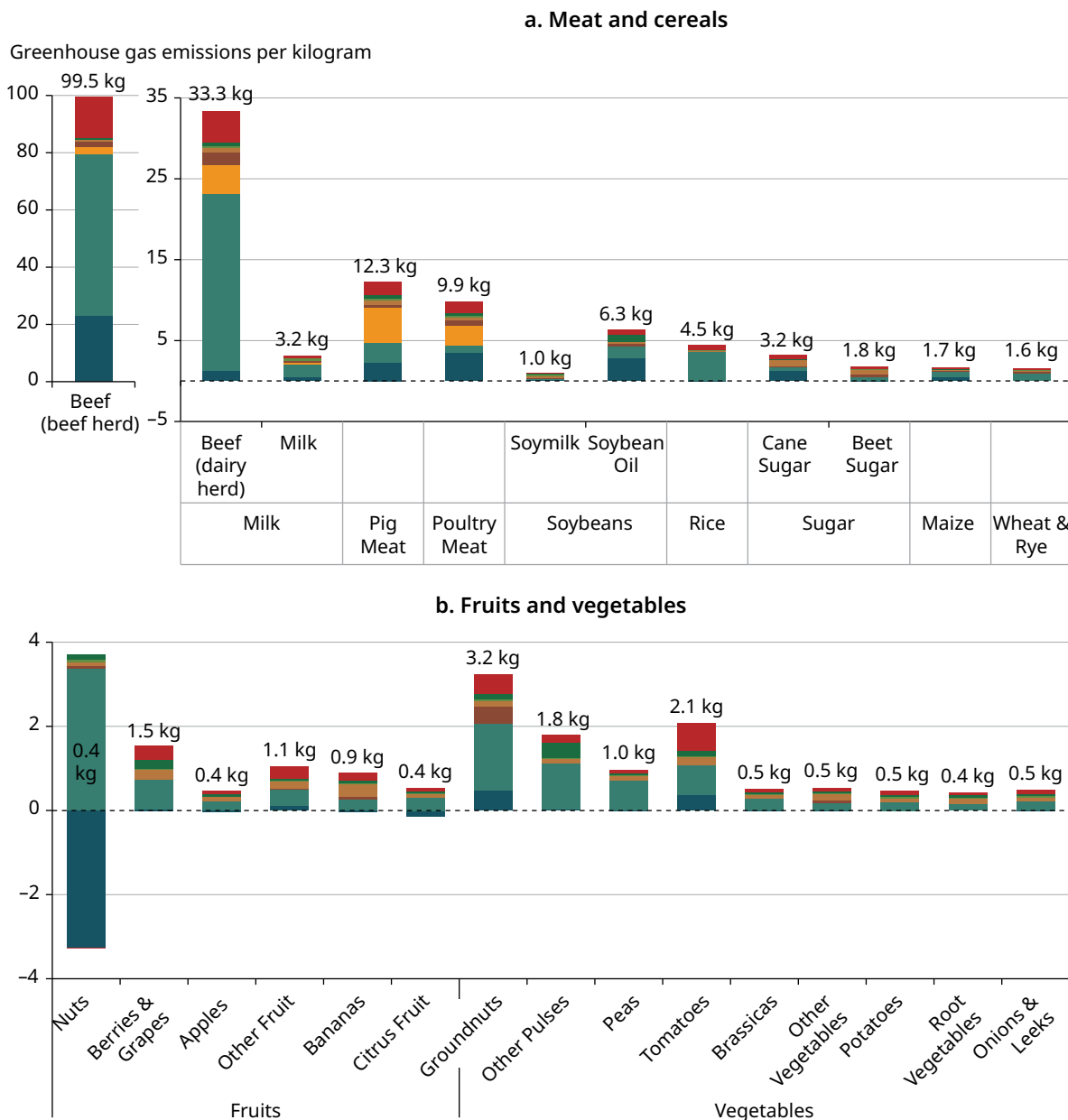
outcomes, there are also repurposing scenarios that provide windows of opportunity for multiple wins. Repurposing agrifood support for healthy diets should consider regional differences, country contexts, and political economy constraints; repurposing must be accompanied by complementary interventions.

The most supported commodities are not only less healthy, but they are also typically worse for the climate. However, repurposing agrifood support requires careful thinking about how to achieve better climate and nutrition outcomes together. There are often tradeoffs between these intertwined but different objectives. Commodities that receive the most support—such as beef, pig, poultry, rice, and sugar—have much higher greenhouse gas (GHG) emissions and freshwater use than other healthier commodities that receive less support, such as fruits and vegetables (see figure 2.5). Thinking of climate and nutrition together would be important in repurposing agrifood support. However, targeting climate outcomes does not necessarily lead to better nutrition outcomes, or vice versa. The EAT–Lancet Commission’s planetary health diet is an important benchmark diet that considers both human health and the environment—including GHG emissions, water use, and biodiversity loss (Willet et al. 2019). But while this benchmark proposes a global standard, there is huge variation in the environmental impacts of dietary changes for different types of environmentally friendly

adjustments (Kim et al. 2020) and for various countries (Semba et al. 2020). For example, if all countries adopt the planetary health diet, overall global GHG emissions would go down but in some, primarily low- and middle-income countries, they would increase. It is crucial then to assess dietary pattern, nutritional value, and environmental impact at the country level. In Bangladesh, for example, evidence shows that GHG emissions would increase

by 10 percent if consumption were adjusted to the national dietary guidelines (which consider only health outcomes), and, counterintuitively, by more than 20 percent if adjusted to the planetary health guidelines (which consider both environment and health outcomes) (Mehra et al. 2022). Similar country-level tradeoffs have been carefully explored in Indonesia (de Pee et al. 2021, among others).

Figure 2.5 Greenhouse Gas Emissions of Food Commodities across the Supply Chain (per kg of food product), 2018



Source: Poore and Nemecek, 2018, with data from Our World in Data.

Note: Greenhouse gas emissions are measured in kilograms of carbon dioxide-equivalents (CO₂eq) per kilogram of food.

Global simulation exercises that look into various repurposing scenarios demonstrate important tradeoffs across a number of outcomes. Multiple modeling exercises have been conducted to analyze the potential of repurposing agriculture public support. Several scenarios of the joint World Bank and International Food Policy Research Institute (IFPRI) report outline some crucial tradeoffs (Gautam et al. 2022). For instance, in one scenario, eliminating the domestic support to producers would reduce agriculture-related GHG emissions by around 1.5 percent of total agricultural emissions in the baseline and lower the land area used by the sector. These results, however, come at the cost of lower farm output and income per farmer as well as increased food insecurity, higher cost of healthy diets, and increased poverty. In another scenario, making producer support conditional on the adoption of emission-reducing practices would reduce agriculture related GHG emissions by 15 percent, yet this number is offset by an increase in agricultural land use, a decline in global income and agriculture production, and an increase in the cost of a healthy diet and in poverty.

The *2022 State of Food Security and Nutrition in the World (SOFI)* global report—which is produced by the FAO jointly with the International Fund for Agricultural Development (IFAD), UNICEF, the World Food Programme (WFP), and the WHO—presents multiple repurposing scenarios and also sheds light on these tradeoffs. In one scenario, eliminating fiscal subsidies to producers reduces GHG emissions but leads to food and nutrition insecurities (FAO et al. 2022). On the other hand, repurposing fiscal subsidies to producers improves the affordability of a healthy diet and lowers global extreme poverty; however, in this scenario, GHG emissions from agriculture increase by 1.5 percent as a result of higher production.

However, these same global simulation exercises suggest that there are opportunities for multiple wins when targeting for better climate outcomes (figure 2.6). Scenario 4 of the joint World Bank and IFPRI report looks at repurposing some of domestic support to specific technological

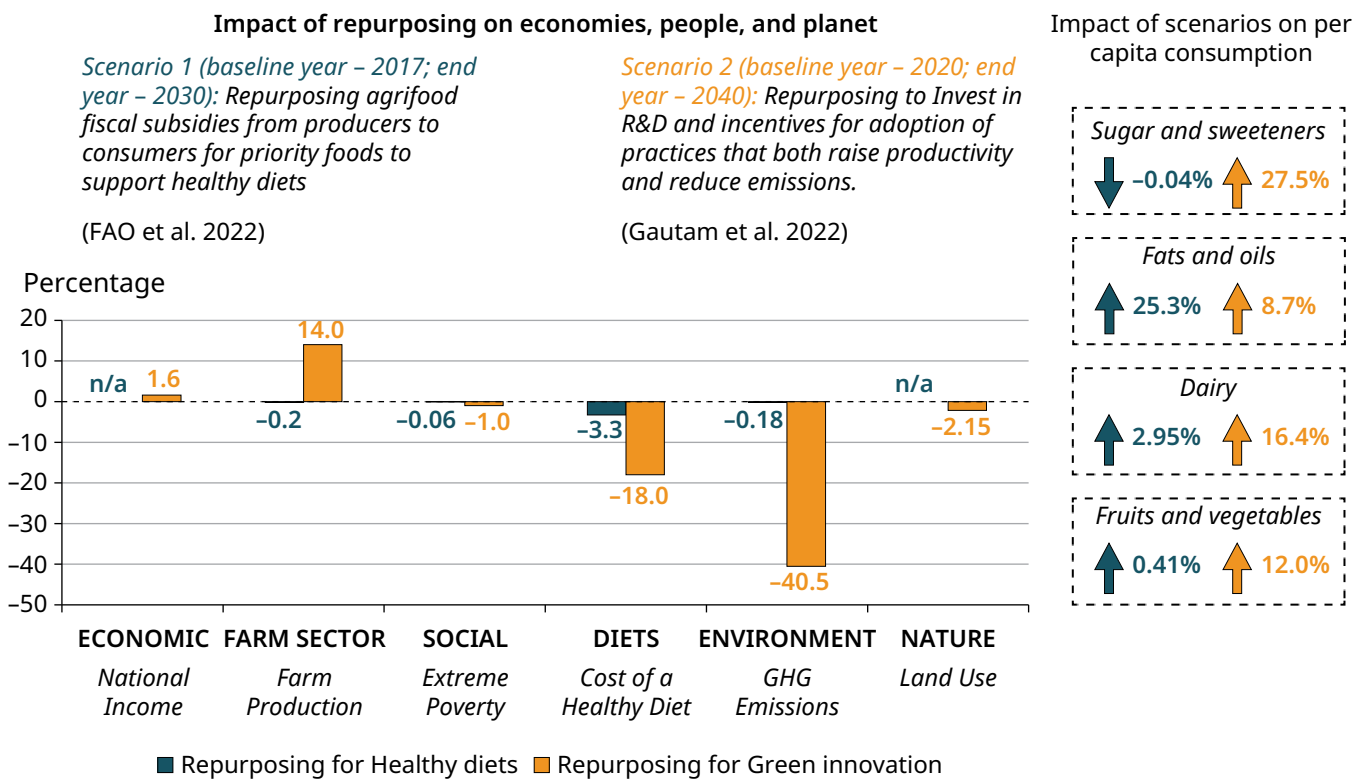
investments, aimed at increasing productivity and decreasing emissions (Gautam et al. 2022); this scenario is called “Repurposing for green innovation.” The modeling in this case shows that redirecting public support to research and development and other technological investments could lead to “triple wins” for a healthy planet, economy, and people. With the baseline year of 2020, the study finds that, by 2040, repurposing for green innovation can lead to a 1.6 percent increase in real national income, a 1 percent reduction in extreme poverty, and an 18 percent reduction in the cost of healthy diet globally compared to the business-as-usual scenario. Agricultural productivity also increases in this repurposing scenario, with the volume of crop production rising by 16 percent and of livestock by 11.5 percent. In addition, repurposing for green innovation can vitally lead to a 40.5 percent reduction in emissions from agriculture and land use, which partially derives from a 2.15 percent decrease in agricultural land. On the negative side, however, the World Bank–IFPRI modeling finds that the above-mentioned scenario can also result in an 8 percent decrease in real farm income per worker, a 10.5 percent reduction in farm employment, and a 27.5 percent increase in the consumption of sugar, which is already an overconsumed commodity (Gautam et al. 2022).

At the same time, these simulation exercises suggest that there are also opportunities for win-wins when targeting for better health outcomes. The 2022 SOFI report’s scenario 6 looks at repurposing agrifood support (fiscal subsidies) from producers to consumers for priority foods to support healthy diets (figure 2.6). This scenario targets high-priority foods with a 10 times increase in average consumer subsidy, keeps the average level of consumer subsidy for medium-priority foods, and keeps only one-tenth of the average level of support for low-priority commodities. With the baseline year of 2017, the study finds that, by 2030, this repurposing scenario can reduce extreme poverty by 0.06 percent, reduce GHG emissions by 0.18 percent, and, importantly, decrease the cost of a healthy diet by 3.34 percent globally. Extreme

poverty falls the most—by 0.22 percent in low-income countries. Since repurposing for healthy diets considers the reduction in the support to low-priority foods, the consumption of sugar and sweeteners can be lowered by 0.04 percent while at the same time increasing the consumption of dairy as well as vegetables and fruits. A substantial tradeoff in this scenario is the reduction in farm income of 3.74 percent and agricultural production of 0.2 percent. However, this outcome significantly

impacts high-income countries; low-income countries experience an increase in farm income of 1.61 percent and agricultural production of 0.36 percent (FAO et al. 2022). In practice, repurposing would require transitioning farmers away from their current livelihoods. While often politically difficult, there are lessons that can be learned from similar experiences, for example for transitioning away from tobacco farming (see box 2.4).

Figure 2.6 Repurposing Simulations at the Global Level: Potential Win-Win Scenarios



Sources: Original figure for this publication based on data from FAO et al. 2022 and Gautam et al. 2022.

Note: The scenario on the left is listed as **Scenario 6** in FAO et al. (2022), shifting fiscal subsidies from producers to consumers in support of healthy diets. In this new scenario the fiscal subsidies initially allocated to producers no longer stay within the agrifood sector, although they remain within the agrifood system. The scenario on the right is listed as **Scenario 4** in Gautam et al. (2022). In this scenario, a portion of current domestic support would be repurposed for increased spending on green innovations; that is, the development, diffusion, and adoption of new technologies that both reduce emissions and raise productivity. “Farm Production” is the average change in the production volume of crops and livestock.

In Africa, simulation exercises indicate that simultaneously increasing and rebalancing agrifood support can yield important benefits. Additional Africa-focused modeling studies have been conducted to look at the repurposing possibilities on the continent. Particular attention was paid to how increasing agriculture spending to up to 10 percent of national budgets and allocating

it to producers to cultivate high-priority crops such as fruits, vegetables, legumes, and nuts. With the baseline year of 2011, the study finds that this repurposing scenario, in 12 years, could have dramatically increased the production of high-priority horticulture by 18.269 million metric tons. However, other commodities would experience a production decline; for instance, wheat and

other grain production would fall by over 1.100 million metric tons and the production of sugar would be cut by 522,000 metric tons. Despite some of the losses, the overall agrifood sector would gain almost \$5.2 billion in sectoral income and export revenue. Excessive or insufficient consumption of various agricultural commodities creates diet-related risk factors, which can even lead to death.² Hence, deaths can be averted by either increasing the consumption of high-priority commodities or reducing the consumption of low-priority ones. This repurposing scenario also models the avoidance of thousands of deaths and leads to a reduction in GHG emissions of around 0.7 percent. Among the avoided deaths, this scenario tackles the underconsumption of legumes, vegetables, nuts and seeds, and fruits and lessens the impact of the underweight risk factor. On the other hand, obesity and overweight deaths rise, but far less than the number of prevented deaths (GLOPAN 2022). This result is particularly important for children, since poor diets can lead to lasting impacts on physical health and cognitive development, such as stunting, which can influence overall well-being and future productivity. Lastly, the tradeoff of this action would be an increase in the use of land and water by around 2.5 percent and 3.8 percent, respectively. Thus, expanding agriculture spending in Africa while targeting high-priority commodities is a viable option for the continent to improve its competitiveness in global markets and to increase the nutritional value of diets in the region. In addition, newer evidence indicates that there is dynamism in the fruits and vegetable supply in Africa owing to investments in wholesale markets, roads, other infrastructure such as electrification, and agricultural research/extension (Reardon et al. 2024).

Repurposing agrifood support requires a set of complementary interventions across various sectors, including agrifood systems, health systems, social protection, and the environment. Central to repurposing is a careful consideration of the political economy to determine what is feasible and how to overcome political economy constraints.

Repurposing for better diet and health outcomes requires a set of complementary interventions. Such interventions are vital to ensure that there are incentives (disincentives) that work together with repurposing scenarios to push for the changes in food supply chains and environments and shift consumer behavior toward healthier options (FAO et al. 2022). A suite of complementary measures is essential to mitigate and protect against unintended consequences stemming from reallocating support, particularly if such transitions result in challenges to accessing nutritious foods and healthy diets for vulnerable and disadvantaged populations. Agrifood systems transformation must consider the roles of private enterprises, such as agribusinesses, that impact the availability, access, utilization, and stability of food systems.

Complementary interventions to repurposing include relevant agrifood systems policies, among others. These policies include implementing limits or targets for food reformulation to improve nutritional quality and availability; enhancing nutritional content via fortification and biofortification; implementing laws regarding the promotion of food and beverages, along with enforcing policies on nutrition labeling; implementing taxes on energy-dense foods, rich in fats, sugars, and/or salt; integrating land-use policies with other complementary measures to tackle food deserts and swamps; enforcing policies for healthy public food procurement and services (for example, having nutrition-guided meals and beverages in public settings, such as schools). Other policies include social protection system policies (for example, expanding existing social protection programs, such as social insurance and labor market interventions; building new shock-responsive systems to safeguard vulnerable populations against potential tradeoffs of public support repurposing); environmental and climate-related policies and incentives (for example, supporting adaptation and mitigations measures, promoting intercropping, and reducing chemical fertilizer use); health system policies (for example, focusing on vulnerable populations by strengthening mother and child nutritional

services, enhancing the One Health approach,³ hence the communication between agrifood, environment and health systems); and other system policies (for example, boosting efficiencies in transportation and energy to reduce the cost of the repurposing transition, ensuring the availability of cold chains to prevent food losses of perishable commodities).

Moreover, a careful consideration of the political economy around repurposing is crucial. The political economy constraints to policy reform are significant because existing policies are often politically popular and serve well-entrenched interests. A review of recent policy reform experiences in China, the European Union, India, and the United States

highlight some important lessons around political economy. These include the significance of the power of ideas around both the links between food security and food availability (without considering diversification) and the contrast between self-sufficiency and multilateral cooperation; the importance of institutional commitments; and the impetus provided by the failure to sustain high or distorted market support prices. Ultimately, reform is hindered without strong commitment from political leaders and an effort toward multilateral collaboration (Vos, Martin, and Resnick 2022). On the topic of crops that promote unhealthy practices, other lessons on reform can be learned from transitioning away from tobacco crop (see box 2.4).

Box 2.4 Lessons in Transitioning Farmers away from Tobacco Farming

Due in large part to global tobacco control measures including tobacco taxes, cigarette consumption and, in turn, demand for tobacco leaf have been declining for nearly two decades. This has coincided with a shift in production from developed to developing countries, often with government support and economic incentives, and stagnant or declining prices that farmers are paid for tobacco leaf. This generates concerns for the livelihoods of farmers and economic development in tobacco-growing countries, and pressure to seek alternatives for tobacco growing.

Unprocessed tobacco leaf is rarely subject to tobacco excise taxes. Tobacco excise taxes levied on manufactured products such as cigarettes are among the most effective tools at reducing the negative externalities and internalities associated with tobacco use. Unprocessed tobacco leaf production is not a large source of tax revenue on its own,

given that farmers and leaf-buyers typically face low tax rates and often benefit from tax exemptions. Most tobacco-producing countries—particularly those with the largest relative economic contribution—are typically net exporters of tobacco leaf, making the connection between domestic excise taxes, consumption, and tobacco growing marginal. Tobacco-growing countries have scope to increase domestic tobacco taxes with limited impact on their leaf-growing markets.

While tobacco growing is generally a small contributor to economies, it can have a significant impact on poverty and farmer welfare. In the 90 countries that grow tobacco, the crop contributes less than 0.2 percent of gross domestic product (GDP) in 70 of them; however, it has a considerable economic impact in a very small number of countries. In many countries, tobacco is also grown by smallholder farmers, with these farmers having higher

rates of poverty than their peers. They are likely to be in a debt cycle with tobacco companies, with few safeguards in place to protect farmers. They experience food insecurity and consistently use household or child labor as a low-cost alternative to hiring adult workers. Tobacco cultivation can have negative health effects for farmers and is one of the most environmentally devastating crops.

As global demand is expected to continue to decline, many tobacco-growing countries are particularly vulnerable since they have little effect on global markets and are price takers, highlighting the urgency of considering transitioning to alternatives. Alternative livelihoods programs for tobacco farmers have been scarce, and the few that have emerged have suffered from well-documented challenges. For example, a set of programs in Kenya in the late 2000s introduced bamboo as an alternative crop. However, the programs failed to establish a strong market mechanism for the farmers to sell their crop, resulting in long-term negative impacts when farmers struggled to sell the bamboo. A new program with a focus on beans is aiming to address this core issue by ensuring that markets exist for farmers to sell their crops.

A considerable number of farmers are shifting gradually away from tobacco where the conditions are favorable. Research from major tobacco-growing regions suggests that tobacco farmers have dynamic on-farm economic lives, often growing other crops including staple and other food crops, many in surplus to sell on the open market (for example, groundnuts in Malawi, wheat in North Macedonia, maize in South Africa, and green vegetables in Zambia). Many farmers in tobacco-growing regions also pursue off-farm economic activities including

paid work in nearby towns, entrepreneurial endeavors, and small businesses. Farmers who spend less time tending their crops have more time to commit to these other endeavors, and data show that these farmers are consistently making a better overall livelihood through alternative economic activities. For example, in Indonesia, average total household income of former tobacco farmers was found to be 30 percent higher than that of current tobacco farmers, reflecting widespread poverty among Indonesian tobacco farmers. Some farmers now move in and out of tobacco cultivation based on tobacco yields, prices, and often crude weather predictions. This transition may be more feasible in countries that are undergoing a broader shift of income-generating opportunities out of agriculture into manufacturing and services, supported by a business-friendly investment environment as well as investment in human capital and economic infrastructure. There are several actions that governments can take to support successful shifting away from tobacco growing:

- *Invest in and support marketplaces to connect farmers to buyers of their crops.* Research suggests that many tobacco farmers grow tobacco because they feel relatively assured of its economic viability and a guaranteed market for the crop. The probability of successfully shifting is greatly enhanced where there are accessible markets to sell other crops.
- *Improve supply and value chains for other products to incentivize farmers to shift.* For example, in Migori County, a major tobacco-growing region in Kenya, a sweet potato processing plant has been established by the government and many farmers there have begun to grow sweet potato, appearing to make more money doing so.

- *Expand extension services.* Many farmers report that they grow tobacco because it is all they know how to do well and that they receive extension services directly from the tobacco companies. To address this issue, governments can consider expanding extension services for farmers to learn how to better grow other locally suitable crops.
- *Support rural credit schemes to provide more options to farmers beyond tobacco.* Farmers consistently cite lack of credit as a reason they choose to grow tobacco, and contracts with leaf-buying companies provide a form of credit. There is a widespread lack of access to credit in rural settings, and governments can actively support rural credit schemes to provide more options to farmers beyond tobacco contracts.
- *Ensure access to information and related technological infrastructure.* Farmers often lack up-to-date information that is key to making better decisions, including planting decisions (for example, information about prices, buyers, weather, and climate). Improving access to and the quality of information results in better outcomes for farmers. For example, in Kenya, farmers with access to mobile phones that have reliable coverage were found to be more likely to shift away from tobacco, have more diverse economic portfolios, and have better overall economic livelihoods. Governments can help farmers by ensuring reliable mobile phone coverage and by developing local platforms on which information is shared.

Source: Drope et al. 2023.

Assessing options for repurposing requires leveraging better data and techniques to carefully assess the links between agrifood policy and support, food consumption, and healthy diets. Assessing options will also require a rich set of country-level deep dives that investigate policy reform simulations and their impacts on health and environmental outcomes.

Country-level simulation exercises in the context of public expenditure reviews provide a good understanding of tradeoffs and win-wins around healthy diets and climate outcomes; such studies can be used as a blueprint for other country-level deep dives. In *Ethiopia*, modeling work focused on healthy diets has assessed ways in which the government could rework its budget to both reduce the cost of diets while achieving inclusive agriculture transformation (IAT), which consists of increasing agrifood output, creating jobs, and

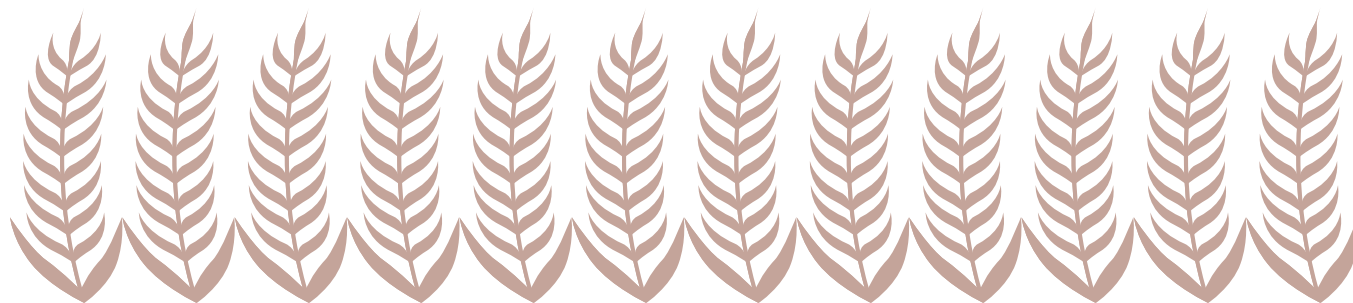
reducing poverty (Sanchez and Cicowiez 2022). Focusing solely on reducing the cost of diets would somewhat slow down progress toward IAT. However, focusing solely on IAT objectives ensures faster progress toward increased output, more jobs, and lower poverty while at the same time reducing the cost of diets, suggesting a window of opportunity for win-wins. In *Uzbekistan*, the government is implementing programs to support modernization in agriculture, including drip irrigation adoption and investments in viniculture (World Bank 2021). Irrigation plays a pivotal role in the country's agriculture sector, particularly the production of cotton. A modeling exercise shows that utilizing effective drip irrigation systems could decrease water consumption and expenses related to fertilizers, fuel, and machinery, meanwhile increasing cotton yields. Rising demand for irrigation services then urges the private sector to enhance their investments in these systems. Furthermore, drip irrigation adoption is also expected to lower the use of fertilizers, fuel, and machinery and,

ultimately, almost double the profits of farmers over the course of five years. However, this will also increase labor costs (Rudenko 2019; World Bank 2021). In *Viet Nam*, two technically and economically sound strategies have been piloted that can preserve or increase rice yields and farmer incomes while decreasing GHG emissions. The first one is alternate wetting and drying (AWD), which promotes water management; the second one is One Must Five Reductions (1M5R) techniques, which focus on optimal input use (World Bank 2022). Simply adopting these technical solutions will not lead

to the largest reductions in GHG emissions. Combining a national carbon tax with technical solutions is expected to yield a much higher GHG reduction. The simulations here are valuable exercises, but there is no-one-size fits all analysis on repurposing for diets at the country level. A variety of analytical work at the country level can help elucidate policy options. Chapter 3 presents some global-level analysis on the links between public agrifood support and food consumption, while chapter 4 presents some country-level case studies on the impacts of various programs on healthy diets.

Notes

1. The term *public support* refers to the total amount of monetary transfers to agriculture producers, consumers, and general services. Public support includes budget subsidies and Market Price Support that derive from trade measures. Chapter 3 provides a detailed explanation of public support and how it is calculated.
2. Risk factors include low consumption of fruits, vegetables, legumes, and nuts and seeds; high consumption of red meat; and being overweight or obese.
3. Details about the WHO's One Health approach can be found at https://www.who.int/health-topics/one-health#tab=tab_1.



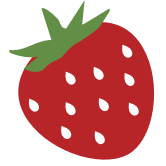
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3.1. Existing research on agrifood support and food consumption

This chapter analyzes the cross-country relationship between different types of agrifood support and consumption of different types of food commodities. Cross-country empirical studies such as those of Magrini et al. (2017) and Miller and Coble (2008) document the heterogeneous effects of agrifood policies on food affordability. Magrini et al. (2017) investigate the comprehensive impacts of agricultural policies on food security for 64 countries over the 1990–2010 period using the nominal rate of assistance (NRA). The findings suggest that both excessive disincentives and incentives for agriculture may discourage food security, while moderate support is likely to enhance food availability, access, and utilization. Miller and Coble (2008) estimate the impact of government agricultural support on the affordability of food in 10 Organisation for Economic Co-operation and Development (OECD) countries—Australia, Canada, Iceland, Japan, Mexico, New Zealand, Norway, Switzerland, the United States, and Türkiye—over the 1986–2004 period using the Producer Support Estimate (PSE) and the Consumer Nominal Protection Coefficient (CNPC) as measures

of agricultural policies. The study documents heterogeneous effects of supports and protections and finds that these measures affect the food affordability for only a subset of countries.

Another related cross-country study is that of Takeshima (2024), which examines the relationship between sectoral public expenditure and health outcomes and finds that public expenditure on agriculture reduces poverty, child stunting, overweight, and malnutrition as well as food prices. A recent study by Gilbert et al. (2024) provides a value-chain approach to explain how trade policies influence the cost of a healthy diet. The study indicates that most food retail items in African countries are based on some imports and emphasizes that food imports need to be viewed as inputs in the food value chain. Their assessments imply that the share of cost of a healthy diet that is attributed to trade measures is small (that is, 0.67 to 2.45 percent globally). Newer work from Hsiao, Moscona, and Sastry (2024) shows that governments intervene in agriculture markets in response to heat shocks primarily through border protection measures, while producer assistance increases with foreign production shocks. A body of literature also documents positive links between trade policy and obesity (see box 3.1).

Box 3.1 Trade Policy and Obesity

Globally integrated economies can be one of the key explanations for global obesity trends. Vogli et al. (2014) examine how economic globalization and body weight outcome are connected and find a positive association

between globalization and body weight in 127 countries from 1980 to 2008. Miljkovic et al. (2015) develop a theoretical model that describes how globalization exacerbates obesity in the importing countries under free

trade agreements. Costa-Font and Mas (2016) empirically test whether globalization impacts obesity using panel data on health outcomes and various measures of globalization for 26 countries in the period 1989–2005. They find the effects of globalization to be an increase of both obesity and caloric intake, both of which are driven by different factors of social globalization, such as changes in lifestyles.

Reduction in tariffs on unhealthy foods can provoke obesity or overweight by reducing the relative price of unhealthy foods. Using the aggregate measure that captures tariff and nontariff barriers for 9 countries, Cutler, Glaeser, and Shapiro (2003) show that more tariff and nontariff barriers to agriculture are likely to decrease obesity. Boysen et al. (2019) analyze how higher import tariffs on highly processed foods influence body weight outcomes in Sub-Saharan Africa countries. They find tariff differences between highly processed foods and less processed foods increase obesity and mitigate underweight and the effects are differential in income level of the country, genders, and regions. They conclude that, while imposing sales taxes can mitigate obesity and aggravate underweight and vice versa, an integrated policy approach is needed to treat these two issues simultaneously. Abay, Ibrahim, and Breisinger (2022) argue that food trade policies can influence the food consumption patterns leading the rise of overweight and obesity, and they study how tariff rates on unhealthy foods and government subsidies affect individuals' health outcomes

in 31 low- and middle-income countries. Their findings validate the association of trade and fiscal policies on unhealthy foods and body weight outcomes and indicate heterogeneity in degrees of exposure to these policies across the level of wealth in households.

In line with prior research examining the link between trade policy and body weight on a global scale, findings from Mexico similarly suggest that a decrease in tariffs could contribute to obesity. Giuntella, Rieger, and Rotunno (2020) examine whether Mexico's greater exposure to foods and beverages from the United States affects obesity through tariff reductions of the North American Free Trade Agreement (NAFTA). Using anthropometric data for adult women with a shift-share approach, they show that increasing US food exports to Mexico aggravated the prevalence of obesity across Mexican states between 1988 and 2012 and find that most impacts of food imports on obesity come from unhealthy food imports. Using annual food supply data from the FAOSTAT, Barlow et al. (2017) analyze the impact of NAFTA on the supply of high-fructose corn syrup (HFCS) that experienced tariff removal once NAFTA was signed. Their findings show that tariff reductions led to more consumption of caloric sweeteners, including HFCS, in Canada. These findings underscore concerns regarding the potential adverse health implications of forthcoming trade agreements despite partial offsets from the targeted public health policies.

A recent report from the World Bank (2024) on trade and food security highlights the critical importance of international trade and integration in international markets for food and nutrition security. Over the past five decades, from 1970 to 2023, the global food system has been repeatedly strained by external shocks such as financial crises, geopolitical conflicts, and climate change.

These disruptions have worsened food insecurity and have led to lower diet quality, especially for poorer populations. Inefficient policies like price insulation have often amplified these problems by creating greater market instability. Ensuring global food security requires comprehensive reforms in trade policies, climate-resilient agricultural practices, and more efficient logistics systems

to address both price volatility and dietary challenges:

- Reducing the use of price insulation measures, such as export restrictions and tariffs, will help governments protect consumers from food price shocks while maintaining access to diverse, nutritious diets. Price insulation, designed to shield domestic markets from global price volatility, frequently achieves the opposite result, increasing domestic price swings and restricting access to essential foodstuffs. Only about 50% of global price changes in key staples, such as rice and wheat, are passed through to domestic markets when price insulation policies are in place. For instance, countries like India and Japan, which applied heavy insulation policies, saw significant price volatility in their domestic markets despite their efforts to stabilize prices. In Japan, insulated markets for rice often displayed the same or even higher levels of price volatility as global markets. This not only affects market stability but also disrupts household food consumption patterns, leading to poorer diet quality. Conversely, governments that focus on providing targeted safety nets instead of relying on generalized subsidies or trade barriers can better stabilize prices while promoting access to higher-quality diets, especially during crises. Case studies from Egypt and Morocco show how entrenched food subsidies for staples like bread have imposed significant fiscal burdens, making it difficult for governments to reform these policies. In Egypt, for instance, over 70% of the population relies on subsidized bread, a system that became politically entrenched and unsustainable during global food crises. When global prices rose sharply after Russia's invasion of Ukraine, Egypt was forced to increase its already enormous subsidies, exacerbating the financial strain. Shifting toward more adaptable and cost-effective policies, such as targeted safety nets, will help address food security challenges more efficiently, ensuring that vulnerable populations receive timely assistance while maintaining fiscal sustainability (World Bank 2024).
- Strengthening regional markets and enhancing agrifood logistics can ensure food security and dietary diversity. In times of global disruption, regional trade agreements and robust agrifood logistics systems serve as essential buffers, enabling countries to maintain access to diverse food sources and stabilizing local diets. Data from Chile and Colombia illustrates how countries that relied on regional imports were able to mitigate the effects of global price shocks (World Bank 2024). For instance, during a period of heightened global maize prices, Chile increased its share of maize imports from regional partners to nearly 100%, which limited price hikes. Similarly, Colombia's reliance on regional maize imports rose from 22% to 52%, allowing the country to avoid more severe price increases that would have occurred if it had depended solely on global markets. Regional trade plays an instrumental role in smoothing out supply disruptions and helping to maintain a consistent flow of essential food items.
- Enhancing agrifood logistics, particularly shipping routes and transportation infrastructure, is equally critical in safeguarding food security. The logistical challenges created by the COVID-19 pandemic and the the invasion have exposed the vulnerability of global food supply chains. Rising freight rates, coupled with delays at key shipping points like the Suez and Panama Canals, have further exacerbated food price instability. Investing in resilient logistics networks is important—such as upgrading infrastructure for storage, reducing post-harvest losses, and using digital technologies to streamline food supply chains. For instance, using blockchain technology to coordinate logistics between smallholder farmers and food vendors, as implemented in Kenya, has reduced food spoilage and increased efficiency. By improving logistics and reducing food waste, countries can ensure more stable access to a variety of foods, thereby maintaining both food security and dietary diversity in times of global crisis (World Bank 2024).

- Climate-resilient agricultural practices are essential for securing future food production and consumption patterns. Climate change will have a profound impact on agricultural productivity and food systems, necessitating proactive investment in sustainable, climate-smart agricultural practices to safeguard future diets. Artuc et al. (2023) highlights that climate change is expected to alter growing conditions in many regions, with some areas benefiting from warmer temperatures and extended growing seasons, while others face devastating declines in productivity. For example, regions in Sub-Saharan Africa and South Asia are particularly vulnerable to reduced yields of staple crops like wheat, maize, and rice. Without significant investment in climate-resilient agricultural infrastructure, poorer households in these regions will face even more severe food insecurity and reduced access to nutritious foods. Through the adoption of sustainable agricultural technologies—such as improved irrigation methods, drought-resistant crop varieties, and soil health management practices—countries can mitigate some of the negative impacts of climate change on food production. Real income losses due to climate-related shocks could be as high as 63% in the most vulnerable areas (Artuc et al. 2023). Investments in climate-resilient infrastructure will be critical not only to protect local food production but also to ensure that international trade in climate-resilient crops continues to supply diverse and nutritious foods to regions at risk of climate-driven food shortages.

3.2. Different types of agrifood public support

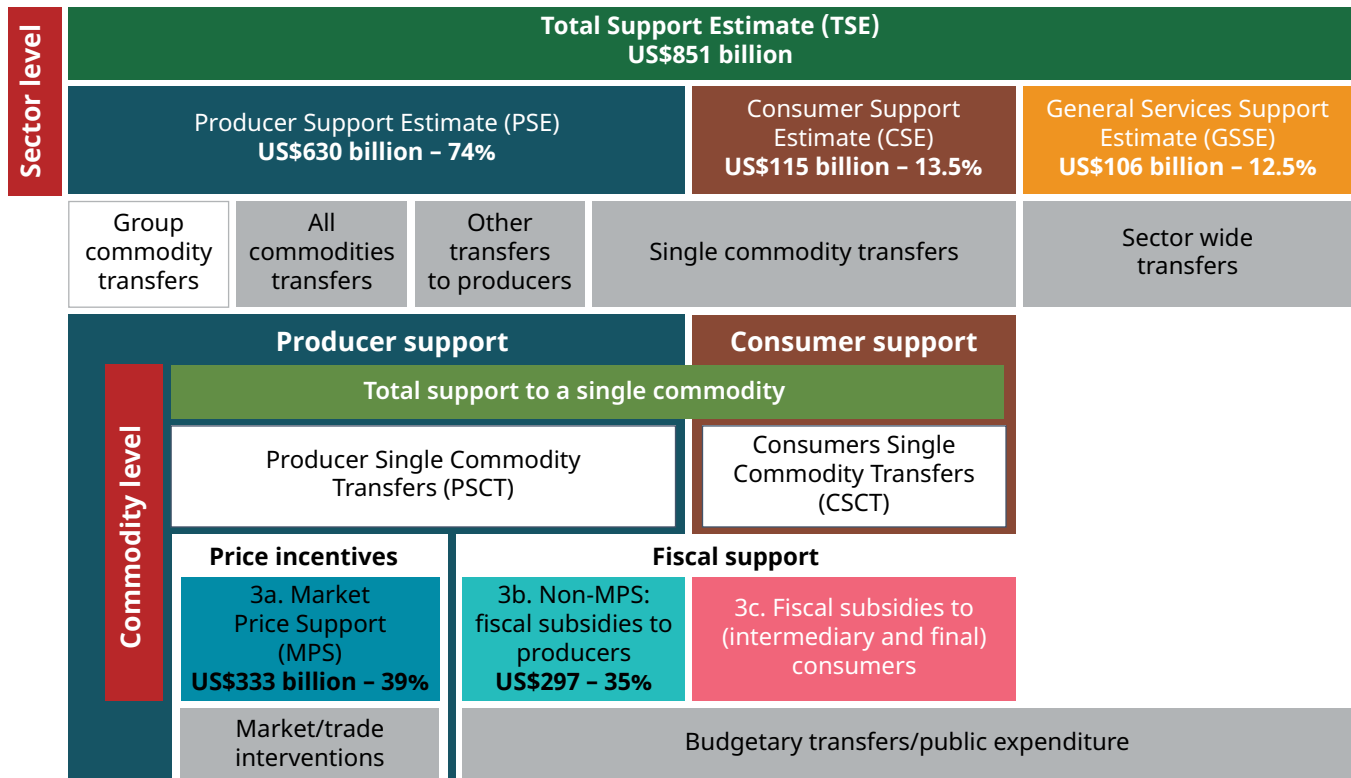
The overall principles that underpin the analyses proposed here are that not all types of agrifood public support are the same, that not all types of food commodities are the same, and that the impacts of a given type of support can vary depending on the type of food commodity.

The OECD support estimates aim to quantify the gross transfers to agriculture that originate both from consumers and producers of agricultural commodities and from taxpayers. These transfers are the result of diverse government support policies, which may include direct payments, trade barriers, and other forms. It is crucial to understand that these indicators primarily measure the level of governmental support effort, rather than the direct impact of this support. The OECD methodology encompasses several indicators. These indicators, collectively, offer a comprehensive view of government support in agriculture, aiding in the understanding and analysis of policy impacts on the sector. Figure 3.1 displays the sector and commodity levels of this study's analysis, based on OECD data for years between 2020 and 2022 (average, per year).

At the agrifood sector level, there are different types of public support. At the sector level, agriculture support is comprised of three components that, added together, make up the *Total Support Estimate* (TSE). These three elements are *Producer Support Estimate* (PSE), *Consumer Support Estimate* (CSE), and *General Services Support Estimate* (GSSE). PSE is the largest recipient of agrifood public support, with 74 percent; CSE is second, with only 13.5 percent; and GSSE is third, with around 12.5 percent of public support (OECD 2023). It is important to note that PSE can be negative if government interventions lead to negative transfers, essentially taxing producers rather than supporting them.

Besides the sectoral level, agriculture support can further be separated into commodity-specific indicators. Both PSE and CSE can be broken down into a combination of commodity-related indicators, unlike GSSE, which remains only at the sectoral level. *Producer Single Commodity Transfers* (PSCT) and *Consumer Single Commodity Transfers* (CSCT) are key components of TSE and allow for commodity-specific analysis. A large portion of PSCT and PSE is *Market Price Support* (MPS), which is a distortive measure that impacts the price of a commodity. Definitions of the above-mentioned indicators are provided in box 3.2.

Figure 3.1 Composition of Agrifood Public Support



Source: Original figure for this publication based on data from OECD 2023.

Note: Producer Support, Consumer Support, Total Support to a Single Commodity, Price Incentives, Fiscal Support, Market/Trade Interventions, and Budgetary Transfers / Public Expenditure are all characteristics of different agrifood public support indicators and are not official OECD terms. 3B and 3C are also not official OECD terms but are a simplified version of the OECD methodology for our analysis and will be introduced below.

Box 3.2 Indicator Definitions for Public Support Variables

Total Support Estimate (TSE): The annual monetary value of all gross transfers from taxpayers and consumers arising from policies that support agriculture, net of the associated budgetary receipts, regardless of their objectives and impacts on farm production and income, or consumption of farm products.

Producer Support Estimate (PSE): The annual monetary value of gross transfers from consumers and taxpayers to agricultural producers, measured at the farm gate level, arising from policies that support agriculture, regardless of their nature, objectives or impacts on farm production or income.

Consumer Support Estimate (CSE): The annual monetary value of gross transfers from (to) consumers of agricultural commodities, measured at the farm gate level, arising from policy measures that support agriculture, regardless of their nature, objectives or impacts on consumption of farm products.

General Services Support Estimate (GSSE): The annual monetary value of public expenditures aimed at providing public goods and services to the agriculture sector, such as research and development, infrastructure, extension services, and marketing support. This indicator captures the government's investment in supporting the overall agricultural sector rather than targeting specific commodities or producers.

Producer Single Commodity Transfers (PSCT): the annual monetary value of gross transfers from consumers and taxpayers to agricultural producers, measured at the farm gate level, arising from policies linked to the production of a single commodity such that the producer must produce the designated commodity in order to receive the transfer.

Consumers Single Commodity Transfers (CSCT): The annual monetary value of gross transfers from (to) consumers of agricultural commodities, measured at the farm gate level, arising from policy measures that support agriculture, regardless of their nature, objectives or impacts on consumption of farm products.

Market Price Support (MPS): The annual monetary value of gross transfers from consumers and taxpayers to agricultural producers arising from policy measures that create a gap between domestic market prices and border prices of a specific agricultural commodity, measured at the farm gate level. Usually, expressed as percentage of GFR. This Knowledge Note, similar to existing literature, also refers to MPS's "distortionary support" or equivalent.

Non-MPS Fiscal Support^a (aka Σ BOT, which is aggregate budgetary and other transfers to producers from policies): The annual monetary value of gross transfers from taxpayers to agricultural producers arising from policy measures that do not create a gap between domestic market prices and border prices of a specific agricultural commodity, measured at the farm gate level. Usually, expressed as a percentage of GFR

Source: OECD 2018.

Note: a. OECD methodology does not include the term *non-MPS Fiscal Support*. This category was created by taking the OECD's classification of BOT (budgetary and other transfers). Since Σ BOT includes a lot of different categories and for the analysis, they were combined into one category, which is PSE - MPS = non-MPS Fiscal Support. Public subsidies to producers from national budgets are generally the largest contributor to non-MPS. The definition for Non-MPS Fiscal Support here is the same as MPS, yet the gap between domestic market and border prices is not created. GFR = gross farm receipts.

The data used come from the OECD and the Inter-American Development Bank (IDB), which contains information on public support to agricultural commodities for all OECD members, other key agricultural producers, and IDB countries. The two sources provide data from 1986 until 2021, which is also the data range the analysis follows. This data set is matched with the Global Dietary Database (GDD), which contains information on the mean daily intake of different food groups across 187 countries since 1990 (described below). Depending on the commodity in the analysis, the number of countries in the sample changes, since not all countries in the data sample produce each given commodity. For instance, the sample includes 44 countries that are in both the GDD and the agrifood policy data set based on OECD and IDB's Agrimonitor.¹ There are more observations for the sugar analysis as there is one more year (2020) in the GDD for sugar. The data allow for a comparative analysis across different types of agrifood support at both the sector and commodity levels.

- The OECD collects and reports agriculture support data for 54 countries—specifically the 38 OECD countries, 11 emerging economies,² and 5 non-OECD EU Member States. The OECD allows for an opportunity to compare agriculture support data across these countries, as the numbers are also converted into US dollars. OECD data are aggregated and used for *Agricultural Policy Monitoring and Evaluation* reports (OECD, various years); the statistics are available at stats.oecd.org.
- The IDB Agrimonitor collects and reports agriculture support data for countries in Latin America and the Caribbean (26 countries);³ it also has data for the European Union, Canada, and the United States.⁴ The Agrimonitor follows the OECD methodology, separating public support into PSE, CSE, and GSSE, which makes the comparison and matching between the two sources possible.

3.3. Different types of food commodities

The analysis in this note covers three commodities with large public support: grains, meats, and sugar. The analysis assesses the relationship between public support to the agrifood sector and the consumption of grains, meats, and sugar.⁵ Consumption data come from the GDD, which is based at the Friedman School of Nutrition Science and Policy at Tufts University. Further information about the commodities in the analysis is provided below.

- Grains: The GDD reports refined and whole grains separately, measured in grams per day. The analysis uses the sum of the two categories.
- Meats: The GDD reports processed and unprocessed meats separately, measured in grams per day. The analysis uses the sum of the two categories.
- Sugar: The GDD reports both sugar-sweetened beverages (SSB) in grams per day and added sugars in percentage of total kilocalories per day. The analysis used added sugars and converted percentage of total kilocalories per day to grams per day.

The data used come from the GDD. Despite extensive nutrition research, the complex effects of various dietary factors on health remain largely ambiguous. This gap largely stems from a lack of systematic and comprehensive efforts to consolidate evidence from controlled interventions and observational studies. Historically, global nutritional research has predominantly focused on individual micronutrients, neglecting the broader spectrum of dietary components including macronutrients, foods, and overall dietary patterns that might have equally significant or greater impacts on health. To address this deficiency, the GDD has been developed as a pivotal resource. The GDD serves as a compendium of dietary data, encapsulating 55 dietary factors across 185 countries (GDD 2018).⁶ It distinguishes itself

through its detailed stratification, categorizing data by 16 age groups, urban and rural settings, and gender. This expansive database is informed by more than 300 nationally representative dietary surveys, covering the dietary preferences of approximately 1.75 million individuals. This represents about 89 percent of the global adult population (Muhammad et al. 2017). The GDD's extensive scope includes 14 food groups, 7 beverage categories, 15 macronutrients, 19 micronutrients, and 2 indexes of carbohydrate quality, making it one of the most comprehensive dietary databases globally.

3.4. Methodology: Cross-country estimations

The cross-country analysis estimates correlations of different types of agrifood support with food consumption of different food items using cross-country panel regressions. The regression analyses leverage the panel of 44 countries in the years 1990, 1995, 2000, 2005, 2010, 2015, 2018 (and for sugar, 2020 is also covered) and employ two-way fixed effects to estimate correlations between public support for agrifood commodities and consumption. The primary specification is:

$$y_{it} = \alpha + BX_{it} + u_i + v_t + e_{it} \quad (1)$$

where y_{it} is the outcome—that is, the consumption of a food group (in grams per day) for country i in year t ; X_{it} is a vector of the agrifood support variables; and u_t and v_i are year- and country-specific fixed effects. Equation (1) is estimated by each food group separately.

For the specification of the vector, X_{it} , two approaches are considered. The first is an estimate of how different types of sectorwide (that is, non-commodity-specific) agrifood support (TSE, PSE, CSE, and GSSE), and correlate that with the consumption of each food group. For this approach, five specifications of X_{it} are considered (TSE, PSE, CSE, GSSE, and [PSE, CSE, GSSE]). The second focuses on the commodity-specific

agrifood support. Here, five specifications of X_{it} (PSCT, MPS, Non-MPS, [Non-MPS, Non-MPS²], and [MPS, Non-MPS, Non-MPS²]) are considered, as well as the specification without and with controlling for CSCT.

3.5. Results: Support to the agrifood sector

At the agrifood sector level, the level of non-Market Price Support has been growing quickly over time, while growth in General Services Support Estimate has been slow. But it is precisely General Services Support Estimate that is found to increase overall productivity and translate into increased consumption of all food commodities assessed. There were no clear impacts of sector wide non-Market Price Support and Market Price Support on food consumption. However, across all types of sectorwide support, the impact of General Services Support Estimate is found to be positive on the consumption of all commodities assessed. A 10 percent increase in General Services Support Estimate leads to a 0.14 percent increase in consumption of grains, a 0.22 percent increase in the consumption of meats, and a 0.35 percent increase in the consumption of sugar.

This section presents descriptives of the measures of *total agrifood support* (PSE, CSE, and GSSE) and estimations of their relationship with the consumption of grains, meats, and sugar, as these are the three commodities with the most public support. Section 3.5 presents descriptives of the measures of *commodity-specific support* (PSCT, MPS, and non-MPS) and estimations of their relationship with the consumption of grains, meats, and sugar, respectively.

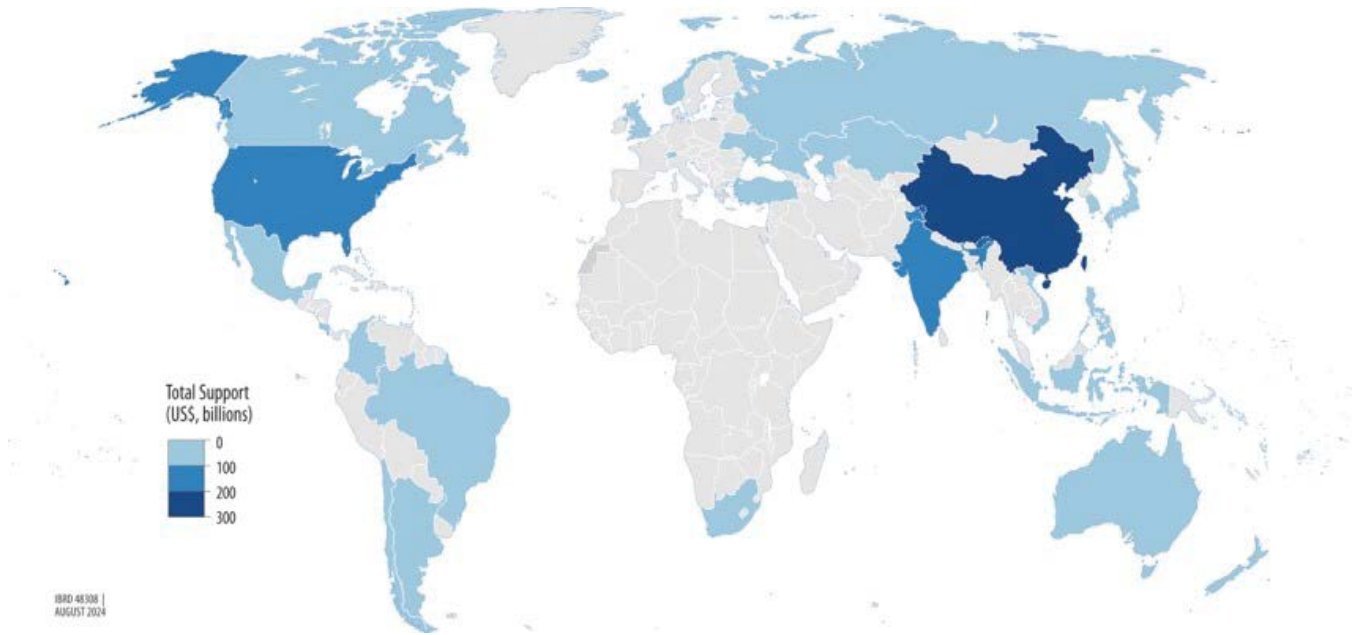
The level of support varies across countries. Map 3.1 presents total agrifood support and PSE across countries (average of dollar values from 2020 and 2022). China strongly supported both the agrifood sector and its producers, with \$310 billion in total support and \$271 billion in PSE. India was the second country that strongly supported agrifood, with \$124 billion, and the United States was the third, with \$122 billion in total support. In terms of PSE, the European Union was the second most supported agricultural producer, with \$93 billion, and the United States was the third, with \$44 billion in PSE. Argentina, Australia, Brazil, Canada, and Russia show overall low total support and low level of PSE.

Most countries have positive PSE and negative CSE. Figure 2.3 presents PSE as a share of gross farm receipts (GFR) and CSE as share of consumption expenditures. Countries with the highest PSE as a share of GFR include Norway, Iceland, Switzerland, the Republic of Korea, Japan, and the Philippines. Countries with the highest CSE as a share of consumption expenditure are India, the United States, Argentina, and Viet Nam. Among those four, the United States is the only country also with positive PSE. Public support to agriculture in most countries provides transfers to agricultural producers and burdens consumers through taxes and other measures.

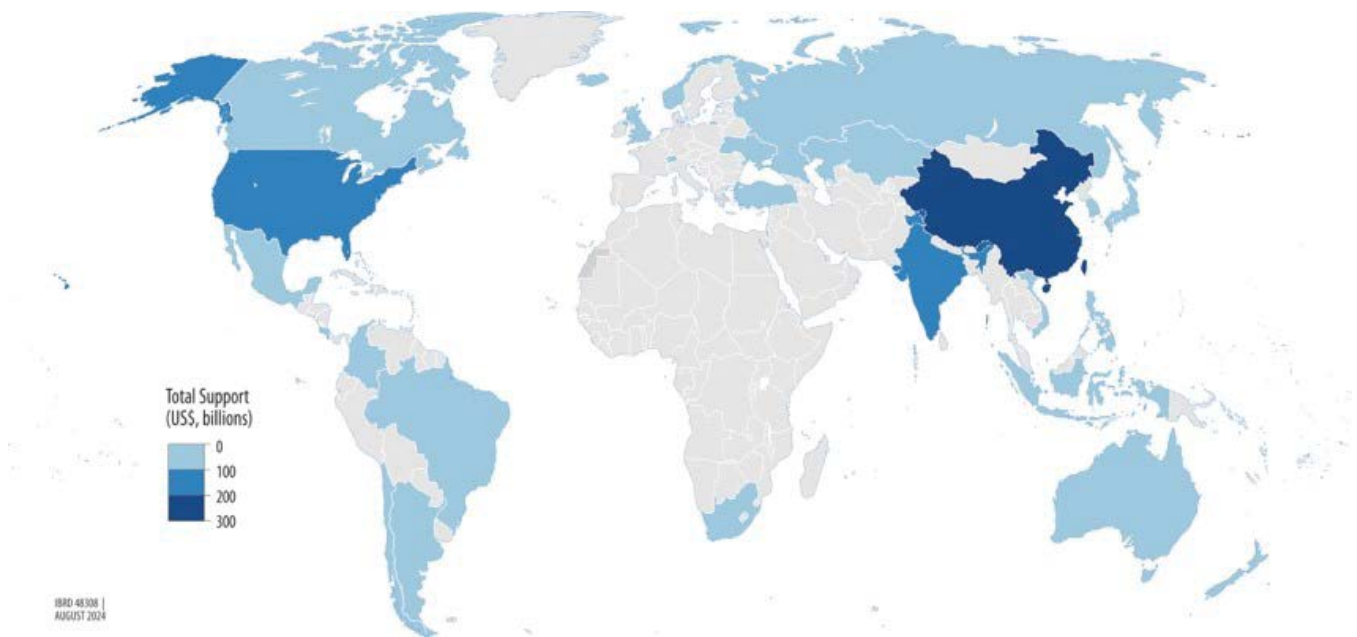
The level of total non-MPS has been the fastest and most steadily growing type of support over time, so that it now surpasses the level of total MPS. Figure 3.3 presents MPS, non-MPS, GSSE, and CSE over time. The level of non-MPS support has been increasing since 1980s; until recently, GSSE has also been increasing over time, but much more slowly than the increase in non-MPS and has lower amount. Therefore, the gap between non-MPS and GSSE has widened over time while both have been increasing steadily. In contrast, despite various fluctuations, MPS and CSE have largely stayed at the same level over time. The largest swings for MPS and CSE occurred around 2008, 2011, and 2021, when MPS dropped and CSE increased.

Map 3.1 Total Support and PSE across Countries

a. Total support, 2020–22



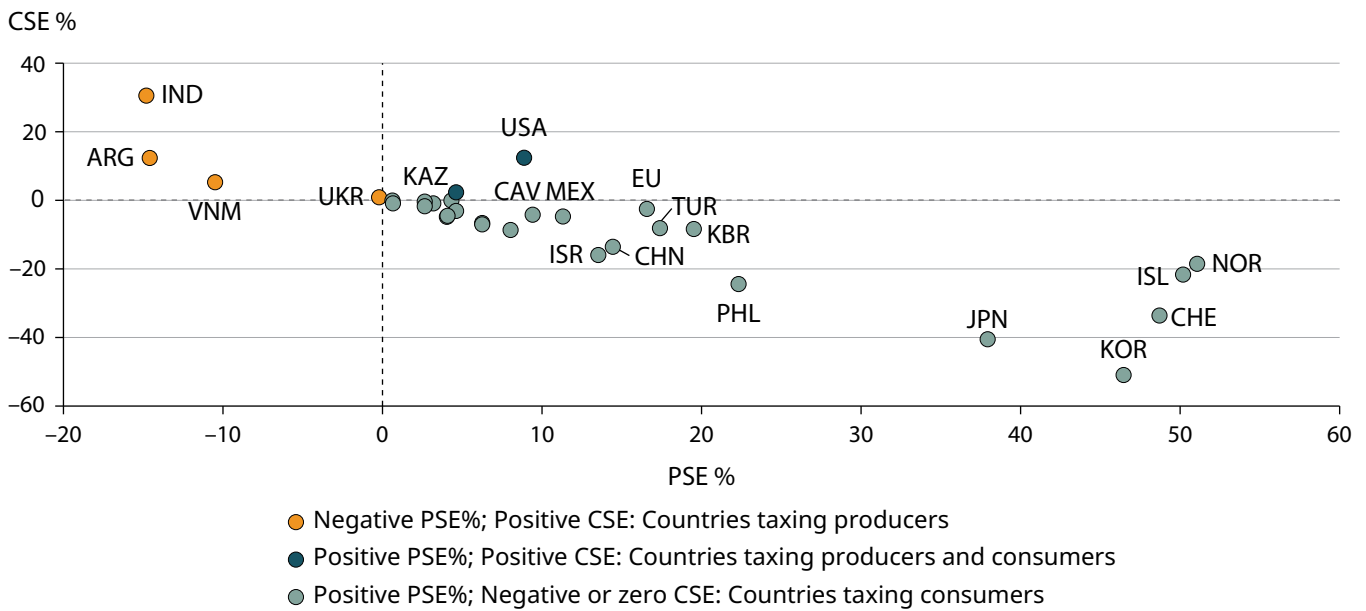
b. PSE, 2020–22



Source: Original map for this publication based on data from OECD 2023.

Notes: The measure of total support includes *Market Price Support (MPS)*, transfers away from producers (negative MPS), *Transfers to Consumers from Taxpayers (TCT)*, and *General Services Support Estimate (GSSE)*. *Producer Support Estimate (PSE)* is defined as the gross transfers from consumers and taxpayers to agricultural producers, measured at the farm gate level, arising from policies that support agriculture.

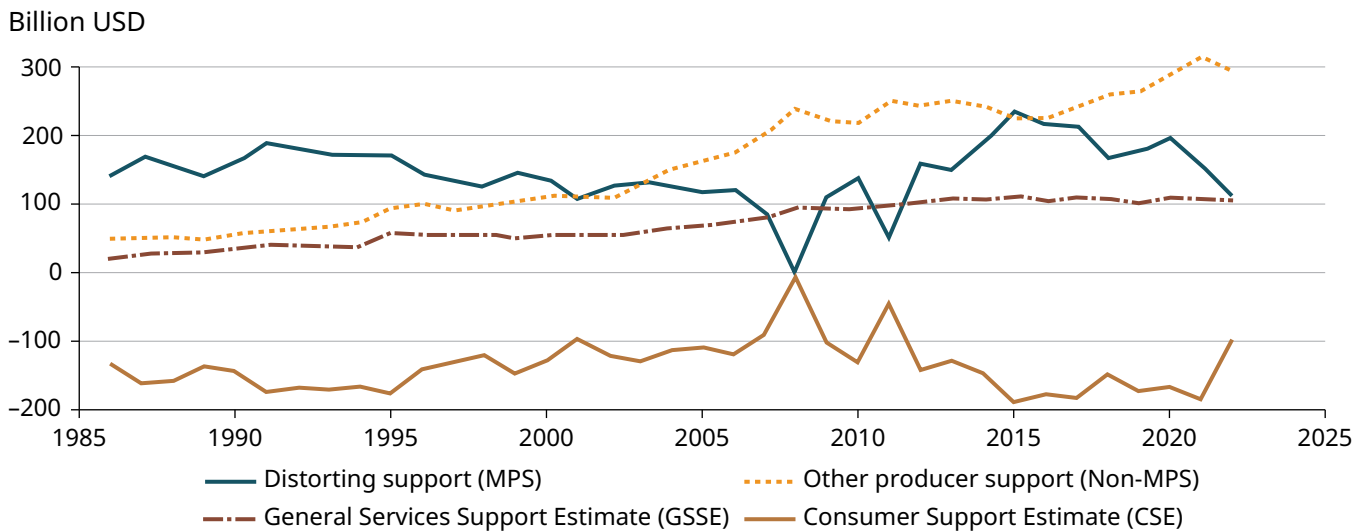
Figure 3.2 PSE vs CSE, 2020–22



Source: Original figure for this publication based on data from OECD 2023.

Note: The percentage of Producer Support Estimate (%PSE) measures transfers to producers as a share of gross farm receipts. The percentage of consumer support estimate (%CSE) measures transfers to consumers as a share of consumption expenditure measured at the farm gate. The PSE and CSE are averaged across 54 OECD+ countries, which include 38 OECD countries, 5 non-OECD EU Member States, and 11 emerging economies. Untitled data points represent Australia, Brazil, Costa Rica, Colombia, Chile, and Brazil, Indonesia, New Zealand, Russia, and South Africa. Countries are indicated by their three-letter ISO codes, available at <https://www.iban.com/country-codes/>. CSE = Consumer Support Estimate; EU = European Union; OECD = Organisation for Economic Co-operation and Development; PSE = Producer Support Estimate.

Figure 3.3 MPS, Non-MPS, GSSE, and CSE, 1986–2022



Source: Original figure for this publication based on data from OECD 2023.

Note: Distorting support indicates *Market Price Support (MPS)*, defined as the gross transfers to agricultural producers arising from policy measures that distort domestic market prices of a specific commodity. Other producer support indicates *Non-MPS Support*, defined as the gross transfers to agricultural producers arising from policy measures that do not distort domestic market prices (calculated as PSE – MPS). *General Services Support Estimate (GSSE)* is defined as the government's investment to support the overall agrifood sector. *Consumer Support Estimate (CSE)* is defined as the gross transfers from (to) consumers of agricultural commodities. This covers 54 OECD+ countries, which refers to the 38 OECD countries, the 5 non-OECD EU Member States, and 11 emerging economies. EU = European Union; OECD = Organisation for Economic Co-operation and Development.

At the overall sectorwide level, there are no clear impacts of TSE seen on the consumption of grains, meat, and sugar. But there are impacts of GSSE seen on the total consumption of all commodities assessed—grains, meat, and sugar. This suggests that there are overall impacts of GSSE on productivity, which translate into consumption gains across food commodities:

- For grains, no statistically significant effects are found for TSE, PSE, CSE, and GSSE when they each enter in regression equations standalone (table C.6 in appendix C). GSSE becomes significant and positive when PSE and CSE are controlled for (table C.6, column 5). The estimated results imply that for every increase of \$1 million in GSSE, the consumption of grains increased by 0.00258 grams per day (p -value < 0.1) when controlling for PSE and CSE (table C.6, column 5), which translated to a 0.14 percent increase in consumption as a response to a 10 percent increase in GSSE.
- For meats, a positive and significant effect of TSE, PSE, and GSSE is found (table C.8, columns 1, 2, and 4). While estimates are noisy, it seems to be the case that the positive effect of TSE is driven by GSSE (table C.8, column 5). The estimated results imply that \$1 million increases in TSE, PSE, and GSSE led to an increase in consumption of meat ranging from 0.000206 grams per day to 0.00108 grams per day. In other words, a 10 percent increase in TSE would increase consumption by 0.22 percent and for PSE and GSSE, those are 0.18 and 0.22 percent increases, respectively.
- For sugar, no statistically significant effects of TSE, PSE, CSE, and GSSE are found when they each enter in regression equations standalone (table C.10). GSSE becomes significant and positive when controlling for PSE and CSE (table C.10, column 5). The estimated results imply that a \$1 million increase in GSSE leads to a 0.000986 grams per day increase in sugar consumption (p -value < 0.05) when controlling for PSE and CSE

(table C.10, column 5), which translated to a 0.35 percent increase in consumption as a response to a 10 percent increase in GSSE

3.6. Results: Support to specific agrifood commodities

An increase in commodity-specific Market Price Support decreases the consumption of grains and sugar, which are often more easily traded than meat. A 10 percent increase in grain-specific Market Price Support reduces consumption of grains by 0.35 percent, and a 10 percent increase in sugar-specific Market Price Support reduces consumption of sugar by 0.60 percent. These distortionary Market Price Support measures increase domestic prices and reduce consumption. Hence, policy reform toward removing market-distorting commodity-specific Market Price Support must be accompanied by complementary measures to curb the consumption of commodities that are less healthy and already overconsumed.

Support to grains

The United States, China, and the European Union are the largest producer of grains, while Kazakhstan, Korea, and India are the largest consumers of grains per capita per day (see table 3.1). Top producers such as the United States, Brazil, Russia, Argentina, Ukraine, and Canada are not part of top consumers, as many of their grain productions are for feed or export. Asian countries, with rice-based diets, are located as top grain-consuming countries. Only China and Indonesia are also in the list of top producers.

Table 3.1 Top Producers and Consumers of Grains

Rank	Top producers in 2018			Top consumers in 2018		
	Country	Production (million metric tons)	Daily consumption (grams per day)	Country	Production (million metric tons)	Daily consumption (grams per day)
1	United States	606.6	108.4	Kazakhstan	19.3	543.9
2	China	548.8	402.6	Republic of Korea	4.1	432.3
3	European Union	277.1	—	India	261.1	424.2
4	India	261.1	424.2	Japan	9.4	415.5
5	Brazil	221.5	216.6	China	548.8	402.6
6	Russia	105.3	130.6	Philippines	20.2	369.9
7	Argentina	99.8	185.1	Viet Nam	48.9	348.5
8	Indonesia	81.5	302.1	Indonesia	81.5	302.1
9	Ukraine	68.2	195.5	South Africa	13.8	295.3
10	Canada	65.5	169.2	Chile	2.4	294.4

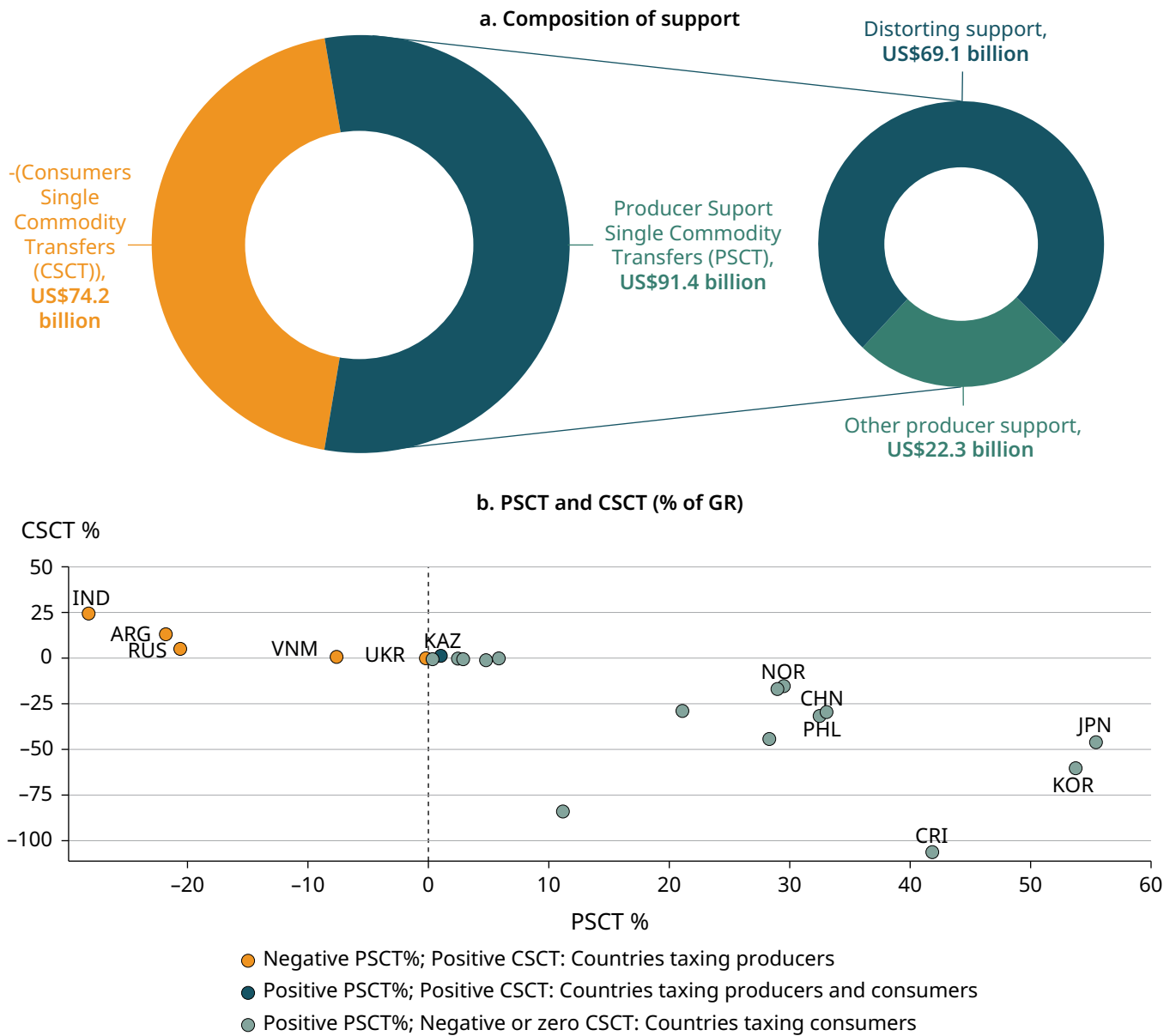
Source: Original table based on production data from OECD 2023 and consumption data from the Global Nutrition and Policy Consortium 2022.

Note: This covers 54 OECD+ countries, which refers to the 38 OECD countries, the 5 non-OECD EU Member States, and 11 emerging economies. Top producers and consumers are ranked in descending order based on the production quantity and consumption in 2018. Data on the daily consumption for the European Union are not available. EU = European Union; OECD = Organisation for Economic Co-operation and Development; — = not available.

Of the \$91.4 billion in PSCT to grains, close to \$70 billion is considered distortionary support and \$22.3 billion is non-distortionary support. The monetary value of transfers from consumers to grain producers is \$74.2 billion. Japan, Korea, and Croatia are the countries with the highest PSCT for grains as a percentage of gross receipts from grains, while India, Argentina, and Russia are the countries with the highest CSCT for grains as a share of gross receipts from grains. Overall, the PSCT and the CSCT have a negative correlation (see figure 3.4).

Mean daily consumption of grains was 245 grams per day in 1990 (figure 3.5). It dropped to 222 grams in 1995 and steadily increased since then until 2010 (265 grams). In 2015 and 2018, the consumption slightly decreased to 261 and 259 grams. Mean daily consumption of grains remained at or above 260 grams per day between 2005 and 2018, increasing slightly from the levels of consumption during 1990–2000. Levels of MPS and non-MPS were higher in more recent years. Levels of MPS were highest in 2015 and 2018, while levels of non-MPS were highest in 2018. MPS has been generally substantially higher than non-MPS.

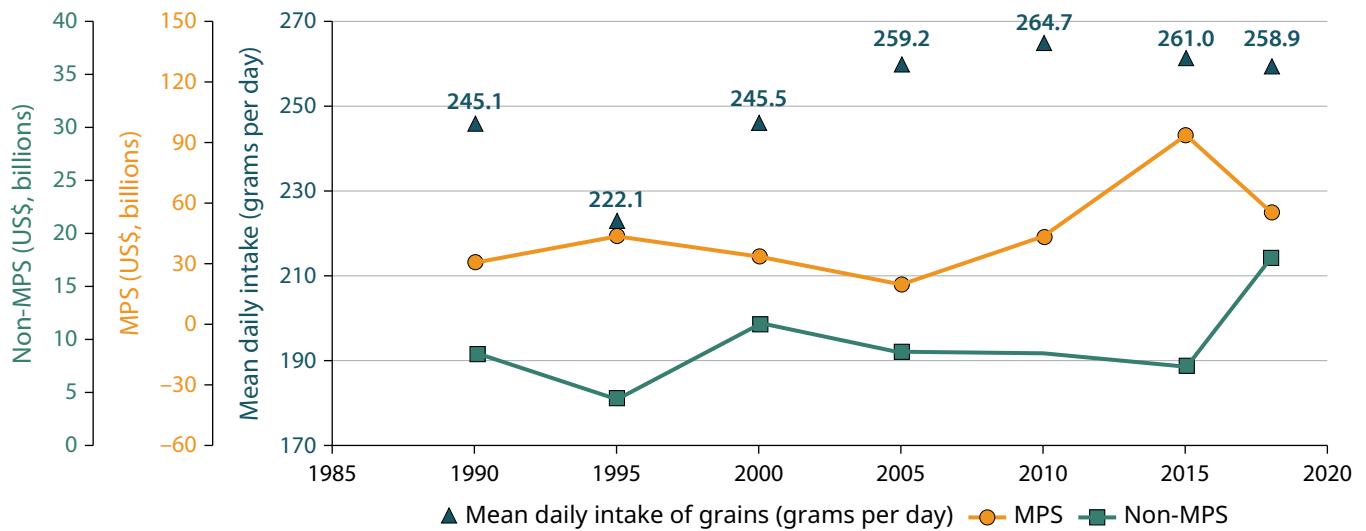
Figure 3.4 Composition of Support to Grains, and PSCT and CSCT by Country, 2020–22



Source: Original figure for this publication based on data from OECD 2023.

Note: The measure of public support, the *Producer Single Commodity Transfers* (PSCT), is defined as the total gross transfers from consumers and taxpayers to agricultural producers, measured at the farm gate level, arising from policies linked to the production of a single commodity. The *percentage of Producer Single Commodity Transfers* (%PSCT) is defined as the single commodity transfers as a share of gross farm receipts for the specific commodity. The *percentage of Consumer Single Commodity Transfers* (%CSCT) is defined as transfers from (to) consumers of a single commodity as a share of gross farm receipts (GR) for the specific commodity. Panel A covers 54 OECD+ countries, which refers to the 38 OECD countries, the 5 non-OECD EU Member States, and 11 emerging economies. Panel B covers OECD+ countries except Chile, New Zealand, Iceland, and Australia, where PSCT and CSCT are zero. Untitled data points represent Israel, Brazil, United Kingdom, Mexico, United States, Türkiye, the European Union, Switzerland, Colombia, South Africa, Indonesia, and Canada. Countries are indicated by their three-letter ISO codes, available at <https://www.iban.com/country-codes/>. EU = European Union; OECD = Organisation for Economic Co-operation and Development.

Figure 3.5 Grains: Daily Intake, MPS, and non-MPS, 1990–2018



Source: Original figure for this publication based on data from the Global Nutrition and Policy Consortium 2022; IDB 2023; OECD 2023.
 Note: Market Price Support (MPS) is defined as the gross transfers to agricultural producers arising from policy measures that distort domestic market prices of a specific commodity. Non-MPS is defined as the gross transfers to agricultural producers arising from policy measures that do not distort domestic market prices. This covers 44 countries in the samples for the analysis, which refers to the 27 OECD+ countries and the 17 countries from Latin America and the Caribbean. The consumption, MPS, and non-MPS amounts are averages across countries by year. The data are not balanced, so not all countries possess complete information on the gross transfers for the entire period. OECD = Organisation for Economic Co-operation and Development.

Commodity-specific support to grains in the form of MPS reduces grain consumption, but the effects are quite small. Commodity-specific single-commodity support for producers (PSCT and MPS) has negative and statistically significant effects (p -value < 0.01) on consumption when controlling for CSCT (table C.7, columns 6 and 7 in appendix C). Estimations indicate that a 10 percent increase in the level of PSCT leads to a 0.34 percent decrease in consumption of grains. Similarly, a 10 percent increase in MPS leads to a 0.35 percent decrease in consumption of grains.

Support to meats

The United States, China, and the European Union are the largest producers of meats, while Russia, Israel, and Colombia are the largest consumers of meats per capita per day (see table 3.2). The

United States, India, Mexico, Australia, and Canada are top producers that are not in the list of the top consumers. Most of the top consumers, except China and Brazil, are not top producers, indicating that they are sourcing their meat consumption via import.

Of the \$89 billion in PSCT to meats, \$82 billion is considered distortionary support. About \$113 billion in consumer transfers to meat producers is estimated to have occurred between 2020 and 2022. Switzerland, Iceland, Norway, Korea, and Japan are the countries with the highest PSCT for meats as a percentage of gross receipts from meats, while Viet Nam and Argentina are the countries with the highest CSCT for meats as a share of gross receipts from meats. Similar to the case of grains, the negative correlation between CSCT and PSCT is evident (see figure 3.6).

Table 3.2 Top Producers and Consumers of Meats

Rank	Top producers in 2018			Top consumers in 2018		
	Country	Production (million metric tons)	Daily consumption (grams per day)	Country	Production (million metric tons)	Daily consumption (grams per day)
1	China	85.2	115.7	Russia	9.3	240.3
2	European Union	48.5	—	Israel	0.5	221.5
3	United States	45.8	58.6	Colombia	2.8	175.3
4	Brazil	26.5	114.3	South Africa	3.2	164.6
5	India	9.7	6.3	Kazakhstan	0.9	142.1
6	Russia	9.3	240.3	Costa Rica	0.3	122.2
7	Mexico	6.8	65.5	China	85.2	115.7
8	Australia	6.0	74.0	Brazil	26.5	114.3
9	Argentina	5.8	112.1	Norway	0.4	112.6
10	Canada	5.6	68.2	Argentina	5.8	112.1

Source: Original table for this publication based on production data from OECD 2023 and consumption data from the Global Nutrition and Policy Consortium 2022.

Note: This covers 54 OECD+ countries, which refers to the 38 OECD countries, the 5 non-OECD EU Member States, and 11 emerging economies. Top producers and consumers are ranked in descending order based on their production quantity and consumption in 2018. Data on the daily consumption for the European Union are not available. EU = European Union; OECD = Organisation for Economic Co-operation and Development; — = not available.

Mean daily consumption of meats was 91 grams per capita per day in 1990 and declined to 83 grams in 2000, but it has been increasing over time to reach 102 grams per capita per day in 2018, surpassing the levels of consumption in 1990 (see figure 3.7). Levels of MPS for meat have increased substantially after 2005, while levels of non-MPS for meat have declined significantly after 2010 and have remained negative after 2015. The increase in MPS from 2005 to 2010 coincides with the increase in consumption (from 87 to 96 grams between 2005 and 2010). Again, similar to grains, non-MPS is overall substantially lower than MPS.

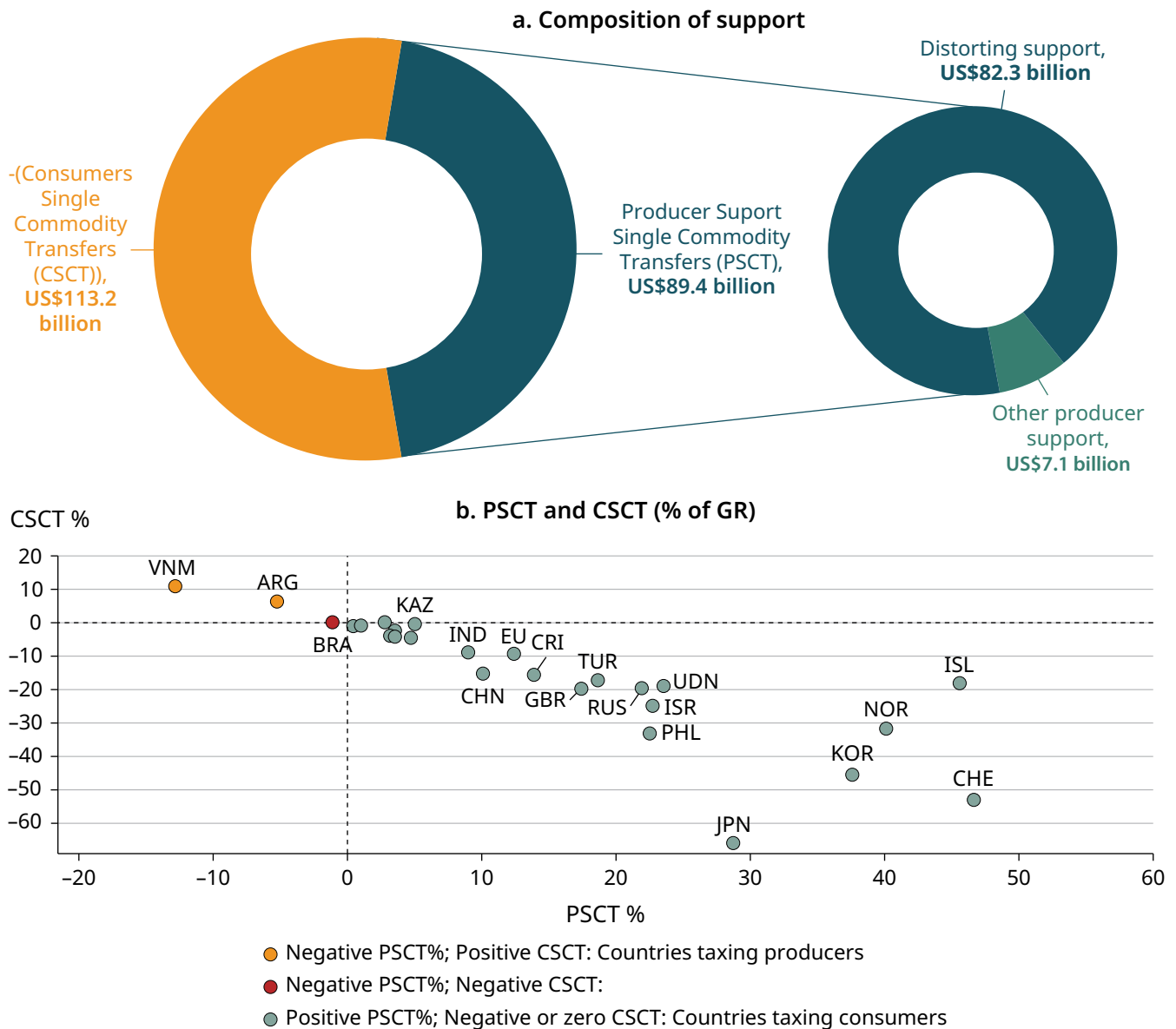
Commodity-specific support to meats has no clear impact on meat consumption. Consistent effects of commodity-specific single commodity support for producers are not found as the signs and statistical significances are noisy or mixed across different specifications (table C.9 in appendix C). Positive and significant effects were found for PSCT and MPS when other support variables were not controlled for.

Support to sugar

Brazil, Mexico, and India are the largest producers of sugar, while Iceland, India, and Korea are the largest consumers of sugar per capita per day (see table 3.3). Mexico, India, Russia, and the United States are the only countries that are in both top producers and top consumers lists. South Africa, China, Australia, and Türkiye are top producers that do not consume sugar heavily.

Commodity-specific support to meats has no clear impact on meat consumption. Consistent effects of commodity-specific single commodity support for producers are not found as the signs and statistical significances are noisy or mixed across different specifications (table C.9 in appendix C). Positive and significant effects were found for PSCT and MPS when other support variables were not controlled for.

Figure 3.6 Composition of Support to Meats and PSCT and CSCT by Country, 2020–22



Source: Original figure for this publication based on data from OECD 2023.

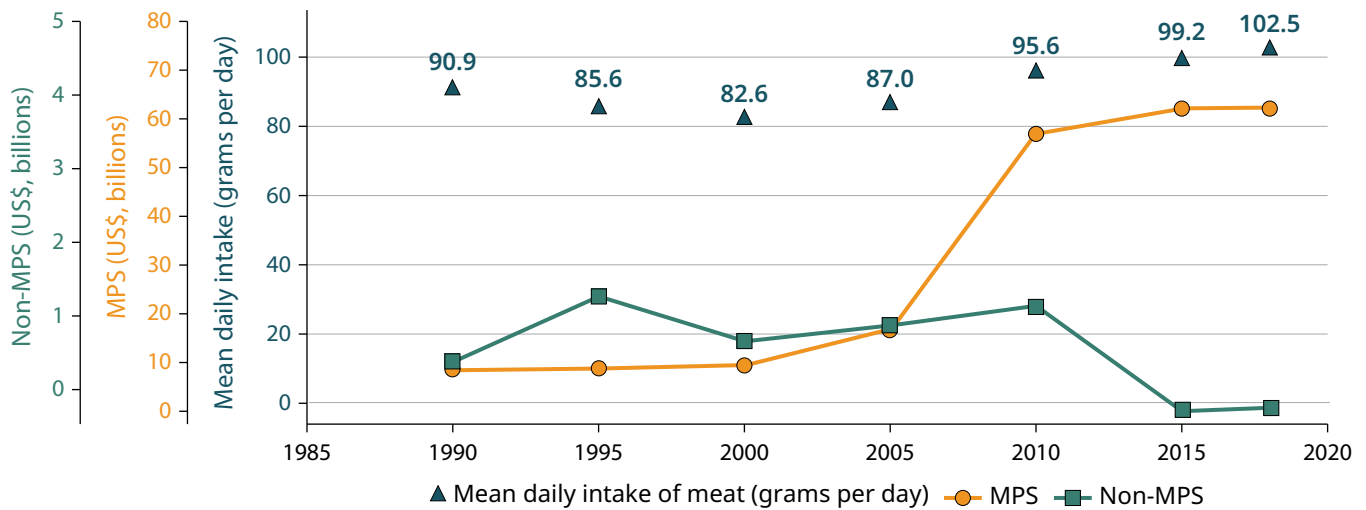
Notes: The measure of public support—the *Producer Single Commodity Transfers* (PSCT)—is defined as the total gross transfers from consumers and taxpayers to agricultural producers, measured at the farm gate level, arising from policies linked to the production of a single commodity. The *percentage of Producer Single Commodity Transfers* (%PSCT) is defined as the single commodity transfers as a share of gross farm receipts for the specific commodity. The *percentage of Consumer Single Commodity Transfers* (%CSCT) is defined as transfers from (to) consumers of a single commodity as a share of gross farm receipts for the specific commodity. Panel A covers 54 OECD+ countries, which refers to the 38 OECD countries, the 5 non-OECD EU Member States, and 11 emerging economies. Panel B covers OECD+ countries except Australia and South Africa, where PSCT and CSCT are zero. Untitled data points represent Mexico, United States, Chile, Ukraine, New Zealand, Colombia, and Canada. Countries are indicated by their three-letter ISO codes, available at <https://www.iban.com/country-codes/>. EU = European Union; OECD = Organisation for Economic Co-operation and Development.

Support to sugar

Brazil, Mexico, and India are the largest producers of sugar, while Iceland, India, and Korea are the largest consumers of sugar per capita per day (see

table 3.3). Mexico, India, Russia, and the United States are the only countries that are in both top producers and top consumers lists. South Africa, China, Australia, and Türkiye are top producers that do not consume sugar heavily.

Figure 3.7 Meats: Daily Intake, MPS, and non-MPS, 1990–2018



Source: Original figure for this publication based on data from the Global Nutrition and Policy Consortium 2022; IDB 2023; OECD 2023.
 Note: Market Price Support (MPS) is defined as the gross transfers to agricultural producers arising from policy measures that distort domestic market prices of a specific commodity. Non-MPS is defined as the gross transfers to agricultural producers arising from policy measures that do not distort domestic market prices. This covers 44 countries in the samples for the analysis, which refers to the 27 OECD+ countries and the 17 countries from Latin America and the Caribbean. The consumption, MPS, and non-MPS are averages across countries by year. The data are not balanced, so not all countries possess complete information on the gross transfers for the entire period. OECD = Organisation for Economic Co-operation and Development.

Table 3.3 Top Producers and Consumers of Sugar

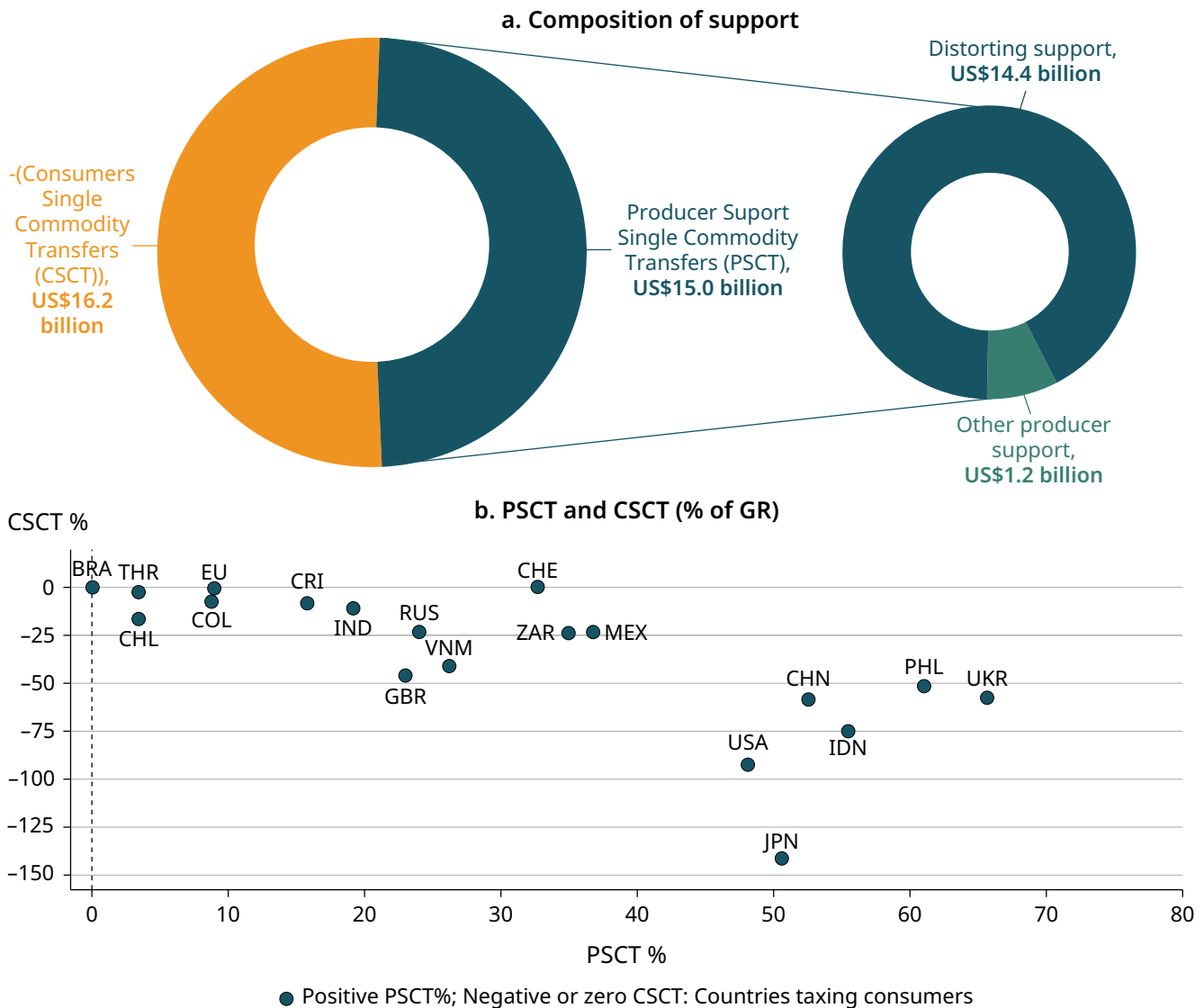
Rank	Top producers in 2020			Top consumers in 2020		
	Country	Production (million metric tons)	Daily consumption (grams per day)	Country	Production (million metric tons)	Daily consumption (grams per day)
1	Brazil	654.5	62.1	Iceland	—	146.5
2	Mexico	53.5	81.7	India	31.1	115.3
3	India	31.1	115.3	Korea	—	93.0
4	South Africa	19.3	36.8	Mexico	53.5	81.7
5	European Union	15.5	—	Chile	0.2	77.0
6	China	14.4	3.0	Russia	5.8	74.4
7	United States	7.1	67.9	New Zealand	5.2	73.1
8	Russia	5.8	74.4	Colombia	2.2	70.5
9	Australia	4.2	46.6	Costa Rica	0.4	69.6
10	Türkiye	3.0	31.9	United States	7.1	67.9

Source: Original table for this publication based on production data from OECD 2023 and consumption data from Global Nutrition and Policy Consortium 2022.
 Notes: This covers 54 OECD+ countries, which refers to the 38 OECD countries, the 5 non-OECD EU Member States, and 11 emerging economies. Top producers and consumers are ranked in descending order based on their production quantity and consumption in 2020. Data on the daily consumption for the European Union and data on the production for Iceland and Korea are not available. EU = European Union; OECD = Organisation for Economic Co-operation and Development; — = not available.

Of the \$15 billion in PSCT to sugar, \$14.4 billion is considered distortionary support. About \$16 billion in consumer transfers to sugar producers is estimated between 2020 and 2022. While PSCT to sugar is smaller than that for grains and meat as noted above, PSCT as a share of GFR is highest for sugar (see chapter 2). The Philippines, Ukraine, China, Japan, the United States, and Indonesia are

the countries with the highest PSCT for sugar as a percentage of gross receipts from sugar, while Brazil, Türkiye, Chile, Colombia, and the European Union have the lowest. A noticeable difference from the earlier two commodities is that there is no country with a positive CSCT or negative PSCT. Overall, the correlation between PSCT and CSCT appears to be negative (see figure 3.8).

Figure 3.8 Composition of Support to Sugar, and PSCT and CSCT by Country, 2020–22



Source: Original figure for this publication based on data from OECD 2023.

Notes: The measure of public support—the *Producer Single Commodity Transfers* (PSCT)—is defined as the total gross transfers from consumers and taxpayers to agricultural producers, measured at the farm gate level, arising from policies linked to the production of a single commodity. The *percentage of Producer Single Commodity Transfers* (%PSCT) is defined as the single commodity transfers as a share of gross farm receipts for the specific commodity. The *percentage of Consumer Single Commodity Transfers* (%CSCT) is defined as transfers from (to) consumers of a single commodity as a share of gross farm receipts for the specific commodity. Panel A covers 54 OECD+ countries, which refers to the 38 OECD countries, the 5 non-OECD EU Member States, and 11 emerging economies. Panel B covers OECD+ countries except Korea, Israel, New Zealand, Iceland, Norway, Argentina, Australia, Kazakhstan, and Canada, where PSCT and CSCT are zero. OECD = Organisation for Economic Co-operation and Development.

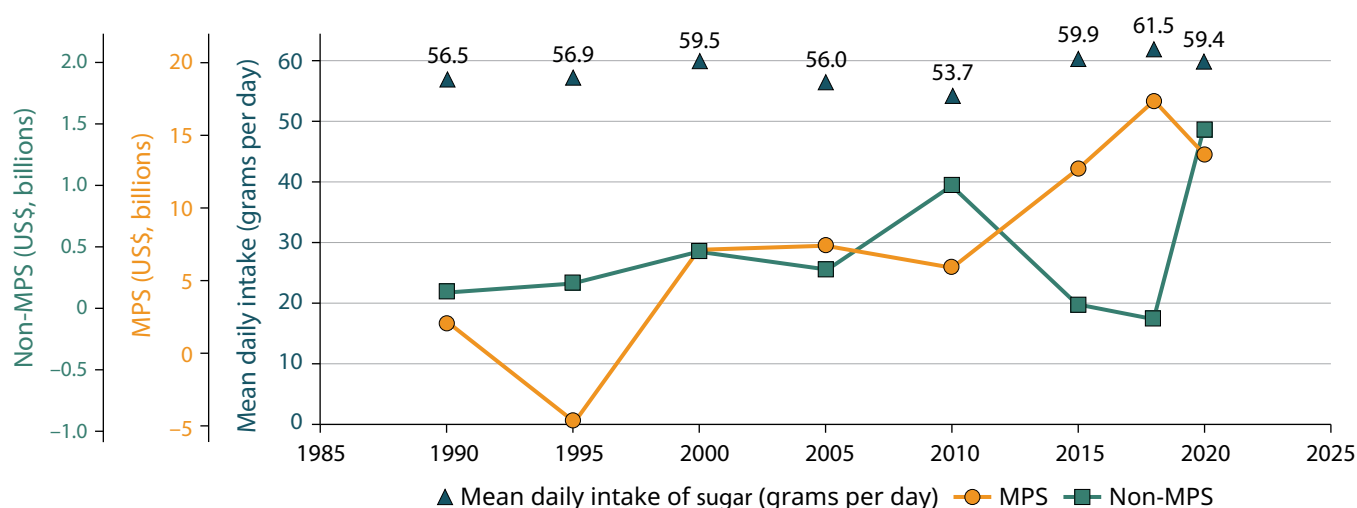
Mean daily consumption of sugar has been around 60 grams per capita per day in the period 2015–20 (see figure 3.9). The consumption decreased to 54 grams in 2010 from a peak of 60 grams in 2000. The increase in consumption from 2010 to 2015 coincides with the increase in the levels of MPS for sugar, with nearly \$17 billion of distortionary support in 2018. Levels of non-MPS for sugar have generally followed an upward trend from 1990 to 2020, except during 2015–18, which were the periods with the lowest non-MPS for sugar. Similar to the two earlier commodities, the levels of non-MPS are generally lower than those of MPS.

Commodity-specific support to sugar in the form of MPS reduces sugar consumption, but the effects are quite small. Commodity-specific single commodity support for producers (PSCT and MPS) has negative and statistically significant

effects (p-value < 0.1) on consumption when controlling for CSCT (table C.11, columns 6 and 7). Estimations indicate that a 10 percent increase in the level of PSCT leads to a 0.62 percent decrease in consumption of sugar. Similarly, a 10 percent increase in MPS leads to a 0.60 percent decrease in consumption of sugar. The magnitudes of the estimates are unsurprising given that the PSCT for sugar mostly consists of MPS.

Using the existing cross-country database developed for this analysis, there are opportunities to revisit the cross-country regression specifications, such as by looking at cross-elasticities. Further analytical work could also expand on the range of commodities assessed (for example, including fruits, vegetables, and milk), and by looking at subcategories of broader commodity groups (for example, different types of grains and meats).

Figure 3.9 Sugar: Daily intake, MPS, and non-MPS, 1990–2020



Source: Original figure for this publication based on data from the Global Nutrition and Policy Consortium 2022; IDB 2023; OECD 2023.
Notes: Market Price Support (MPS) is defined as the gross transfers to agricultural producers arising from policy measures that distort domestic market prices of a specific commodity. Non-MPS is defined as the gross transfers to agricultural producers arising from policy measures that do not distort domestic market prices. This covers 44 countries in the samples for the analysis, which refers to the 27 OECD+ countries and the 17 countries from Latin America and the Caribbean. The consumption, MPS, and non-MPS are averages across countries by year. The data are not balanced, so not all countries possess complete information on the gross transfers for the entire period. OECD = Organisation for Economic Co-operation and Development.

Notes

1. The 44 countries in the analysis include Argentina, Australia, Barbados, Belize, Bolivia, Brazil, Canada, Chile, China, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, the European Union, Guatemala, Guyana, Haiti, Honduras, India, Indonesia, Israel, Jamaica, Japan, Kazakhstan, Mexico, New Zealand, Nicaragua, Norway, Panama, Paraguay, Peru, Philippines, Russian Federation, South Africa, Suriname, Switzerland, Trinidad and Tobago, Türkiye, Ukraine, the United Kingdom, the United States, Uruguay, and Viet Nam.
2. Argentina, Brazil, China, India, Indonesia, Kazakhstan, the Philippines, the Russian Federation, South Africa, Ukraine, and Viet Nam.
3. Argentina, The Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Trinidad and Tobago, Uruguay, and Venezuela.
4. Data can be downloaded at https://mydata.iadb.org/Indicator-Catalog/IDB-Agrimonitor-PSE-Agricultural-Policy-Monitoring/2dqw-u35p/about_data.
5. Other commodities that are accessible in the final database include fruits, vegetables, and dairy/milk.
6. The GDD 2018 is available at <https://globaldietarydatabase.org/available-gdd-2018-estimates-datafiles>.

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4 Country-Level Cases: Comparing Different Interventions



Chapter 3 assessed the relationship between different types of agrifood support and the consumption of different types of commodities. However, while there are correlations between Market Price Support policies and consumption, there are no clear correlations between agrifood subsidies and consumption, on average. This suggests that country context varies significantly, and that the impact of various policy and intervention options are largely country specific. This chapter presents two country cases: one for Bangladesh and one for Malawi, both of which are receiving support from the FoodSystems2030 Trust Fund to repurpose agrifood support for better outcomes.¹ The goal of these case studies is to look at the country-level impacts of various types of agrifood sector support (that is, input subsidies, irrigation, infrastructure, and social protection) on measures of food security and healthy diets.

For the Bangladesh case study, with a grant of \$18 million and \$500 million leveraged,² farmers will receive direct support through an innovative inputs subsidy pilot utilizing an e-voucher system to experiment with various options, with the aim to eventually inform gradual repurposing of the current Fertilizer Subsidy Program of over \$2 billion and expand coverage nationally. In Malawi, there is a grant of \$20 million with \$250 million leveraged,³ which will allow farmers to gain more technical support for efficient usage of fertilizer subsidies and are provided incentives to diversify crop production, improve soil health restoration practices, and assist with paying for ecosystems services. The aim is for the government to repurpose the existing inputs program by testing other options and scaling up the most promising interventions.

4.1. Input subsidies, roads, and cash transfers in Bangladesh

In the case of Bangladesh, contrary to the impact of social protection programs and input subsidies, there is a positive impact of rural infrastructure development, an important public good, on various measures of healthy diets.

Public investment in the agriculture sector in Bangladesh has mainly been through input subsidies, which constitute around 43 percent of the country's Ministry of Agriculture budget. The major component of the input subsidy in Bangladesh is the fertilizer subsidy, which is based on the twin policy objectives of the government: keeping the food grain price low enough to make it affordable for the poorer section of the society and keeping the price high enough to incentivize the farmers to produce crops. Although the existing studies show a significant impact of input subsidies on enhancing the production and income of farming households, little is known about its impact on food and nutrition security in Bangladesh (Nasrin, Bauer, and Arman 2018; Sarma and Hossain 2020; Sarma and Rahman 2020; Uddin and Dhar 2018). However, alternative agriculture interventions—such as irrigation infrastructure/ community infrastructure as well as research and agricultural education—are also important to facilitate positive outcomes and complement input subsidies. Improved rural infrastructure such as roads can create opportunities for economic growth and poverty reduction through a range of mechanisms (Khandker, Bakht, and Koolwal 2009). Similarly, social cash transfers targeting the ultra-poor or vulnerable groups in Bangladesh

could complement input subsidies, hence calling for harmonization of the different assistance programs from the government. However, existing studies show a mixed impact of different social protection programs on the food and nutrition security of Bangladeshi households (Ahmed et al. 2009; Badhan et al. 2019; Mamun 2019; Rahman 2012). In this context, this Bangladesh case study evaluates the relative effectiveness of different interventions for rural farming households to ensure their food and nutrition security.

Data and methodology

This country case study utilizes the Bangladesh Integrated Household Survey (BIHS) 2018-2019 developed by the International Food Policy Research Institute (IFPRI). This was the third-round survey IFPRI collected, after the first round in 2011-12 and the second round in 2015. It is a nationally representative survey that collects data at both household and community levels. It mainly collects data on the rural areas of Bangladesh, and thus it is representative of the agricultural sector of rural Bangladesh. Here it needs to be noted that, to make the result of different interventions comparable, this study restricts the sample to only farming households.

It is essential to create a counterfactual assessment of what may have happened in the absence of the program in order to compare beneficiary results to what those outcomes would have been had the program not been introduced. This is how program impact is measured. The most effective method for creating a legitimate counterfactual is to choose recipients at random from a group of candidates who are all equally deserving. Every person (or community, school, and so on) has an equal chance of getting chosen for the program if the assignment is made at random. The average results for individuals who were not chosen at random ought to offer a fair assessment of what the beneficiaries would have gone through in the absence of the program.

Beneficiaries and nonbeneficiaries will, on average, have the same observed features and,

more importantly, the same unseen traits (more essential because they are more difficult to control for) when a randomized design evaluation is done effectively. This eliminates selectivity issues, establishes a reliable foundation for comparison, and establishes the direction of causality. A randomized design also has the benefit of making program impact simple to calculate, which makes it easier to comprehend and discuss.

However, because the three different types of programs (that is, input subsidy, social protection, and rural agricultural infrastructure) in Bangladesh had already been put into action prior to the evaluation, a randomized approach was not practical for the assessment. As a result, a nonrandomized approach was used for impact assessment in this work.

In this study, the propensity score matching (PSM) estimator is used to estimate the effect of different programs on the household spending behavior. The PSM method consists of generating a single propensity score based on the observable characteristics to construct a counterfactual group. In this method, each treated observation is matched to several control observations based on the propensity score, which would help to construct a counterfactual to examine what would happen to the food and nutrition security of program beneficiary household if it did not receive the benefits of the program. Thus, this method ensures the robustness of the effect of treatment variable on the outcome variable.

In order to construct the propensity score, a participation equation needs to be estimated where the dependent variable will be the treatment variables. In this case study, the treatment variables for the three different interventions are different. For example, for the input subsidy the treatment variables will be 1 for those receiving the subsidy and 0 for those not receiving the subsidy. For the social protection program, the treatment variable will be 1 for those enjoying the benefit of the program and 0 for those not enjoying the benefit. Because the treatment variable is a dichotomous or

binary variable, the propensity score is usually calculated using the probit model. The propensity score, which can be expressed as $P(D = 1 | X)$, represents the probability of enjoying the benefit of a particular intervention based on observed different characteristics of the households and communities. The basic descriptive statistics of the variables used for estimating the participation equation are presented in table 4.1.

To evaluate the relative effect of different rural support schemes in Bangladesh on food and nutrition security, five different indicators of food security based on the BIHS 2018-2019 were constructed. The five indicators include the household per capita food expenditure, household dietary diversity score (HDDS), Household Hunger Scale (score), the Food Consumption Score (FCS), and the Food Insecurity Experience Scale (FIES) (table 4.2).

Table 4.1 Basic Descriptive Statistics of Selected Variables

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
Social protection program beneficiary	2,675	0.059	0.236	0	1
Beneficiary of improved infrastructure	2,675	0.597	0.491	0	1
Beneficiary of input subsidy	2,675	0.033	0.177	0	1
Household wealth index	2,675	0.0912	0.2879	0	1
Household total land (hectares)	2,674	118.49	111.065	7	1,311.5
Primary level of education	2,675	0.267	0.442	0	1
Secondary level of education	2,675	0.227	0.419	0	1
Tertiary level of education	2,675	0.043	0.204	0	1
Household size	2,675	5.946	2.342	1	23
Proportion of household members (age < 15)	2,675	0.238	0.186	0	0.778
Proportion of household members (age 15–64)	2,675	0.509	0.207	0	1
Proportion of household members (age ≥ 65)	2,675	0.254	0.228	0	1
Community has a government clinic	2,675	0.326	0.469	0	1
Number of educational institutions in the community	2,675	2.884	1.929	0	10
Community has a government primary school	2,675	0.769	0.422	0	1
Barisal (division)	2,675	0.068	0.252	0	1
Rangpur (division)	2,675	0.136	0.343	0	1
Sylhet (division)	2,675	0.122	0.327	0	1
Chattogram (division)	2,675	0.12	0.325	0	1
Rajshahi (division)	2,675	0.131	0.338	0	1
Khulna (division)	2,675	0.116	0.32	0	1

Source: Original table for this publication based on data from BIHS 2018-2019 (IFPRI 2020).

Note: BIHS = Bangladesh Integrated Household Survey.

Table 4.2 Basic Descriptive Statistics of Different Food Security Variables

Food security variable	Observations	Mean	Standard deviation	Minimum	Maximum
Per capita food expenditure (BDT)	2,664	403.45	337.77	5.36	3,107.14
Food consumption score	2,675	71.113	17.05	25.5	112
Household dietary diversity score (HDDS)	2,675	10.36	1.314	6	12
Food Insecurity Experience Scale (FIES) score	2,675	1.327	1.813	0	8
Household Hunger Scale (score)	2,675	0.051	0.293	0	5

Source: Original table for this publication based on data from BIHS 2018-2019 (IFPRI 2020).

Note: BDT = Bangladeshi taka (currency); BIHS = Bangladesh Integrated Household Survey.

The *per capita food expenditure* is an economic gauge that reflects whether households spend adequately on food and dietary intake. Food consumption expenditure is calculated based on money spent on food items. Total food-related consumption expenditure per month was then divided by the number of household members to calculate per capita food consumption expenditure. *Dietary diversity* is measured as the total food groups consumed in the last 7 days as per the BIHS. The Food Consumption Score can be measured as weighted frequency of the number of food groups consumed in the previous 7 days. The household hunger score is calculated based on three questions related to availability of food and hunger of the household members. Finally, the FIES consists of a total of eight binary questions pertaining to the household's behaviors and experiences that are associated with the accessibility of the food. A score ranging between 0 and 8 is developed based on the responses of these eight questions.

Social protection and food and nutrition security

In evaluating the effect of social protection programs on food and nutrition security, the first step is to identify the treatment and control groups. In this regard, the usual practice is to consider the households receiving the benefits of at least one social protection program as the treatment group while households not receiving

the benefits of any social protection programs are considered control groups. However, there can be major problems associated with using such wide-ranging treatment and control groups. The problem with using the beneficiaries of all the programs as the treatment group is that each of the programs has different target groups (mainly poor) based on some selection criteria; this makes it difficult to find control groups with similar characteristics. Moreover, the data used in this case study have not been designed to conduct this kind of outcome research and, therefore, they contain all kinds of households (that is, rich and poor). In this context, including all the households not receiving the benefits of social protection program might lead to a biased result as the treatment and control groups would not be comparable.

Against this backdrop, this case study first considers the beneficiaries of a particular social protection program as the treatment group. Second, to make the treatment and control groups comparable, it considers only the households that belong to the poorest groups where *the poorest* is defined as the households belonging the first quintile of household total expenditure. Finally, to make the results comparable with the impact of other interventions such as input subsidy and rural agricultural infrastructure, this case study considers only farming households while evaluating the effect of social protection program on food and nutrition security.

The social protection program considered in this study is the Old Age Allowance (OAA), which is a cash transfer program. The OAA program was introduced in 1998 to provide a monthly cash payment to older people to help reduce their vulnerabilities and income insecurity. Currently, it is one of the largest social protection programs in Bangladesh. The program is not universal: beneficiaries are prioritized on the basis of age and socioeconomic status, so that the poorest are selected to become recipients.

The average value of different food security indicators for the beneficiaries and nonbeneficiaries of different OAA is presented in table 4.3. Here the ultra-poor households receiving the benefits of OAA have a higher per capita food expenditure than those not receiving the benefits of the OAA program. However, there is no significant difference in the average value of other food security indicators between the two groups.

The impact of OAA on the different food and nutrition security indicators estimated with a PSM technique is presented in table 4.4. Here it needs to be noted that, to obtain the average treatment effect based on PSM, first it is necessary to calculate the propensity score, which reflects the probability of being treated or the probability of receiving the benefits of OAA. The propensity score has been estimated including different variables such as the wealth index and household land holding, as well as the presence of people

65 years or older in the households. Based on the propensity score, the treatment and control groups have been matched with different matching techniques.

The result of the treatment effect estimated based on PSM shows that social protection programs have a positive impact on the household per capita food expenditure (table 4.4). The result is consistent across different matching techniques. For example, the ultra-poor households receiving OAA have, on average, 70–75 more BDT per capita for food expenditure than those who do not receive the benefits. However, for another two indicators of food and nutrition security—the food consumption score and the household dietary diversity score—the effect is negative and statistically insignificant. This implies that receiving the benefits of the OAA program does not lead to a significant impact on diversifying the food basket of the beneficiary households. Moreover, in terms of the FIES and Household Hunger Scale, the beneficiary households lag the nonbeneficiary households, which contradicts our expectation. There might be several reasons for this contradictory result. First, the Food Insecurity Experience Scale (FIES) and Household Hunger Scale scores reflect the psychological aspect of food security of the households; households report their past experience, when they might not have availed themselves of the program and, therefore, experienced food insecurity. Second, the apparent insignificant impact of social protection

Table 4.3 Average Value of Different Food Security Variables for the Beneficiaries and Nonbeneficiaries of the OAA Social Security Program

Food security variable	OAA nonbeneficiary	OAA beneficiary
Per capita food expenditure (BDT)	233.97	387.65
Food consumption score	59.29	58.14
Food Insecurity Experience Scale (FIES) score	2.28	2.71
Household Hunger Scale (score)	0.25	0.44
Household dietary diversity score (HDDS)	9.43	9.28

Source: Original table for this publication based on data from BIHS 2018-2019 (IFPRI 2020).

Note: BDT = Bangladeshi taka (currency); BIHS = Bangladesh Integrated Household Survey; OOA = Old Age Allowance.

Table 4.4 Average Impact (Treatment Effect) of Social Protection Program on the Food Security of Households

Outcome variable	Matching technique	N				Average Treatment Effect on the Treated	Standard error	T-statistic
		(treatment group)	(control)	Treated	Control			
Per capita food expenditure (BDT)	Nearest neighbor (3)	999	110	387.65	312.63	75.01	58.44	1.28
	Nearest neighbor (5)	999	110	387.65	309.96	77.68	57.49	1.35
	Kernel	999	110	387.65	316.85	70.79	27.97	5.49
Food consumption score	Nearest neighbor (3)	999	110	57.99	58.68	-1.4	1.48	-0.95
	Nearest neighbor (5)	999	110	57.99	58.68	-0.68	1.96	-0.35
	Kernel	999	110	57.99	58.94	-0.95	1.63	-0.58
Food Insecurity Experience Scale (FIES) score	Nearest neighbor (3)	999	110	2.73	2.45	0.27	0.3	0.91
	Nearest neighbor (5)	999	110	2.73	2.42	0.3	0.29	1.03
	Kernel	999	110	2.73	2.37	0.36	0.26	1.38
Household Hunger Scale (score)	Nearest neighbor (3)	999	110	0.445	0.33	0.11	0.11	1.05
	Nearest neighbor (5)	999	110	0.445	0.32	0.127	0.102	1.24
	Kernel	999	110	0.445	0.309	0.136	0.091	1.5
Household dietary diversity score (HDDS)	Nearest neighbor (3)	999	110	9.28	9.23	0.04	1.9	0.22
	Nearest neighbor (5)	999	110	9.28	9.27	0.009	0.185	0.05
	Kernel	999	110	9.28	9.3	-0.02	0.167	-0.12

Source: Original table for this publication based on data from BIHS 2018-2019 (IFPRI 2020).

Note: Nearest neighbor and Kernel are matching techniques that have been used to estimate the impact of the programs. The numbers indicate the variants of nearest neighbor matching. Number 3 indicates that matching has been done with the three nearest neighbors. Number 5 indicates that matching has been done with the five nearest neighbors. BDT = Bangladeshi taka (currency); BIHS = Bangladesh Integrated Household Survey.

program on dietary diversity might be because these households are extremely vulnerable and therefore often take fewer calories than required. Therefore, although they might have spent the allowance for food to fill the gap, they might fail to spend the amount for a more diversified food.

Rural infrastructure and food and nutrition security

In evaluating the effect of rural agricultural infrastructure on food and nutrition security, this case study considers the presence of roads in the village passable by bus or truck during 12 months of the year as an indicator of rural infrastructure. The households residing in such villages are considered to be the treatment group. Households residing in villages having roads not passable by a bus or truck for even a single month in the year are considered to be the control group. To make the result comparable, the analysis is restricted to only farming households.

The average value of different food security indicators for the households enjoying the benefits of improved roads and those not enjoying the benefits have been presented in table 4.5

Here the improved rural roads significantly contribute to ensure the food security of the farming households. Households enjoying the benefits of improved rural roads have a higher per capita food expenditure than those not enjoying the benefits. Moreover, these households have a higher food consumption score and dietary diversity score. Finally, although the household with improved rural roads have significantly lower scores in terms of the Household Hunger Scale than those without improved infrastructure, the difference is not significant for the Food Insecurity Experience Scale.

The next step is to estimate the impact of rural road infrastructure based on the PSM technique. In this regard, a participation equation has been estimated to match the treatment and control groups based on the propensity score. The participation equation reflects the probability of the households enjoying the benefits of improved roads, which has been estimated based on the different household- and community-level variables such as location of the households or community, the presence of government hospital or primary schools in the community, the education level of the heads of households, and the wealth of the households.

Table 4.5 Average of Food Security Variables by the Presence of Improved Roads

Food security variable	Without improved road	With improved road
Per capita food expenditure (BDT)	189.256	222.791
Food consumption score	57.995	60.517
Household dietary diversity score (HDDS)	9.233	9.598
Household Hunger Scale (score)	0.107	0.073
Food Insecurity Experience Scale (FIES) score	1.864	1.863

Source: Original table for this publication based on data from BIHS 2018-2019 (IPFRI 2020).

Note: BDT = Bangladeshi taka (currency); BIHS = Bangladesh Integrated Household Survey.

The impact of improved rural road infrastructure on the different indicators of food and nutrition security is shown in table 4.6. The result shows that rural improved roads have positive impact on per capita food expenditure of the farming households in Bangladesh. The impact is highly statistically significant and consistent across the three matching methods. The Average Treatment Effect on the Treated (ATT) ranges between BDT 99 and BDT 107, which indicates that, for each matched group, households enjoying the benefits of improved rural road infrastructure on average have a BDT 99–107 higher per

capita food expenditure than households not enjoying the benefits of the improved infrastructure.

The impact of improved rural road infrastructure on the other two indicators of food and nutrition security—the food consumption score and dietary diversity score—is also positive and statistically significant. The results show that the treatment group has a significantly more diversified food basket than the control group. In other words, the improved infrastructure not only leads to a higher per capita food expenditure, it also improves

Table 4.6 Average Impact (Treatment Effect) of Improved Rural Infrastructure on the Food Security of Households

Outcome variable	Matching technique	N		Treated	Control	Average Treatment Effect on the Treated	Standard error	T-statistic
		(treatment group)	(control)					
Per capita food expenditure (BDT)	Nearest neighbor (3)	1,071	1,552	441.84	335.38	106.5	18.46	5.76
	Nearest neighbor (5)	1,071	1,552	441.84	340.1	101.7	17.86	5.7
	Kernel	1,071	1,552	441.84	343.04	98.8	15.56	6.35
Food consumption score	Nearest neighbor (3)	1,071	1,552	72.22	70.588	1.633	1.033	1.58
	Nearest neighbor (5)	1,071	1,552	72.22	70.76	1.453	1.001	1.45
	Kernel	1,071	1,552	72.22	70.85	1.36	0.857	1.6
Household dietary diversity score (HDDS)	Nearest neighbor (3)	1,071	1,552	10.48	10.24	0.238	0.079	2.99
	Nearest neighbor (5)	1,071	1,552	10.481	10.255	0.226	0.077	2.92
	Kernel	1,071	1,552	10.481	10.27	0.204	0.066	3.08
Food Insecurity Experience Scale (FIES) score	Nearest neighbor (3)	1,071	1,552	1.259	1.37	-0.111	0.112	-0.99
	Nearest neighbor (5)	1,071	1,552	1.259	1.366	-0.106	0.11	-0.97
	Kernel	1,071	1,552	1.259	1.385	-0.126	0.092	-1.36
Household Hunger Scale (score)	Nearest neighbor (3)	1,071	1,552	0.0464	0.043	0.003	0.0175	0.15
	Nearest neighbor (5)	1,071	1,552	0.046	0.042	0.004	0.017	0.25
	Kernel	1,071	1,552	0.046	0.045	5E-04	0.015	0.04

Source: Original table for this publication based on data from BIHS 2018-2019 (IFPRI 2020).

Note: Nearest neighbor and Kernel are matching techniques that have been used to estimate the impact of the programs. The numbers indicate the variants of nearest neighbor matching. Number 3 indicates that matching has been done with the three nearest neighbors. Number 5 indicates that matching has been done with the five nearest neighbors. BDT = Bangladeshi taka (currency); BIHS = Bangladesh Integrated Household Survey.

the quality of the food basket of the beneficiary households.

Finally, the improved rural infrastructure also helps to reduce the food insecurity of the rural farming households as measured by the Household Hunger Scale and Food Insecurity Experience Scale. The score for the treatment group is lower than the score for the control, which confirms the impact of the intervention on reducing food insecurity. However, the effect is not statistically significant across the different matching techniques.

Input subsidy, productivity, and food and nutrition security

As discussed earlier, in evaluating the impact of a program, a treatment group enjoying the benefits of the program is needed, as well as a control group with similar characteristics that has not enjoyed the benefits of the program. The most prevalent input subsidy in Bangladesh is fertilizer subsidy. The major problem with evaluating the effect of input subsidy is that it is universal in Bangladesh and, therefore, there is no control group for the program with similar characteristics. The government sets a ceiling price for different fertilizers that is much lower than the market price. The government pays the difference between the market price and the subsidized price. Anyone can purchase the subsidized fertilizers at the subsidized price and, therefore, can enjoy the benefits of the subsidy.

Against this backdrop, this case study follows an alternative approach to find the impact of input subsidy on the food and nutrition security of the household. The BIHS data include information about the input subsidy card, which is not universal. Only cardholder farmers can get the subsidized input for free or at a lower price. Cardholder households can be considered to be the treatment group while the non-cardholder households can be considered to be the control group. To make the result comparable with the impact of other interventions, only the rural farming households receiving no input subsidy card are considered as the control group for evaluating the impact of input subsidy.

The average value of different food security indicators by the input subsidy card status has been presented in table 4.7. Here the households having an input subsidy card have a lower per capita food expenditure than the households without the input subsidy card. This indicates a negative effect of the input subsidy card on the household per capita food expenditure, which is contradictory to expectations. Looking into the other indicators of food and nutrition security shows mixed results. Table 4.7 shows that households having an input subsidy card have a higher food consumption score and dietary diversity score compared to the households not having the card. However, the average value of Household Hunger Scale, and the Food Insecurity Experience Scale is higher for the beneficiaries of the input subsidy card than for their nonbeneficiary

Table 4.7 Average of Food Security Variables by Input Subsidy Card Status

Food security variable	Households without input subsidy card	Households with input subsidy card
Per capita food expenditure (BDT)	207.98	190.69
Food consumption score	59.18	64.03
Household dietary diversity score (HDDS)	9.42	9.64
Household Hunger Scale (score)	0.085	0.214
Food Insecurity Experience Scale (FIES) score	1.847	2.357

Source: Original table for this publication based on data from BIHS 2018-2019 (IFPRI 2020).

Note: BDT = Bangladeshi taka (currency); BIHS = Bangladesh Integrated Household Survey.

counterparts. This indicates that households receiving the input subsidy card are relatively more food insecure.

The next step estimates the impact of input subsidy on the household food and nutrition security based on the PSM technique. In this regard, a participation equation has been estimated to match the treatment and control groups based on the propensity score. The participation equation reflects the probability of the households of having the input subsidy card; this probability has been estimated based on the different variables such as location of the households or community, the

wealth index, education of the household head, and other socioeconomic characteristics.

Table 4.8 shows the impact of input subsidy card on the different indicators of food and nutrition security. The result shows that input subsidies have a negative effect on the per capita food expenditure of the rural farming households, which is counter to expectations. This surprising result might be because these households are consuming the domestically produced food more and therefore have to spend less on food.

Table 4.8 Average Impact (Treatment Effect) of Input Subsidy on the Food Security of Households

Outcome variable	Matching technique	N (treatment group)	N (control)			Average Treatment Effect on the Treated	Standard error	T-statistic
				Treated	Control			
Per capita food expenditure (BDT)	Nearest neighbor (3)	87	2,576	366.29	431.17	-64.88	37.48	-1.73
	Nearest neighbor (5)	87	2,576	366.29	416.37	-50.08	34.98	-1.43
	Kernel	87	2,576	366.29	431.85	-65.56	29.87	-2.19
Food consumption score	Nearest neighbor (3)	87	2,576	75.24	73.72	1.51	2.204	0.69
	Nearest neighbor (5)	87	2,576	75.25	73.36	1.88	2.14	0.88
	Kernel	87	2,576	75.25	74.58	0.661	1.938	0.34
Household dietary diversity score (HDDS)	Nearest neighbor (3)	87	2,576	10.471	10.475	-0.003	0.167	-0.02
	Nearest neighbor (5)	87	2,576	10.471	10.448	0.023	0.161	0.14
	Kernel	87	2,576	10.471	10.474	-0.003	0.143	-0.02
Food Insecurity Experience Scale (FIES) score	Nearest neighbor (3)	87	2,576	1.25	1.386	-0.134	0.243	-0.55
	Nearest neighbor (5)	87	2,576	1.252	1.488	-0.235	0.236	-0.99
	Kernel	87	2,576	1.252	1.512	-0.259	0.206	-1.25
Household Hunger Scale (score)	Nearest neighbor (3)	87	2,576	0.0804	0.0344	0.046	0.047	0.97
	Nearest neighbor (5)	87	2,576	0.0804	0.0344	0.046	0.046	0.046
	Kernel	87	2,576	1.252	1.512	-0.259	0.206	-1.25

Source: Original table for this publication based on data from BIHS 2018–2019 (IFPRI 2020).

Note: Nearest neighbor and Kernel are matching techniques that have been used to estimate the impact of the programs. The numbers indicate the variants of nearest neighbor matching. Number 3 indicates that matching has been done with the three nearest neighbors. Number 5 indicates that matching has been done with the five nearest neighbors. BDT = Bangladeshi taka (currency); BIHS = Bangladesh Integrated Household Survey.

Although the input subsidy has a positive effect on the food consumption score of the households, the effect is not statistically significant. Moreover, while the impact of input subsidy on dietary diversity varies across different matching techniques, the impact is statistically insignificant. It implies that input subsidy does not have any significant impact on diversifying the food basket of the farming households. Finally, the impact is also statistically insignificant for the Food Insecurity Experience Scale and Household Hunger Scale. The insignificant impact of the input subsidy on different indicators of food security might be due to the very poor size of the support provided through the input subsidy card. Moreover, the transmission mechanism of the impact of input subsidy may also be weak, such that it fails to influence the food security of the households.

Discussion

This country case study evaluates the relative effectiveness of different interventions for rural farming households to ensure their food and nutrition security. The interventions include the social protection program, the input subsidy program and rural infrastructure development. The PSM technique has been applied to find the impact of the different interventions. While looking into the impact of social protection program as proxied by the OAA program, this study finds that such a program leads to a significant increase in the per capita food expenditure of the poor beneficiary households. However, no significant impact of the program was found on other variables of food and nutrition security such as food consumption score, dietary diversity score, the Food Insecurity Experience Scale score, or the Household Hunger Scale score. The impact of social protection programs on food and nutrition security in Bangladesh is mixed in the extant literature. Ahmed et al. (2009) and Uraguchi (2011) found a similar result of the impact of cash transfer program on food security. However, there are other studies (Ahmed et al. 2009; Badhan et al. 2019; Mamun 2019) showing positive effects of the program. The literature confirms that the impact of a social

protection program depends on the size of the benefits, as well as the duration of the support. The benefit under the OAA program is very small. This negligible support program helps poor households to increase their per capita food expenditure. But the benefit might fall short of diversifying the food basket of the beneficiary households.

The impact of input subsidies on food and nutrition has also been found to be insignificant. Although the result is inconsistent with expectations, other studies also confirm a similar result. For example, Uddin and Dhar (2018) confirmed that the beneficiaries of an input subsidy card continued to have a lower calorie intake than the minimum calorie requirement. Although the input subsidy is helpful for farmers to increase production, the size of the benefits as well as their duration might be inadequate to improve their food security.

Contrary to the impact of social protection programs and input subsidy, this study finds a significant positive impact of rural infrastructure development on the different indicators of food and nutrition security. Households having access to improved roads have a significantly higher per capita food expenditure and a more diversified food basket than those having no access to such roads. Therefore, a direct transfer program such as social protection and input subsidy works less effectively than an indirect support program such as rural infrastructure development.

4.2. Input subsidies, irrigation, and cash transfers in Malawi

In the case of Malawi, input subsidies and food and cash transfers have different impacts on food and nutrition security. Input subsidies, which typically support maize production, reduce the likelihood of undertaking negative coping strategies but

do not improve diet diversity or the food consumption score. In contrast, although the likelihood of undertaking negative coping strategies increase with food and cash transfers, the transfers lead to improved diet diversity and food consumption score. Irrigation infrastructure is found to have no effects on food and nutrition security. Moreover, there are no positive effects of a combination of input subsidies, food and cash transfers, and irrigation infrastructure, suggesting that production- and transfer-based programs are not designed to leverage synergies

Global priorities for sustainable development include food and nutrition security. However, climate change, pandemics, economic shocks, and conflicts pose threats to food systems (Poole, Donovan, and Erenstein 2021). Malawi faces malnutrition, stunting, obesity, and hunger, with 37 percent of children under the age of five stunted (NSO and ICF 2017) and one-third of the 20 million people living in the country at risk of hunger (IPC 2022). Among strategies to boost incomes and productivity of resource-constrained smallholder farmers in Malawi and other African countries are agricultural input subsidy programs (Jayne et al. 2018). However, there are several gaps with the model, including tight fiscal space for the program and other public investments such as agricultural extension (Holden 2019). Furthermore, the greater emphasis on maize and inorganic fertilizers is linked to reduced diversification, higher consumption of energy-dense diets, and soil health issues (Ickowitz et al. 2019). The use of inorganic fertilizers in maize production in Malawi has also been found to be largely unprofitable at current market prices, under the assumption that farmers face positive transaction costs associated with fertilizer use (Darko, Ricker-Gilbert, and Kilic 2024). Additionally, input subsidies' impact on productivity, welfare, and food and nutrition security shows mixed results (Hemming et al. 2018). Other interventions—such as food aid, cash transfers, and irrigation investments—have

also been found to support food and nutrition security (Baird, McIntosh, and Özler 2019; Nkhata, Jumbe, and Mwabumba 2014). However, there is a dearth of studies evaluating the impacts of participating in multiple programs (Tirivayi, Knowles, and Davis 2016). This country case study compares and assesses the combined effects of social protection and irrigation investments using integrated household panel surveys for three years, extending the literature on food and nutrition security.

Input subsidy programs have evolved in Malawi (Nkhoma 2018). Malawi's prominent Farm Input Subsidy Program (FISP), a 15-year program, was replaced by the Affordable Inputs Program (AIP) in 2020. This program provides inorganic fertilizers and improved maize, sorghum, or rice to productive poor farmers. The Social Cash Transfer Program (SCTP) provides monthly cash transfer of Malawian kwacha (MK) 14,919 (equivalent to \$9) to ultra-poor households with labor constraints. The program also responds to disasters such as floods, food inadequacy, and the COVID-19 pandemic. Food aid is another direct welfare transfer from government used to abate shock-induced hunger and food insecurity. Households receive cereals (maize), pulses (beans), cooking oil, and nutritious food (corn soya blend) through the Malawi Vulnerability Assessment Committee (MVAC) response and supplementary feeding programs. Malawi's government irrigation projects, managed by cooperatives, have benefited 348,572 smallholder farmers, but only 36 percent of potential 407,862 hectares are irrigated. The farmers cultivate a range of crops including maize, rice, and vegetables such as tomatoes, onions, cabbages, and potatoes. Government irrigation projects with credit financing include the Shire Valley Transformation Program and the Linga Irrigation Scheme. This study considers the paired effects of these social protection and irrigation investment programs on food and nutrition security.

A recent study assessed whether Malawi's input subsidy programs should target non-poor farmers instead of poor farmers by estimating the net

gain in maize yield from targeting non-poor farmers (Darko 2024). The analysis accounted for differences in inorganic fertilizer use efficiency and differences in crowding out of commercial fertilizer by subsidized fertilizer in both groups. The findings show that non-poor farmers are significantly more efficient in their use of inorganic fertilizer, but experience much higher levels of crowding out compared to poor farmers. However, the study also indicates that targeting non-poor farmers would yield an overall increase of 3.14 to 4.33 kilograms of maize per kilogram of nitrogen distributed through the subsidy program, even after accounting for the crowding out effect. This opens the question of whether focusing on non-poor farmers, rather than poor farmers, might better achieve the goal of enhancing productivity through Malawi’s input subsidy program (Darko, Ricker-Gilber, and Kilic 2024).

Data and methods

This case study uses Living Standards Measurement Studies (LSMS) data for Malawi, panel data for the years 2013, 2016, and 2019. The 2013 survey was conducted between April and October 2013, the 2016 survey field work occurred between April 2016 and April 2017, and the 2019 survey was conducted between April 2019 and March 2020. The surveys included individual and community questionnaires collecting data on agriculture, employment, and consumption assets, among others, to explain the living conditions of Malawians. In Malawi, the surveys are conducted by the National Statistical Office with support from the World Bank.

To estimate the impact of social protection and irrigation investment on food and nutrition security, a model of the following form is used:

$$FNS_{it} = \alpha_i + \beta_1 Interv1_{it} + \beta_2 Interv2_{it} + \beta_3 (Interv1_{it} \times Interv2_{it}) + \Sigma \beta X_{it} + \varepsilon_{it}, \quad (2)$$

where FNS_{it} represents the food and nutrition security measure for an individual household i in the period of survey t . $Interv1_{it}$ and $Interv2_{it}$ capture

the individual/standalone effects of participation in farm input subsidies program, social assistance program, or public irrigation scheme. The combined effects of farm input subsidies with social protection or irrigation investment on food and nutrition security are assessed using the interaction term ($Interv1_{it} \times Interv2_{it}$). Control variables, including household socioeconomic characteristics and location-specific fixed effects, are denoted by X_{it} , whereas ε_{it} is the idiosyncratic error term and β represent the slope coefficients.

This case study uses several measures of food and nutrition security including household dietary diversity score (HDDS), food consumption score, and coping strategy index (Maxwell, Vaitla, and Coates 2014). The main independent variables are production and cash transfer–based investments. Production policies under consideration include the input subsidies and irrigation investment measures. The case study also considers participation in social assistance programs—in particular, receipt of cash transfer and/or food aid. Because of the modest sample sizes for each component, participation in the two social assistance programs was pooled to facilitate meaningful analysis. Apart from these variables of interest, the study accounts for household and location-specific characteristics.

To estimate dietary diversity, the case study employs instrumental variable Poisson (IV Poisson) regression via the generalized method of moments (GMM). The instrumental variable is employed because there is potential selection bias for the variables of interest resulting in endogeneity. Several instrumental variables are used, depending on the endogenous variable under consideration. The instrumental variables’ validity is checked using the Instrumental Variable Two Stage Least Squares (IV-2SLS) estimation for panel-data models since the IV Poisson method does not produce post-estimation tests. The combined effects of the interventions are assessed by including interaction terms in the models.

Models estimating program effects on food consumption scores are estimated using single-equation instrumental-variables regression via the GMM to take advantage of pooled data. Additional analysis considers food and nutrition security as measured by coping strategies using tobit estimation. A comparison of the panel tobit model with the pooled tobit model using the likelihood-ratio test shows that there were panel-level effects in the relationship, hence results based on panel data analysis are reported.

Descriptive statistics

Table 4.9 presents the descriptive statistics for the pooled sample. On average, households

consumed food from 8 food groups and the maximum was 12 food groups. The consumption of 8 food groups compares well with other national-level studies (Jones, Shrinivas, and Bezner-Kerr 2014; Matita et al. 2022). The mean food consumption score was 49, which indicates that food and nutritional insecurity is not severe but visible. The proportion of households with a borderline and poor food security situation was 20.4 and 2.5 percent of the sample, respectively. Close to 77.1 percent reported acceptable levels of food security. About coping with food shortages, at least 61 percent of the sample used some coping strategy in the past week of the survey to deal with food insecurity. The average coping strategy index score was 6 with a maximum of 56 – the higher the

Table 4.9 Food and Nutrition Variables and Program Participation

Variable	Overall mean	Standard deviation	Minimum	Maximum
Household dietary diversity	8.058	2.017	1	12
Food consumption score	49.28	18.53	8	126
Coping strategy index score	5.664	7.603	0	56
Received subsidized inputs (1/0)	0.280	0.449	0	1
Received food/cash transfer (1/0)	0.115	0.319	0	1
Community has irrigation scheme (1/0)	0.133	0.340	0	1
HH uses irrigation scheme (1/0)	0.032	0.177	0	1
Subsidized inputs × irrigation scheme presence (1/0)	0.037	0.188	0	1
Subsidized inputs × use of irrigation scheme (1/0)	0.012	0.107	0	1
Subsidized inputs × share of HH in irrigation scheme	0.001	0.007	0	0.09
Subsidized inputs × food/cash transfer (1/0)	0.042	0.200	0	1
Food/cash transfer × irrigation scheme presence (1/0)	0.015	0.120	0	1
Food/cash transfer × share of HH in irrigation scheme	0.001	0.013	0	0.30
Food/cash transfer × HH use an irrigation scheme (1/0)	0.004	0.066	0	1
Received cash transfer	0.028	0.164	0	1
Received food aid	0.087	0.282	0	1
Number of observations	3,009			

Source: Original table for this publication based on an analysis of Living Standards Measurement Studies (LSMS) data for Malawi; data panel for 2013, 2016, and 2019 (LSMS-ISA).

Note: HH = household. (1/0) indicates dichotomous variable equal to 1 for the included category, otherwise equal to 0 for the base category.

coping strategy index score the greater the use of negative coping mechanisms with food insecurity. The finding of a lower coping strategy index score and a higher food consumption score and dietary diversity is in line with the consensus that there is an inverse relationship between coping strategy index and other related scores (Maxwell, Caldwell, and Langworthy 2008).

About 28 percent of the sample received subsidized farm inputs. Government transfers were accessible to few households; only 3 percent received cash transfers and 9 percent obtained food aid. In the econometric analysis, receipt of either cash transfers and/or food aid representing 12 percent of the sample were considered. The presence of an irrigation scheme in a community was reported by 13 percent of the sample and only 3 percent have access to use the schemes. Joint program participation is minimal in the sample. For example, only 4 percent of households reporting the presence of an irrigation scheme in their community received input subsidies. According to pairwise correlation in table 4.10, receiving input subsidies is weakly associated with the use of an irrigation scheme ($p < 0.10$). The proportion using the irrigation schemes and benefiting from the subsidy program is far less: only 1.2 percent. A qualitative assessment about the eligibility of SCTP beneficiaries for other social assistance programs demonstrates that,

while stakeholders support multiple program participation to enhance possibility of graduation, informal rules of exclusion are promoted by chiefs and communities in the targeting process (Chirwa et al. 2016).

The study's estimates show that participation in both cash transfer and input subsidy programs is limited to only 4 percent of the sample with no significant correlation. There is, however, strong positive correlation between receiving food aid and input subsidies ($p < 0.01$), suggesting that households might concurrently benefit from the programs.

Table 4.11 presents mean differences in food and nutrition measures by program participation. It is observed that, although households receiving input subsidies cope less with food insecurity, their FCS is significantly lower. A significantly lower FCS and dietary diversity as well as an increase in usage of coping strategies to address food insecurity is linked to presence and use of an irrigation scheme. Furthermore, receiving food/cash transfers is associated with higher dietary diversity; but such households cope with significantly more food insecurity.

The modeling approach also controlled for several variables whose descriptive statistics are reported in table 4.12. The majority of the household heads

Table 4.10 Pairwise Correlation of Program Participation

Program	Received subsidized inputs (1/0)	HH use of an irrigation scheme (1/0)	Irrigation scheme presence (1/0)
HH use an irrigation scheme (1/0)	0.0323*	n.a.	n.a.
Irrigation scheme presence (1/0)	-0.0029	n.a.	n.a.
Food aid and/or cash transfer (1/0)	0.0688***	0.0115	-0.0035
Food aid	0.0795***	0.0237	-0.0052
Cash transfer	-0.0060	-0.0193	0.0005

Source: Original table for this publication based on an analysis of Living Standards Measurement Studies (LSMS) data (LSMS-ISA).

Note: HH = household; n.a. = not applicable. (1/0) indicates dichotomous variable equal to 1 for the included category, otherwise equal to 0 for the base category. Reported values are correlation coefficients. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4.11 Mean Differences in Food and Nutrition Security Measures by Program

Program	Household dietary diversity	Food consumption score	Coping strategy index	Number of observations
Received subsidized inputs (yes)	8.144	48.27	5.24	846
Received subsidized inputs (no)	8.024	49.81**	5.83**	2,163
HH use an irrigation scheme (yes)	7.89	45.83	6.16	97
HH use an irrigation scheme (no)	8.06	49.50**	5.65	2,912
Irrigation scheme presence (yes)	7.76	47.52	7.09	396
Irrigation scheme presence (no)	8.10***	49.66	5.45***	2,613
Received food/cash transfer (yes)	8.23	50.82	6.71	343
Received food/cash transfer (no)	8.04*	49.19	5.53***	2,666
Food aid (yes)	8.58	52.29	5.79	262
Food aid (no)	8.01***	49.10**	5.65	2,747
Cash transfer (yes)	7.12	45.99	9.61	83
Cash transfer (no)	8.08***	49.47*	5.55***	2,926

Source: Original table for this publication based on an analysis of Living Standards Measurement Studies (LSMS) data (LSMS-ISA).

Note: (1/0) indicates dichotomous variable equal to 1 for the included category, otherwise equal to 0 for the base category. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4.12 Descriptive Statistics for Pooled Sample

Variable	Mean	Standard deviation	Minimum	Maximum
Age of household head (years)	44.06	15.98	10	104
Male headed household (1/0)	0.735	0.441	0	1
Household size	4.995	2.195	1	16
Years of education for the head	7.152	3.725	0	23
Number of household members 0–5 years	0.872	0.841	0	5
Number of household members 6–14 years	1.168	1.175	0	8
Number of household members 15–55 years	2.410	1.298	0	9
Number of household members \geq 56 years	0.412	0.689	0	4
Wage employment (1/0)	0.130	0.336	0	1
Business employment (1/0)	0.107	0.310	0	1
Agriculture employment (1/0)	0.591	0.492	0	1
Asset index	0.794	4.263	-0.042	23.22
Distance to nearest weekly market	7.605	5.745	0	37
Number of crops cultivated	2.632	1.397	0	9
Received any extension service (1/0)	0.680	0.466	0	1
Received credit (1/0)	0.246	0.431	0	1
Farmland size (acreage)	1.780	1.604	0	18
Southern region (1/0)	0.494	0.500	0	1
Central region (1/0)	0.387	0.487	0	1
Number of observations	3,021			

Source: Original table for this publication based on an analysis of Living Standards Measurement Studies (LSMS) data for Malawi (LSMS-ISA).

Note: (1/0) indicates dichotomous variable equal to 1 for the included category, otherwise equal to 0 for the base category.

(74 percent), who are on average forty-four years old and have seven years of schooling, are men. On average, a household with five members cultivates 1.9 acres of land. Only 25 percent of the sample accessed credit, although over half received extension services (68 percent).

Regression results

Summarized results are presented for a set of food and nutrition measures—household dietary

diversity, food consumption scores, and coping strategy index—in tables 4.13, 4.14, and 4.15, respectively. The models presented are all jointly statistically significant at the 1 percent level as indicated by the obtained log-likelihood ratio chi-squared statistic. The included instrumental variables were valid and the test of endogeneity was significant. Two endogenous variables are considered in each paired analysis. All models include control variables such as household

Table 4.13 Effects of Interventions on Household Dietary Diversity

Dependent variable: Household dietary diversity	Model 1	
	Incidence rate ratio	Standard errors
Panel A		
Received subsidized farm inputs (1/0)	1.348	(0.317)
HH uses an irrigation scheme (1/0)	1.509	(0.925)
Subsidized inputs × use of irrigation scheme (1/0)	0.550	(0.397)
Panel B		
Received subsidized farm inputs (1/0)	1.348	(0.277)
Community has an irrigation scheme (1/0)	1.183	(0.438)
Subsidized inputs × community has irrigation scheme (1/0)	0.690	(0.299)
Panel C		
Received subsidized farm inputs (1/0)	0.808	(0.321)
Received food/cash transfer (1/0)	2.072***	(0.528)
Subsidized inputs × food/cash transfer (1/0)	0.660	(0.237)
Panel D		
Community has an irrigation scheme (1/0)	0.706	(0.375)
Received food/cash transfer (1/0)	1.738***	(0.287)
Irrigation scheme × food/cash transfer (1/0)	0.858	(0.447)
Panel E		
Received food/cash transfer (1/0)	1.810***	(0.300)
HH uses an irrigation scheme (1/0)	1.401	(0.773)
HH uses an irrigation scheme × food/cash transfer (1/0)	0.443	(0.263)

Source: Original table for this publication based on an analysis of Living Standards Measurement Studies (LSMS) data for Malawi (LSMS-ISA). Note: All models include control variables such as household characteristics and location fixed effects. Exponentiated coefficients. Standard errors are in parentheses. (1/0) indicates dichotomous variable equal to 1 for the included category, otherwise equal to 0 for the base category. HH = household. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

socioeconomic characteristics and location fixed effects.

Table 4.13 reports the effects of various interventions on household dietary diversity estimated using IV Poisson regression. No statistically significant joint effects on dietary diversity from participation in any of the programs under consideration were found. However, receiving food/cash transfers improves food consumption ($p < 0.01$). The results suggest households receiving food/cash transfers consume

an additional two food groups compared to those without such transfers (panels C, D, and F). Nonetheless, this significant standalone effect driven by food aid does not persist when food/cash transfers are considered in combination with other interventions. For instance, the results show that households receiving food/cash transfers in communities where an irrigation scheme exists do not experience dietary diversity that is significantly different from those in communities without an irrigation scheme and who are not receiving government social transfers.

Table 4.14 Effects of Interventions on Food Consumption Score

Dependent variable: Food consumption score	Model 1	
	Coefficient	Standard errors
Panel A		
Received subsidized farm inputs (1/0)	29.146	(20.216)
HH uses an irrigation scheme (1/0)	72.026	(67.444)
Subsidized inputs × use of irrigation scheme (1/0)	-90.862	(77.749)
Panel B		
Received subsidized farm inputs (1/0)	31.290	(20.468)
Community has an irrigation scheme (1/0)	47.295	(36.394)
Subsidized inputs × community has irrigation scheme (1/0)	-66.622	(44.156)
Panel C		
Received subsidized farm inputs (1/0)	-12.241	(21.464)
Received food/cash transfer (1/0)	72.839**	(35.939)
Subsidized inputs × food/cash transfer (1/0)	-55.317*	(31.705)
Panel D		
Community has an irrigation scheme (1/0)	2.341	(23.620)
Received food/cash transfer (1/0)	45.362***	(16.032)
Irrigation scheme × food/cash transfer (1/0)	-40.182	(26.488)
Panel E		
Received food/cash transfer (1/0)	47.961***	(17.949)
HH uses an irrigation scheme (1/0)	45.316	(50.633)
HH uses an irrigation scheme × food/cash transfer (1/0)	-86.161	(57.079)

Source: Original table for this publication based on an analysis of Living Standards Measurement Studies (LSMS) data for Malawi (LSMS-ISA).

Note: All models include control variables such as household characteristics and location-fixed effects. Obtained coefficients are the same as conditional marginal effects (dy/dx). Standard errors in parentheses. (1/0) indicates dichotomous variable equal to 1 for the included category, otherwise equal to 0 for the base category. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4.14 shows the effects of different interventions on food consumption scores generated from the IV Poisson regression. Positive joint effects on food consumption scores are found to be lacking. In other words, there are no significant combined effects on food consumption scores from investing in irrigation and receiving input subsidies. Additionally, the findings demonstrate that households are significantly disadvantaged in food consumption scores when they combine participation in input subsidies

with food/cash transfers (panel C in the table). Households receiving input subsidies as well as food/cash transfers experience reduced food consumption scores by a margin of 55 points ($p < 0.10$). However, receiving food/cash transfers alone has significant favorable benefits on food consumption scores (panels C, D, and E), implying that households receiving government food/cash transfers experience greater balance in food consumption.

Table 4.15 Effects of Interventions on Coping with Food Insecurity

Dependent variable: Coping strategy index (CSI)	Model 2	
	Coefficient	Standard errors
Panel A		
Received subsidized farm inputs (1/0)	-0.135*	(0.074)
HH uses an irrigation scheme (1/0)	-0.318	(0.217)
Subsidized inputs × use of irrigation scheme (1/0)	0.267	(0.360)
Panel B		
Received subsidized farm inputs (1/0)	-0.115	(0.077)
Community has an irrigation scheme (1/0)	-0.001	(0.108)
Subsidized inputs × community has an irrigation scheme (1/0)	-0.094	(0.203)
Panel C		
Received subsidized farm inputs (1/0)	-0.158**	(0.078)
Received food/cash transfer (1/0)	0.144	(0.120)
Subsidized inputs × transfer (1/0)	0.182	(0.200)
Panel D		
Received food/cash transfer (1/0)	0.257**	(0.104)
Community has an irrigation scheme (1/0)	0.026	(0.098)
Irrigation scheme × food/cash transfer (1/0)	-0.412	(0.283)
Panel E		
Received food/cash transfer (1/0)	0.224**	(0.099)
HH uses an irrigation scheme (1/0)	-0.159	(0.187)
HH uses an irrigation scheme × food/cash transfer (1/0)	-0.548	(0.503)

Source: Original table for this publication based on an analysis of Living Standards Measurement Studies (LSMS) data (LSMS-ISA).

Note: All models include control variables such as household characteristics and location fixed effects. Because the dependent variable is log transformed, the obtained coefficients can be interpreted in terms of percentage change. Standard errors in parentheses. (1/0) indicates dichotomous variable equal to 1 for the included category, otherwise equal to 0 for the base category. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4.15 presents panel tobit estimates of the effects of social assistance and irrigation investments on food and nutrition security as measured by coping strategy index. The results indicate no significant combined effects from participation in multiple programs. However, receiving input subsidies alone has a significant effect on a household's ability to cope with food insecurity (panels A and C). For example, households receiving input subsidies cope between 13–16 percent less with food poverty on average, suggesting a better food security situation, insofar as they engage less in negative coping strategies. Conversely, receiving food/cash transfers is linked to a significant use of coping mechanisms (panel D and E). On average, beneficiaries of food/cash transfers cope 21–26 percent more with food and nutrition insecurity ($p < 0.05$), thus implying greater use of negative measures such as reducing food portions and the number of meals, among others, to deal with food insecurity.

Discussion

A growing number of Malawian households are experiencing food and nutrition insecurity because of the effects of COVID-19 pandemic; supply chain disruptions caused by Russia's invasion of Ukraine; and climate shocks that result in the loss of produce, livestock, and livelihoods. Furthermore, the recent devaluation of the Malawi kwacha relative to the US dollar has made the macroeconomic environment even more dire, making it difficult to afford nutritious foods. Public programs to achieve food and nutrition security include the provision of input subsidies, the establishment of irrigation infrastructure, and direct welfare transfers in the form of food or cash. Prior evaluation of these programs found positive association with food and nutrition security; there is, however, a dearth of studies evaluating the impacts of participating in multiple programs (Tirivayi, Knowles, and Davis 2016). This country case study contributes to the literature by comparing and assessing the combined effects of social protection and irrigation

investments using integrated household panel surveys for three years.

Overall, the findings suggest weak and insignificant joint effects from participating in several programs. In particular, the availability of irrigation infrastructure in a community and its use by households that receive food/cash transfers or input subsidies has no influence on food and nutrition security outcomes. This is contrary to evidence demonstrating standalone positive effects of irrigation infrastructure on production, livestock, and livelihoods (Fan, Gulati, and Thorat 2008; Nkhata, Jumbe, and Mwabumba 2014), but these are localized studies that did not focus on food and nutrition security measures. It is also likely that the low coverage of the programs may be driving the counterintuitive results.

This case study has also revealed that receiving input subsidies has no effect on dietary diversity, consistent with other studies suggesting that the effects are indirect—that is, through the sale of maize, the growing of nutrient-rich crops, food expenditures, or filling the maize basket (Karamba 2013; Matita et al. 2022; Smale, Thériault, and Mason 2020; Snapp and Fisher 2015). The finding about the lack of input subsidies' effect on food consumption scores, however, differs from that of Harou (2018), who reported that, depending on the number of vouchers received between 2008 and 2013, the effects are positive in Malawi. Nevertheless, a recent study by Chakrabarti et al. (2024) corroborates that the impact of input subsidies on food and nutrition are largely indirect and come through improvements in productivity and income. Therefore, the lack of joint impacts may not necessarily reflect a lack of relationship but rather that the association between food security and the programs is indirect.

This case study indicated that the combined effects of food/cash transfers and input subsidies on FCS are negative, which is contrary to study expectations. Especially in light of research showing that input subsidies raise household food production capacity while cash transfers address

liquidity constraints, which—when combined—have positive incremental effects (Pace et al. 2017; Thome, Taylor, and Filipski 2014). Even then, the lack of influence of the two programs could be a manifestation of the characteristics of the beneficiaries. Since typically social cash transfer programs target labor-constrained households in Malawi, households receiving food assistance or cash transfers are already constrained. They lack the labor to use the subsidized inputs in their production. Furthermore, those receiving food/cash transfers are more vulnerable to food insecurity, and sourcing food for consumption would take precedence over making efficient use of the subsidized inputs. There is also literature indicating that households that are food insecure in terms of meeting their calorie requirements are unlikely to respond to incentives to grow nutrient-rich crops or to participate in output marketing to earn income, both of which are key to improving the diversity of foods consumed (Aberman and Roopnaraine 2020; Carletto, Corral, and Guelfi 2017; Chirwa and Matita 2012; Matita et al. 2022). Additionally, this is in keeping with the findings of Thome, Taylor, and Filipski (2014) that households with larger land holdings benefit more from the input subsidies and the finding of Pace et al. (2017) that positive synergies exist for labor-unconstrained households receiving cash transfers and input subsidies. Therefore, the combined effects could be heterogeneous.

Furthermore, looking across the indicators, input subsidies are found to have no effect on dietary diversity and food consumption scores and are only useful in lowering the use of negative coping strategies, in keeping with Zingwe, Manja, and Chirwa (2021). It is likely that food availability assured through own-food production makes it less likely for households to use negative coping mechanisms, a finding corroborated by Tirivayi, Knowles, and Davis (2016) in a review of the links between social protection and agriculture. The notion that the coping strategy index captures more food quantity than quality helps to further explain this (Vaitla et al. 2017). The coping strategy index is therefore more sensitive to input subsidies, as subsidies in Malawi aim to increase

the quantity of maize. In other words, subsidizing farm inputs for the growing of maize increases food monotony rather than diversification, as also demonstrated by Chakrabarti et al. (2024). Conversely, receipt of food/cash transfers is associated with increased use of negative food coping mechanisms and positively impacts on both dietary diversity and food consumption score—both measures of diversity of dietary intake. This exemplifies how cash/food transfers may not be sufficient to promote other dimensions of food and nutrition security in Malawi. Providing food/cash transfers supports market purchases and consumption of a wider variety of foods at home but not the quantity of food consumption.

There are very few collaborative programs in Malawi that encompass both production- and transfer-based instruments. This results from, among other things, the structural or inherent distinctions in the program designs, where the targeting of transfer-based programs focuses on a criterion linked to the characteristics of individuals or households. For instance, transfer-based instruments are primarily designed for ultra-poor and labor-constrained households, whereas production-based instruments are purposed to enhance crop productivity among resource-constrained smallholder farmers but with land (Harou 2018). This implies that, in as much as joint programs show significant impact elsewhere (Sulaiman 2016), there are no deliberate efforts to consolidate these instruments into a unified approach in Malawi.

This study concludes that the combined effects of input subsidies, food/cash transfers, and irrigation investments on food and nutrition security are minimal. Therefore, there might not be many opportunities to build synergies between social assistance and irrigation investments through the existing stand-alone implementation model. Nevertheless, households simply receiving food/cash transfers showed improvements in food consumption and dietary diversity scores. In addition, input subsidies helped households to use fewer coping strategies to manage their food insecurity even if the program also reduced dietary

diversity and food consumption scores, suggesting that overreliance on agriculture input subsidies leads to reduced variety in consumption. Policy pursuits for more explicit links between programs, while commendable, might require addressing in parallel the need to diversify and rebalance public spending intended to reduce food and nutrition insecurity. This might include rebalancing spending toward food/cash transfers from high spending on agricultural input subsidies, sequencing interventions as well as targeting agricultural input subsidies to poor households receiving food/cash assistance that might make better use of these inputs.

The results of this study should be interpreted with caution. First, the various program impacts on food and nutrition security are largely indirect via crop production, productivity, and likely income increases, pathways that have not been addressed in this study. Therefore, the weak joint program effects may be resulting from the indirect relation between the food security and the programs, and not necessarily a lack of relationship. Second, low coverage and under-sampling of programs' participants might have contributed to the weak effects estimated. Future studies could address these limitations

Notes

1. Details about the World Bank's FoodSystems 2030 Umbrella Multi-Donor Trust Fund can be found at <https://www.worldbank.org/en/programs/food-systems-2030>.
2. This grant comes from the Program on Agricultural and Rural Transformation for Nutrition, Entrepreneurship, and Resilience (PARTNER) in Bangladesh is to promote diversification, food safety, entrepreneurship, and climate resilience in the agri-food systems of Bangladesh. See <https://projects.worldbank.org/en/projects-operations/project-detail/P176374> for details.
3. This grant comes from the Food Systems Resilience Program for Eastern and Southern Africa Project, which aims to increase the resilience of food systems and preparedness for food insecurity in the participating countries. Details about this project are available at <https://projects.worldbank.org/en/projects-operations/project-detail/P178566>.

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5 Future Directions



There are significant opportunities to build on this important knowledge agenda.

Some areas for future work include a deeper dive on trade policy and political economy considerations. Further analysis on trade can focus on how a country's participation in international trade is linked to dietary diversity and food composition within countries. This work can make use of time series country-level data capturing the contribution of individual items to total domestic food supply (including the availability of various micronutrients) and combine this with data characterizing a country's participation in international trade. Political economy analysis can identify ways to reform policies towards curbing the growth in the consumption of unhealthy foods. The analysis can be based on a framework that considers factors that influence policy design, implementation, and effectiveness. Successful experiences in addressing global public health issues—including parallel lessons from tobacco policies—can be further examined. Key stakeholders, and their incentives and constraints can be identified, along with their roles in supporting or hindering the reform process.

Another area for future work is to develop country-level analyses which articulate the hidden health costs of food systems. Doing so would help in advocating the value of and the need for repurposing agrifood policies and support for healthier diets. Healthy diets have been characterized as responding to four universal principles—nutrient adequacy, dietary diversity, macronutrient balance, and moderation. Previous estimates of the economic cost of unhealthy diets have used nutritional status as a proxy or have made estimates of the impact of noncommunicable diseases (NCDs) by adding up known risks of individual diet factors. Both these methods have limitations. A new proposed method to accurately estimate hidden health costs of food systems takes advantage

of newer and more holistic measures of diet quality, particularly the Global Diet Quality Score. Ongoing joint work of the World Bank and the Food and Agriculture Organization of the United Nations (FAO) has developed and is piloting this new country-level method in Ethiopia and in the Philippines. This work looks at the overall burden of unhealthy diets, including the economic costs of undernutrition, as well as the economic costs (i.e. treatment costs and premature mortality) of major diet risk factors such as overweight and obesity, high blood pressure, and high fasting blood glucose. The pilot findings reveal that both Ethiopia and the Philippines had low overall diet quality scores. Urbanization and higher income are associated with decreased consumption of nutrient-rich vegetables and increased consumption of unhealthy foods. The initial findings also highlight the high economic costs of unhealthy diets, particularly from child stunting in Ethiopia and from diet-related NCDs in the Philippines. This new method can be used to inform health and agrifood investment discussions, especially in low- and middle-income countries (LMICs) undergoing a nutrition transition.

A third area for future work is to develop country-level assessments of climate and nutrition win-wins and tradeoffs. Doing so would allow for a more holistic assessment of the impact of various policy levers across a range of outcomes that policymakers need to weigh. To better support policy making, there is a need to assess diet-related synergies and tradeoffs between nutrition and the environment, including through country assessments of the nutrition and environmental impacts of diets. Such work can assess and compare a country's current starting point and targets for dietary pattern, nutritional adequacy, nutritional impact of adaptation to climate change, environmental impact, and cost and affordability of diet scenarios. Ongoing joint work of the World Bank and the World Food Programme (WFP) is piloting the use of a new

tool in Cambodia to assess the potential impact of project-level interventions on the cost and affordability of nutrient adequate and healthy diets, and on environmental outcomes such as greenhouse gas emissions, water use, and land use change. The Environment, Nutrition, and Health Analytics for National Consumer and Emergency Diets (ENHANCE) tool was recently developed by WFP, Capgemini, Zero Hunger Lab of Tilburg University, and Johns Hopkins University. This multi-objective linear programming approach

identifies diet combinations that minimize cost, closeness to current diet patterns, and greenhouse gas emissions. Initial results in Cambodia indicate that there are trade-offs between greenhouse gas emissions and current consumption habits. To achieve lower emissions, current consumption habits must shift, but these shifts are within reach. The pilot in Cambodia will provide solutions across a range of food subsectors, including rice, fruits and vegetables, livestock, and alternative proteins.

OECD Database on Agrifood Support

Total Support Estimate

The *Total Support Estimate* (TSE) is defined as the annual monetary value of all gross transfers from taxpayers and consumers arising from policy measures that support agriculture, net of the associated budgetary receipts, regardless of their objectives and impacts on farm production and income or the consumption of farm products. It can be found by summing transfers to producers, consumers, and general services:

$$TSE = PSE + CSE + GSSE$$

Producer Support Estimate

The *Producer Support Estimate* (PSE) encapsulates the annual monetary value of gross transfers from consumers and taxpayers to agricultural producers. This measure, calculated at the farm-gate level, encompasses a range of policy measures aimed at supporting agriculture, irrespective of their specific objectives or impacts on farm production and income. The PSE is

composed of two main elements (see table A.1 for the categories and subcategories):

- *Market Price Support* (MPS) is defined as the “annual monetary value of gross transfers from consumers and taxpayers to agricultural producers, arising from policy measures that create a gap between domestic market prices and border prices of a specific agricultural commodity, measured at the farm gate level,”¹ from which we subtract price levies (LV) and excess feed costs (EFC).^{2,3} The MPS can be positive (in which case policy measures benefit producers) or negative (in which case policy measures are essentially an implicit tax on producers). For example, import tariffs, import quotas, levies, licensing systems, minimum guaranteed prices, export taxes, are all MPS policies benefiting producers via prices except for the export tax.
- *Budgetary transfers* (BT) are direct transfers from the government to farmers, enhancing their financial support.

$$PSE = MPS + \Sigma BT$$

Box A.1 Producer Support Estimate Categories and Subcategories

PSE categories and subcategories

A. Support based on commodity output

A.1. Market Price Support (MPS)

A.2. Payment based on output

(Continued)

Box A.1 Producer Support Estimate Categories and Subcategories (Continued)

PSE categories and subcategories

B. Payment based on input use

- B.1. Variable input use
- B.2. Fixed capital formation
- B.3. On-farm services

C. Payments based on current area/animal number/receipts/income

- C.1. Based on current receipts/income
- C.2. Based on current area/animal numbers

D. Payments based on non-current area/animal number/receipts/income, production required

E. Payments based on non-current area/animal number/receipts/income, production not required

- E.1. Variable rates
- E.2. Fixed rates

F. Payments based on non-commodity criteria

- F.1. Long-term resource retirement
- F.2. A specific non-commodity output
- F.3. Other non-commodity criteria

G. Miscellaneous payments

Over 60 percent of the support to producers for the 2020–22 period was in the form of policies classified as support based on commodity output (category A) and variable input use (subcategory B.1); these policies are considered the most distorting. They encourage farmers to expand production and the use of variable inputs (fertilizers, pesticides, herbicides) beyond what they would have produced/used otherwise. As a result, these policies are linked to poor environmental outcomes such as freshwater ecosystem pollution. Furthermore, these policies do a poor job of raising farm incomes: it has been found that for every policy-induced dollar transferred through MPS, farmers' income increased by 25 cents (OECD 2001). Lastly, these policies impact the global availability of food by favoring inefficient allocation of resources (farmers might have switched crops or exited the agricultural sector altogether), leading to

inefficient production locations. Consequently, this has an impact on diets by changing the type of food consumed and the quantity of each food group consumed. For instance, positive MPS causes domestic prices for the supported commodity to be higher than international prices, which leads to an increase of food consumption expenditure of the supported commodity. This is especially true for low-income consumers.

The remaining 40 percent of the support includes payments based on land area, animal numbers, receipts, or income for current (category C), non-current but linked to production (category D) or not (category E), or payments not linked to the production of agricultural commodities (category F), such as payments based on historical entitlements. Despite not being as distortive as the previously mentioned policy categories, policies can distort

incentives, leading to environmental degradation and inefficient resource allocation. This is the case for support policies coupled to current production (C), which create incentives to increase land area/livestock. This is likely to cause a negative environmental impact (in the case of livestock) or, at best, to have an ambiguous effect (in the case of land area). In addition, payments to land area favor a shift away from livestock production. Lastly, payments based on categories D and E are considered fully decoupled. These are among the least environmentally harmful support policies and allow farmers to respond to market signals.

Indicators of support to producers based on commodity specificity

The OECD also uses complementary indicators of producer support based on commodity specificity. There are four indicators: Producer Single Commodity Transfers (PSCT), Group Commodity Transfers (GCT), All Commodity Transfers (ACT), and Other Transfers to Producers (OTP). They measure the annual monetary transfers to producers from consumers and taxpayers based on the production of a single commodity, one or more commodities from a designated list, any commodity, and no commodity at all, respectively. The payments considered for each indicator are mutually exclusive, meaning that the payments considered for one indicator are not included in the others. For example, transfers to sugar producers coming from a program for which sugar (along with other commodities) is eligible will be considered as part of the GCT and not the PSCT. These indicators can also be expressed as a share of GFR.

The PSCT can be computed for specific commodities and groups, respectively. It is interesting to highlight a few aspects of these indicators. First, PSCT can be understood as the amount of incentive distorting transfers. This is because only producers of that specific commodity can benefit from the transfers that can make producing that specific commodity relatively more attractive than producing another. Transfers based

on a broad group of commodities and non-commodity criteria influence the decisions of farmers to produce a specific commodity less and allow them to respond to market signals. Second, the GCT, ACT, and OTP necessarily involve taxpayers who are either sources or recipients of the transfers. As mentioned above, MPS is included in PSE and constitutes a share of PSCT. Lastly, the sum of the indicator makes up the PSE:

$$PSE = PSCT + GCT + ACT + OTP$$

Consumer Support Estimate (CSE)

Like the PSE, the CSE considers market transfers and budgetary transfers such as food assistance and cash transfer programs. Like the PSE, it can also be measured by commodity, in which case we talk about Consumer Single Commodity Transfers (CSCT). When expressed as a percentage (%CSE), it measures transfers to consumers as a share of consumption expenditure measured at the farm gate. If the CSE is negative it measures the burden (implicit tax) on consumers. This can be the result of higher prices through Market Price Support to producers that more than offsets consumer subsidies that lower prices to consumers. It is important to note that the MPS component of the CSE is the same one as the PSE but has the opposite sign. In that sense, the CSE usually mirrors PSE such that countries heavily supporting consumers are generally penalizing their consumers.

General Services Support Estimate (GSSE)

The GSSE is defined as the annual monetary value of gross transfers arising from policy measures that create enabling conditions for the primary agricultural sector through the development of private or public services, institutions, and infrastructure, regardless of their objectives and impacts on farm production and income or

the consumption of farm products. It includes policies where agriculture is the main beneficiary collectively but not those where individual producers or consumers receive direct support. It includes spending on research and development, innovation, inspection services, infrastructure development and maintenance, marketing and promotion, and public stockholding. It essentially measures spending on public goods or support to goods with public characteristics. When expressed

as a percentage of GSSE (%GSSE), it measures the share of total government support going to agriculture.

Spending on GSSE should be favored to spending on PSE because it allows producers to follow market signals, create an enabling environment to strengthen competitiveness, and increase productivity in the long term.

Notes

1. It is important to bear in mind that the MPS measures implicit or explicit transfers arising from a policy creating a price differential, it is not a measure of public expenditure.
2. Price levies are production taxes that are imposed on producers as part of MPS.
3. Excess feed cost is a concept accounting for transfers between feed producers and livestock producers as a result of policies impacting the price of feed crops.

Reference

OECD (Organisation for Economic Co-operation and Development). 2001. *Agricultural Policy Monitoring and Evaluation*. Paris: OECD. https://doi.org/10.1787/agr_oecd-2001-en.

Global Dietary Database on Food Consumption

Global Dietary Database (GDD) data are based on a series of various sources, such as food and consumption reports, partner information, the Food and Agriculture Organization of the United Nations (FAO), and Demographic Health Surveys (DHSs) that date from 1990 to 2018. As of July 2021, the latest GDD 2018 iteration includes 1,240 surveys, which were then included in the GDD 2018 model.

GDD data includes the following regions, which are then separated into 185 countries and economies:

Asia: East Asia, Southeast Asia, Oceania, and Asia-Pacific high-income countries

Former Soviet Union: Central Asia, Central Europe, Eastern Europe

Latin America and Caribbean: Caribbean, Andean Latin America, Southern Latin America, Tropical Latin America, Central Latin America

Middle East and North Africa: Western Europe, Middle East, and North Africa

South Asia: South Asia, Southeast Asia.

Sub-Saharan Africa: Central Sub-Saharan Africa, Southern Sub-Saharan Africa, East Sub-Saharan Africa, West Sub-Saharan Africa

Western high-income countries: Australasia, Western Europe, North America high-income countries.

The GDD prediction model

The GDD model incorporates multiple levels of analysis, considering country-specific and region-specific variations. It factors in the impact of age, sex, education, urbanicity, and other relevant demographic details using a hierarchical structure.¹ The hierarchical nature of the data,

where countries are nested within regions, allows for a nuanced analysis of global dietary patterns. This framework accounts for differences across countries and regions after adjustments for demographic and geographic stratifications. This approach is beneficial for capturing the complex nature of dietary patterns globally. The model uses cubic splines for age to address nonlinear age effects and includes country- and year-specific covariates to fine-tune the estimates.

To ensure the reliability and relevance of its data, the GDD model undergoes rigorous validation processes, including cross-validation techniques and the assessment of global heat maps of national mean intakes. This continuous validation process is crucial for maintaining the accuracy and applicability of the database in reflecting changing global dietary trends.

Data set construction

To construct this comprehensive data set, the Organisation for Economic Co-operation and Development (OECD)'s Agricultural Policy Indicators database is integrated with the Agrimonitor database from the Inter-American Development Bank (IDB). (The OECD indicator is used if a country appears in both databases). Additionally, food intake data from the 2022 Global Dietary Database (GDD) is incorporated.

After appending and merging from the three sources mentioned above and dropping observations with missing variables on any of GDD or support variables, a total of 44 countries is found (see table B.1) and 258 observations for sugar and 230 observations for other four food groups.

Table B.1 List of Countries in the Analysis (*N* = 44)

Argentina	Ecuador	Japan	Russian Federation
Australia	El Salvador	Kazakhstan	South Africa
Bahamas, The	Guatemala	Korea, Rep.	Suriname
Bolivia	Guyana	Mexico	Switzerland
Brazil	Haiti	New Zealand	Trinidad and Tobago
Canada	Honduras	Nicaragua	Türkiye
Chile	Iceland	Norway	Ukraine
China	India	Panama	United Kingdom
Colombia	Indonesia	Paraguay	United States
Costa Rica	Israel	Peru	Uruguay
Dominican Republic	Jamaica	Philippines	Viet Nam

Note

1. At the core of the GDD is its sophisticated Bayesian multilevel prediction model. This model synthesizes the mean intake data from various surveys, adjusting for a multitude of relevant covariates.

Cross-Country Regression Estimations

Specifications

The regression analyses leverage the panel of 44 countries spanning 1990, 1995, 2000, 2005, 2010, 2015, and 2018 (for sugar, 2020 is also covered) and employ two-way fixed effects to estimate correlations between public support for agrifood commodities and consumption. The primary specification is:

$$y_{it} = \alpha + BX_{it} + u_i + v_t + e_{it} \quad (1)$$

where y_{it} is the outcome—that is, the consumption of a food group (grams per day) for country i in year t —and X_{it} is a vector of the agrifood support variables, and u_i and v_t are year- and country-specific fixed effects. Equation (1) is estimated by each food group separately for three food groups (grains, meat, sugar). Various specifications for the vector of the agrifood support variables, X_{it} , are considered. Table C.1 summarizes the specifications.

The key underlying assumption behind the estimation of equation (1) is $Cov(X_{it}, e_{it}) = 0$, which, in words, says that the agrifood support variables are uncorrelated with unobservable time-varying country-specific factors that may influence the consumption of each food group. As many policies and support variables are interlinked, some specifications with a single support variable in table C.1 may face biases from the nonzero covariance. Under such logic, specifications such as A5 and B5-10 (see table C.1.) would be less prone to the omitted bias due to possible interlinkages across policies and supports. The limitation for those specifications is that the estimations are underpowered due to relatively large number of variables with small sample size. Hence, the results face multicollinearity where the point estimates are unstable and noisy.

Table C.1 Specifications on the Choice of Support Variables

Support type	Support variables
Overall supports (A)	(1) TSE
	(2) PSE
	(3) CSE
	(4) GSSE
	(5) TSE, PSE, CSE, GSSE
Single commodity supports (B)	(1) PSCT
	(2) MPS
	(3) Non-MPS
	(4) Non-MPS, Non-MPS ²
	(5) MPS, Non-MPS, Non-MPS ²
	(6) PSCT, CSCT
	(7) MPS, CSCT
	(8) Non-MPS, CSCT
	(9) Non-MPS, Non-MPS ² , CSCT
	(10) MPS, Non-MPS, Non-MPS ² , CSCT

Note: CSCT = Consumer Single Commodity Transfer; CSE = Consumer Support Estimate; GSSE = General Services Support Estimate; PSE = Producer Support Estimate; MPS = Market Price Support; PSCT = Producer Single Commodity Transfer; PSE = Producer Support Estimate.

Descriptive statistics of the regression sample

While table C.1 provides descriptive statistics of overall support variables, tables C.2 through C.5 provide descriptive statistics of individual variables.

Table C.2 Descriptive Statistics: Overall Support Variables

Support variables	1990			1995		
	Mean	SD	N	Mean	SD	N
TSE (US\$, millions)	5,344.00	12,643.98	27	7,898.57	19,248.52	27
PSE (US\$, millions)	4,091.88	9,369.36	27	5,371.12	13,766.23	27
CSE (US\$, millions)	-2,965.42	9,355.97	27	-4,394.75	16,819.18	27
GSSE (US\$, millions)	707.80	1,944.36	27	1,765.93	4,751.79	27
Support variables	2000			2005		
	Mean	SD	N	Mean	SD	N
TSE (US\$, millions)	8,855.05	17,967.46	27	9,202.95	18,296.31	27
PSE (US\$, millions)	6,267.09	12,993.41	27	6,017.09	13,161.48	27
CSE (US\$, millions)	-3,545.55	11,545.84	27	-2,463.04	12,745.61	27
GSSE (US\$, millions)	1,737.28	3,434.62	27	1,969.93	3,372.40	27
Support variables	2010			2015		
	Mean	SD	N	Mean	SD	N
TSE (US\$, millions)	9,348.00	25,388.73	43	13,101.08	43,238.18	42
PSE (US\$, millions)	6,075.39	21,332.22	43	8,932.87	34,881.45	42
CSE (US\$, millions)	-2,883.56	23,337.53	43	-4,263.09	29,000.39	42
GSSE (US\$, millions)	1,815.32	4,050.62	43	2,397.41	7,329.84	42
Support variables	2018			2020 ^a		
	Mean	SD	N	Mean	SD	N
TSE (US\$, millions)	13,161.76	39,364.63	37	21,810.08	56,279.73	28
PSE (US\$, millions)	8,810.95	32,086.77	37	13,773.84	48,444.43	28
CSE (US\$, millions)	-3,609.85	28,221.69	37	-5,458.69	56,051.81	28
GSSE (US\$, millions)	2,584.39	6,552.68	37	3,373.28	7,416.99	28

Note: ^a 2020 is available only for sugar.

Table C.3 Descriptive Statistics: Grain Consumption and Single Commodity Support Variables

Support variables	1990			1995		
	Mean	SD	N	Mean	SD	N
Grains (grams per day)	245.13	182.15	27	222.12	121.72	27
PSCT (US\$, millions)	1,419.96	3,947.95	27	1,753.39	5,711.70	27
MPS (US\$, millions)	1,109.42	3,501.26	27	1,601.97	5,491.47	27
Non-MPS (US\$, millions)	310.53	1,363.87	27	151.42	456.64	27
CSCT grains (US\$, millions)	-1,175.43	4,546.60	27	-2,019.19	7,283.19	27
Support variables	2000			2005		
	Mean	SD	N	Mean	SD	N
Grains (grams per day)	245.52	138.48	27	259.23	148.06	27
PSCT (US\$, millions)	1,641.72	4,203.39	27	1,028.75	3,732.56	27
MPS (US\$, millions)	1,221.81	3,636.99	27	708.08	3,303.47	27
Non-MPS (US\$, millions)	419.91	1,659.39	27	320.68	974.60	27
CSCT grains (US\$, millions)	-1,245.87	4,071.05	27	-827.36	3,376.13	27
Support variables	2010			2015		
	Mean	SD	N	Mean	SD	N
Grains (grams per day)	264.73	101.46	43	260.97	107.71	42
PSCT grains (US\$, millions)	1,197.35	4,756.54	43	2,396.03	11,701.77	42
MPS grains (US\$, millions)	998.02	4,565.13	43	2,222.82	11,612.54	42
Non-MPS grains (US\$, millions)	199.34	682.03	43	173.21	757.72	42
CSCT grains (US\$, millions)	-1,083.81	4,331.31	43	-1,911.32	9,229.11	42
Support variables	2018					
	Mean	SD	N			
Grains (grams per day)	258.87	110.61	37			
PSCT grains (US\$, millions)	1,962.38	7,077.07	37			
MPS grains (US\$, millions)	1,487.69	6,315.09	37			
Non-MPS grains (US\$, millions)	474.70	2,073.12	37			
CSCT grains (US\$, millions)	-1,316.91	5,438.37	37			

Table C.4 Descriptive Statistics: Meat Consumption and Single Commodity Support Variables

Support variables	1990			1995		
	Mean	SD	N	Mean	SD	N
Meat (grams per day)	90.91	61.14	27	85.56	48.49	27
PSCT meat (US\$, millions)	327.11	736.97	27	371.03	1,415.12	27
MPS meat (US\$, millions)	312.96	730.00	27	324.17	1,369.53	27
Non-MPS meat (US\$, millions)	14.15	44.65	27	46.87	112.99	27
CSCT meat (US\$, millions)	-452.58	1,080.34	27	-512.50	2,316.52	27
Support variables	2000			2005		
	Mean	SD	N	Mean	SD	N
Meat (grams per day)	82.57	40.84	27	86.98	41.96	27
PSCT meat (US\$, millions)	375.51	808.79	27	646.84	1,176.50	27
MPS meat (US\$, millions)	351.43	802.19	27	614.77	1,172.78	27
Non-MPS meat (US\$, millions)	24.08	47.60	27	32.07	62.42	27
CSCT meat (US\$, millions)	-596.72	1,436.56	27	-1,006.09	1,969.48	27
Support variables	2010			2015		
	Mean	SD	N	Mean	SD	N
Meat (grams per day)	95.61	45.55	43	99.15	47.82	42
PSCT meat (US\$, millions)	1,352.81	4,202.55	43	1,472.82	5,850.06	42
MPS meat (US\$, millions)	1,326.35	4,189.92	43	1,479.85	5,843.64	42
Non-MPS meat (US\$, millions)	26.46	160.38	43	-7.03	121.32	42
CSCT meat (US\$, millions)	-1,679.65	5,137.33	43	-1,809.58	7,108.18	42
Support variables	2018					
	Mean	SD	N			
Meat (grams per day)	102.45	48.71	37			
PSCT meat (US\$, millions)	1,677.40	6,080.75	37			
MPS meat (US\$, millions)	1,684.29	6,075.98	37			
Non-MPS meat (US\$, millions)	-6.89	142.35	37			
CSCT meat (US\$, millions)	-2,142.65	7,535.56	37			

Table C.5 Descriptive Statistics: Sugar Consumption and Single Commodity Support Variables

Support variables	1990			1995		
	Mean	SD	N	Mean	SD	N
Sugar (grams per day)	56.48	32.66	27	56.90	34.20	27
PSCT sugar (US\$, millions)	53.12	161.23	27	-194.89	1,475.03	27
MPS sugar (US\$, millions)	51.38	158.27	27	-199.21	1,488.49	27
Non-MPS sugar (US\$, millions)	1.74	5.71	27	4.31	14.69	27
CSCT sugar (US\$, millions)	-124.29	419.53	27	33.20	1,167.79	27
Support variables	2000			2005		
	Mean	SD	N	Mean	SD	N
Sugar (grams per day)	59.54	32.06	27	56.01	23.31	27
PSCT sugar (US\$, millions)	252.52	418.03	27	255.28	362.45	27
MPS sugar (US\$, millions)	238.57	406.68	27	246.67	353.41	27
Non-MPS sugar (US\$, millions)	13.94	37.82	27	8.61	27.32	27
CSCT sugar (US\$, millions)	-280.58	533.71	27	-318.84	482.09	27
Support variables	2010			2015		
	Mean	SD	N	Mean	SD	N
Sugar (grams per day)	53.67	25.68	43	59.87	24.66	42
PSCT sugar (US\$, millions)	141.74	434.36	43	283.41	734.22	42
MPS sugar (US\$, millions)	120.54	431.07	43	284.69	737.27	42
Non-MPS sugar (US\$, millions)	21.21	78.06	43	-1.28	79.50	42
CSCT sugar (US\$, millions)	-198.51	594.85	43	-323.80	850.88	42
Support variables	2018					
	Mean	SD	N			
Sugar (grams per day)	61.47	31.04	37			
PSCT sugar (US\$, millions)	444.19	1,011.70	37			
MPS sugar (US\$, millions)	448.90	1,014.23	37			
Non-MPS sugar (US\$, millions)	-4.72	105.50	37			
CSCT sugar (US\$, millions)	-502.83	1,130.57	37			

Regression results

Tables C.6 through C.11 provide regressions results.

Table C.6 Regression: Grain Consumption and Overall Support

Support variables	(1)	(2)	(3)	(4)	(5)
	Grains (grams per day)				
TSE (US\$, millions)	-0.0000514 (0.0000732)				
PSE (US\$, millions)		-0.0000445 (0.0000723)			-0.00152** (0.000685)
CSE (US\$, millions)			-0.0000575 (0.0000935)		-0.00133** (0.000552)
GSSE (US\$, millions)				-0.0000842 (0.000605)	0.00258* (0.00141)
Constant	249.5*** (13.31)	249.5*** (13.34)	249.3*** (13.40)	249.4*** (13.38)	249.4*** (13.47)
Observations	230	230	230	230	230
Number of countries	44	44	44	44	44
Elasticity	-0.00202	-0.00119	0.000788	-0.000638	

Note: Standard errors clustered at the country level in parentheses. Country-specific and year-specific fixed effects are included. Elasticity indicates percent change in consumption as a response to 1 percent change in the support variable of interest.

Significance level: * = 0.1, ** = 0.05, *** = 0.01.

Table C.7 Regression: Grain Consumption and Single Commodity Support

Support variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
						Grains (grams per day)				
PSCT grains (US\$, millions)	-0.0000760 (0.000332)					-0.00522*** (0.00182)				
MPS grains (US\$, millions)	-0.0000604 (0.000348)			0.00000556 (0.000389)		-0.00649*** (0.00203)				-0.00642*** (0.00206)
Non-MPS grains (US\$, millions)			-0.00118 (0.000893)	-0.00489 (0.00545)	-0.00492 (0.00635)			-0.00148 (0.00115)	-0.00689 (0.00675)	-0.00358 (0.00498)
Non-MPS grains^2				0.000000295 (0.000000354)	0.000000297 (0.000000415)				0.000000426 (0.000000438)	0.000000192 (0.000000326)
CSCT grains (US\$, millions)										
Constant	249.5*** (13.31)	249.4*** (13.33)	249.7*** (13.44)	250.1*** (13.47)	250.1*** (13.50)	249.2*** (13.20)	247.9*** (13.19)	249.4*** (13.39)	250.0*** (13.46)	248.4*** (13.33)
Observations	230	230	230	230	230	230	230	230	230	230
Number of countries	44	44	44	44	44	44	44	44	44	44
Elasticity	-0.000500	-0.000329	-0.00134	-0.00535		-0.0343	-0.0354	-0.00167		-0.00753

Source:

Note: Standard errors clustered at the country level in parentheses. Country-specific and year-specific fixed effects are included. Elasticity indicates percent change in consumption as a response to 1 percent change in the support variable of interest.

Significance level: * = 0.1, ** = 0.05, *** = 0.01.

Table C.8 Regression: Meat Consumption and Overall Support

Support variables	(1)	(2)	(3)	(4)	(5)
	Meat (grams per day)				
TSE (US\$, millions)	0.000206*** (0.0000261)				
PSE (US\$, millions)		0.000255*** (0.0000183)			-0.0000888 (0.000167)
CSE (US\$, millions)			-0.000286*** (0.0000448)		-0.000295** (0.000136)
GSSE (US\$, millions)				0.00108** (0.000423)	0.000682 (0.000424)
Constant	91.44*** (4.218)	91.39*** (4.214)	91.32*** (4.291)	91.78*** (4.233)	91.39*** (4.201)
Observations	230	230	230	230	230
Number of countries	44	44	44	44	44
Elasticity	0.0220	0.0184	0.0106	0.0223	

Note: Standard errors clustered at the country level in parentheses. Country-specific and year-specific fixed effects are included. Elasticity indicates percent change in consumption as a response to 1 percent change in the support variable of interest.
Significance level: * = 0.1, ** = 0.05, *** = 0.01.

Table C.9 Regression: Meat Consumption and Single Commodity Support

Support variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
						Meat (grams per day)				
PSCT meat (US\$, millions)	0.00132*** (0.000154)					-0.00108 (0.00257)				
MPS meat (US\$, millions)		0.00132*** (0.000153)			0.00132*** (0.000155)		-0.00107 (0.00265)			-0.000955 (0.000271)
Non-MPS meat (US\$, millions)			-0.00280 (0.0121)	0.00190 (0.0152)	0.00402 (0.0151)			-0.00129 (0.0114)	0.00347 (0.0151)	0.00305 (0.0151)
Non-MPS meat^2				-0.0000194 (0.0000251)	-0.0000220 (0.0000245)				-0.0000197 (0.0000246)	-0.0000179 (0.0000247)
CSCT meat (US\$, millions)										
Constant	91.98*** (4.255)	91.96*** (4.255)	91.88*** (4.512)	92.06*** (4.512)	92.14*** (4.214)	91.88*** (4.251)	91.90*** (4.240)	91.90*** (4.209)	92.09*** (4.183)	92.05*** (4.215)
Observations	230	230	230	230	230	230	230	230	230	230
Number of countries	44	44	44	44	44	44	44	44	44	44
Elasticity	0.0141	0.0139	-0.000490	0.000223	-0.0115	-0.0112	-0.000225	0.000496		

Source:

Note: Standard errors clustered at the country level in parentheses. Country-specific and year-specific fixed effects are included. Elasticity indicates percent change in consumption as a response to 1 percent change in the support variable of interest.
Significance level: * = 0.1, ** = 0.05, *** = 0.01.

Table C.10 Regression: Sugar Consumption and Overall Support

	(1)	(2)	(3)	(4)	(5)
Support variables	Sugar (grams per day)				
TSE (US\$, millions)	0.0000131 (0.0000300)				
PSE (US\$, millions)		-0.0000157 (0.0000335)			-0.000110 (0.000205)
CSE (US\$, millions)			0.0000518 (0.0000778)		0.0000364 (0.000200)
GSSE (US\$, millions)				0.000397 (0.000490)	0.000986** (0.000461)
Constant	57.86*** (4.167)	57.93*** (4.149)	58.01*** (4.138)	57.82*** (4.181)	58.04*** (4.109)
Observations	258	258	258	258	258
Number of countries	44	44	44	44	44
Elasticity	0.00254	-0.00203	-0.00329	0.0142	

Source:

Note: Standard errors clustered at the country level in parentheses. Country-specific and year-specific fixed effects are included. Elasticity indicates percent change in consumption as a response to 1 percent change in the support variable of interest.

Significance level: * = 0.1, ** = 0.05, *** = 0.01.

Table C.11 Regression: Sugar Consumption and Single Commodity Support

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Support variables										
PST sugar (US\$, millions)	-0.00208 (0.00319)					-0.0160* (0.00891)				
MPS sugar (US\$, millions)	-0.00212 (0.00311)				-0.00243 (0.00304)	-0.0162* (0.00861)				-0.0204** (0.00824)
Non-MPS sugar (US\$, millions)			0.00217 (0.0243)	-0.0198 (0.0146)	-0.0214 (0.0168)			0.00301 (0.0244)	-0.0193 (0.0153)	-0.0399** (0.0182)
Non-MPS sugar ²				0.0000698*** (0.0000176)	0.0000763*** (0.0000173)				0.0000713*** (0.0000167)	0.000102*** (0.0000263)
CSCT sugar (US\$, millions)						-0.0158* (0.00922)	-0.0159* (0.00948)	0.00124 (0.00325)	0.00138 (0.00327)	-0.0202** (0.00951)
Constant	57.88*** (4.234)	57.89*** (4.242)	57.91*** (4.175)	57.68*** (4.182)	57.67*** (4.237)	57.04*** (4.108)	57.13*** (4.191)	57.97*** (4.237)	57.75*** (4.246)	56.55*** (4.177)
Observations	258	258	258	258	258	258	258	258	258	258
Number of countries	44	44	44	44	44	44	44	44	44	44
Elasticity	-0.00816	-0.00792	0.000411	-0.00347		-0.0626	-0.0605	0.000572	-0.00338	

Source:

Note: Standard errors clustered at the country level in parentheses. Country-specific and year-specific fixed effects are included. Elasticity indicates percent change in consumption as a response to 1 percent change in the support variable of interest.
Significance level: * = 0.1, ** = 0.05, *** = 0.01.

