Food and Agriculture
Organization of the
United Nations

2023

THE STATE OF FOOD AND AGRICULTURE

REVEALING THE TRUE COST OF FOOD TO TRANSFORM AGRIFOOD SYSTEMS

This flagship publication is part of **The State of the World** series of the Food and Agriculture Organization of the United Nations.

Required citation:
FAO. 2023. *The State of Food and Agriculture 2023 – Revealing the true cost of food to transform agrifood systems*. Rome. https://doi.org/10.4060/cc7724en

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ISSN 0081-4539 (print)
ISSN 1564-3352 (online)
ISBN 978-92-5-138167-0
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SPAIN. Fruit market in La Boqueria marketplace in Barcelona.

ISSN 0081-4539

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Food and Agriculture Organization of the United Nations
Rome, 2023

CONTENTS

BOXES

FOREWORD

In the face of escalating global challenges – lack of food availability, food accessibility and food affordability due to the climate crisis, biodiversity loss, economic slowdowns and downturns, worsening poverty, and other overlapping crises – we find ourselves standing at a critical juncture. The choices we make now, the priorities we set and the solutions we implement will determine the trajectory of our shared future. Consequently, the decisions we make about global agrifood systems must acknowledge these interrelated challenges.

There is increased international consensus that transforming agrifood systems to increase their efficiency, inclusiveness, resilience, and sustainability is an essential comprehensive design for realizing the 2030 Agenda for Sustainable Development. Momentum for change led to the first ever United Nations Food Systems Summit (UNFSS), convened by the UN Secretary-General (UNSG) in September 2021, followed by the UN Food Systems Summit + 2 Stocktaking Moment (UNFSS+2), hosted by the Italian Government in the Food and Agriculture Organization of the United Nations (FAO) in late July 2023. These meetings highlighted strong political will and stakeholder support for innovative solutions and strategies to transform agrifood systems and leverage those changes to deliver progress on all the Sustainable Development Goals.

To achieve these goals, including FAO's vision to **transform agrifood systems for better production, better nutrition, a better environment, and a better life for all, leaving no one behind**, it is vital that the impacts of our actions within these systems be transparent. FAO is responding to this essential need by dedicating two consecutive issues of *The State of Food and Agriculture* – for the first time since this flagship publication was launched in 1947 – to uncovering the true impacts, both positive and negative, of global agrifood systems for informed decision-making.

This year's report introduces true cost accounting (TCA) as an approach to uncovering the hidden impacts of our agrifood systems on the environment, health, and livelihoods, so that agrifood systems actors are better informed and prepared before making decisions. There is always concern that if we consider all the hidden costs of producing food, prices will go up, but integrating these costs in the decision-making process, as well as in the incentives faced by producers and consumers, is part of a much larger process of agrifood systems transformation. TCA is about supporting the right investment decisions by countries and the private sector, to reduce existing costs instead of perpetuating them.

The 2023 report further highlights the methodological and data challenges that need to be addressed for greater adoption of TCA, especially in low- and lower-middle-income countries. It quantifies, to the extent possible, the hidden costs of national agrifood systems in a consistent and comparable way for 154 countries. These preliminary results cover hidden costs from greenhouse gas emissions, nitrogen emissions, blue water use, land-use transitions, and poverty, as well as losses in productivity caused by unhealthy dietary patterns and undernourishment.

The results we present in this report should not be viewed as a definitive assessment, but rather as a starting point for stimulating debate and dialogue. Indeed, while these results help us see the big picture of the hidden costs of agrifood systems, action to address these costs will have to be taken at country level. In this context, the next edition of *The State of Food and Agriculture* will aim to improve upon this initial preliminary quantification and analysis using country-specific information and input from in-country stakeholders and experts. This can then inform the planning for more in-depth, tailored analyses to guide transformational policy actions and investments in specific countries.

The pressing need to incorporate hidden costs into our decision-making processes, as part of the broader effort to transform the way our agrifood systems function, is underscored by the striking figures that already emerge from this year's findings, despite their tentative nature and the aim of refinement in 2024. Preliminary results strongly suggest that the global hidden costs of our agrifood systems – despite the exclusion of certain impacts and a considerable degree of uncertainty – exceed USD 10 trillion.

One of the most glaring findings is the disproportionate burden of these hidden costs on low-income countries. Here, hidden costs account for, on average, 27 percent of gross domestic product, primarily due to the impacts of poverty and undernourishment. Compared with, on average, 11 percent in middle-income countries and 8 percent in high-income countries, this reveals a stark economic disparity. Clearly, addressing poverty and undernourishment remains a priority for low-income countries, as these account for about half of all hidden costs quantified in these countries.

Productivity losses from dietary patterns that lead to non-communicable diseases are the most significant contributor to the total hidden costs of agrifood systems and are particularly relevant for high- and upper-middle-income countries. Environmental hidden costs, which constitute more than 20 percent of total quantified hidden costs, correspond to nearly one-third of the value added by agriculture.

Next year's edition of this report aims to provide case studies with more targeted assessments, linking hidden costs to actions that can be taken to reduce them. These consecutive editions are part of a broader strategy by FAO to integrate TCA into agrifood systems assessments and policy advice. The findings presented in the 2023 report underscore the urgent need for systemic transformation. They also reveal the potential of TCA as a catalyst for transformation – a tool for unveiling these hidden costs, informing policy, and improving the value proposition of agrifood systems.

As we turn the pages of this report and look forward to *The State of Food and Agriculture 2024* advancing this work programme, let us remember that the future of our agrifood systems and, indeed, of our planet hinges on our willingness to appreciate all food producers big or small, to acknowledge these true costs and to understand how we all contribute to them. We all have a stake in acting upon them.

It is my sincere hope that this report will serve as a call to action for all stakeholders – from policymakers and private-sector actors to researchers and consumers – and inspire a collective endeavour to transform our agrifood systems for the betterment of all.

Qu Dongyu
FAO Director-General

METHODOLOGY

The preparation of *The State of Food and Agriculture 2023* began with the formation of an advisory group representing all relevant FAO technical units which, together with a panel of external experts, assisted the research and writing team. A virtual inception workshop took place from 3 to 7 October 2022 to discuss the outline of the report. The preparation of the report was further informed by four background papers and original empirical analysis prepared by FAO and external experts. Drafts of the first three chapters were presented to the advisory group and panel of external experts in advance of a workshop held both virtually and in Rome from 22 to 24 March 2023 and chaired by the Director of FAO's Agrifood Economics Division. With guidance from the workshop, the report was revised, and the final chapter completed. The revised draft was sent for comments to the advisory group, to the management team of FAO's Economic and Social Development stream, and to other FAO streams and the FAO Regional Offices for Africa, Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, and the Near East and North Africa. Comments were incorporated in the final draft, which was reviewed by the Director of FAO's Agrifood Economics Division, the FAO Chief Economist and the Office of the Director-General.

ACKNOWLEDGEMENTS

The State of Food and Agriculture 2023 was prepared by a multidisciplinary team from the Food and Agriculture Organization of the United Nations (FAO), under the direction of David Laborde, Director of the Agrifood Economics Division, Marco V. Sánchez Cantillo, Deputy Director of the Agrifood Economics Division, and Andrea Cattaneo, Senior Economist and Editor of the publication. Overall guidance was provided by Máximo Torero Cullen, Chief Economist, and by the management team of the Economic and Social Development stream.

RESEARCH AND WRITING TEAM

Theresa McMenomy, Poilin Breathnach (consulting editor), Ahmad Sadiddin and Sara Vaz.

BACKGROUND PAPERS

Reinier de Adelhart Toorop (Impact Economy Foundation), Steven Lord (University of Oxford), Tavseef Mairaj Shah (TMG Research gGmbH), Anil Markandya (Basque Centre for Climate Change), Alexander Müller (TMG Research gGmbH), Olivia Riemer (TMG Research gGmbH), Bettina Schmiedler (Impact Economy Foundation), Bart van Veen (Impact Economy Foundation) and Loes Verdonk (Impact Economy Foundation).

ADDITIONAL EXTERNAL CONTRIBUTIONS

Andrea Bassi (International Institute for Sustainable Development), Salman Hussain (United Nations Environment Programme [UNEP]) and Jacob Salcone (UNEP).

ADDITIONAL FAO INPUTS

Alethia Cameron, Federico Drogo, Adriana Ignaciuk, Bernardete Neves, Valentina Pernechele, Ugo Pica Ciamarra, Giuseppe Tempio and Dominik Wisser.

FAO ADVISORY GROUP

Koffi Amegbeto, Nada Bougouss, Diana Carter, Romina Cavatassi, Federico Drogo, Aziz Elbehri, Cheng Fang, Daniela Godoy, Adriana Ignaciuk, Joanna Ilicic, Thais Linhares Juvenal, Anne Mottet, Bernardete Neves, Valentina Pernechele, Ugo Pica Ciamarra, Maryam Rezaei, Marco Sanchez Cantillo, Nuno Santos, Shiroma Sathyapala, Antonio Scognamillo, Francesco Tubiello, Jose Valls Bedeau and Dominik Wisser.

PANEL OF EXTERNAL EXPERTS

Reinier de Adelhart Toorop (Impact Economy Foundation), Harold Alderman (International Food Policy Research Institute [IFPRI]), Lauren Baker (Global Alliance for the Future of Food), Andrea Bassi (International Institute for Sustainable Development), Joao Campari (World Wide Fund for Nature), Tim Crosby (Thread Fund), Barbara Gemmill-Herren (UC Davis), Mark Gough (Capitals Coalition), Thomas Hertel (Purdue University), Salman Hussain (UNEP), Amanda Jekums (Global Alliance for the Future of Food), Martin Lok (Capitals Coalition), Steven Lord (University of Oxford), Tavseef Mairaj Shah (TMG Research gGmbH), Anil Markandya (Basque Centre for Climate Change), Robert Price Martin (Johns Hopkins Whiting School of Engineering), William Masters (Tufts University), Kathleen Merrigan (Arizona State University), Alexander Müller (TMG Research gGmbH), Michael Obersteiner (University of Oxford), Carl Obst (IDEEA Group), Valeria Piñeiro (IFPRI), Raghav Puri (University of Cornell), Urvashi Rangan (GRACE Communications Foundation), Martin Reesink (Rabobank), Olivia Riemer (TMG Research gGmbH), Serenella Sala (Joint Research Centre [JRC]), Harpinder Sandhu (Federation University Australia), Marta Santamaria (Capitals Coalition), Esther Sanye-Mengual (JRC), Marco Springmann (University of Oxford), Roy Steiner (Rockefeller Foundation), Pavan Sukhdev (GIST Impact), Bart van Veen (Impact Economy Foundation [IEF]), Martine van Weelden (Capitals Coalition), Loes Verdonk (IEF) and Jenn Yates (Global Alliance for the Future of Food).

ACKNOWLEDGEMENTS

ANNEXES

Sara Vaz prepared the annexes with assistance from Steven Lord (University of Oxford).

ADMINISTRATIVE SUPPORT

Alejandra Jimenez Tabares provided administrative support.

Translations were delivered by the FAO Language Branch of the Governing Bodies Servicing Division.

The FAO Publications and Library Branch of the Office of Communications provided editorial support, design and layout, as well as production coordination, for editions in all six official languages.

ABBREVIATIONS

AEIR	agricultural externalities impact ratio
AFF	agriculture, forestry and fisheries
AMR	antimicrobial resistance
AQUASTAT	FAO's Global Information System on Water and Agriculture
BAU	business-as-usual
BEUC	The European Consumer Organisation
BMI	body mass index
CAF	complex agroforestry
CBD	Convention on Biological Diversity
CIRAD	International Cooperation Centre of Agricultural Research for Development
CONABIO	National Commission for the Knowledge and Use of Biodiversity
CSA	climate-smart agriculture
DALY	disability-adjusted life year
DPIR	dietary patterns impact ratio
ESVD	Ecosystem Services Valuation Database
EUROSTAT	Statistical Office of the European Union
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	FAO's Corporate Database for Substantive Statistical Data
FLE	forestry, land and environment
FMI	The Food Industry Association
FOLU	Food and Land Use Coalition
FSEC	Food System Economics Commission
GAFF	Global Alliance for the Future of Food
GDP	gross domestic product
GHG	greenhouse gas
GLEAM	Global Livestock Environmental Assessment Model
GVA	gross valued added
HLPE	High Level Panel of Experts
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IGAD	Intergovernmental Authority on Development
IHME	Institute for Health Metrics and Evaluation
IISD	International Institute for Sustainable Development
ILO	International Labour Organization
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
ISIC	International Standard Industrial Classification of all Economic Activities
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
IWG-SCGHG	Interagency Working Group on Social Cost of Greenhouse Gases
LCA	life cycle assessment
NCD	non-communicable disease
NPV	net present value

ABBREVIATIONS

OECD	Organisation for Economic Co-operation and Development
PAHO	Pan American Health Organization
PES	payment for environmental services
PPP	purchasing power parity
R&D	research and development
SDGs	Sustainable Development Goals
SDIR	social distribution impact ratio
SEEA	System of Environmental-Economic Accounting
SEEA AFF	SEEA for Agriculture, Forestry and Fisheries
SNA	System of National Accounts
SSP2	second shared socioeconomic pathway
TCA	true cost accounting
TCFD	Taskforce on Climate-related Financial Disclosures
TEEB	The Economics of Ecosystems and Biodiversity
TEV	total economic value
TMG	Think Tank for Sustainability
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFSS	United Nations Food Systems Summit
UNICEF	United Nations Children's Fund
UNSCN	United Nations System Standing Committee on Nutrition
WFP	World Food Programme
WHO	World Health Organization
WOAH	World Organisation for Animal Health
WTO	World Trade Organization

GLOSSARY

Agrifood systems. Cover the journey of food from farm to table – including when it is grown, fished, harvested, processed, packaged, transported, distributed, traded, bought, prepared, eaten and disposed of. They also encompass non-food products that constitute livelihoods and all of the people, as well as the activities, investments and choices, that play a part in getting us these food and agricultural products. In the FAO Constitution, the term "agriculture" and its derivatives include fisheries, marine products, forestry, and primary forestry products.[1]

Capital. The economic framing of the various stocks in which each type of capital embodies future streams of benefits that contribute to human well-being (see also "human capital", "natural capital", "produced capital", "social capital" and "stock").[2]

Human capital. The knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being.[2]

Natural capital. The stock of renewable and non-renewable natural resources that combine to yield a flow of benefits to people.[3, 4]

Produced capital. All manufactured capital, such as buildings, factories, machinery and physical infrastructure (roads, water systems), as well as all financial capital and intellectual capital (technology, software, patents, brands and so on).[2]

Social capital. Networks, including institutions, together with shared norms, values and understandings that facilitate cooperation within or among groups.[2]

Capital change. The net change in quantity and quality of capital stock.[5]

Cost. In common usage, a cost is the monetary value of goods and services that producers and consumers purchase. However, there are situations where such a definition is not helpful. Economists distinguish between the following types of cost:

Abatement cost. The monetary cost to reduce a hidden cost from capital change. Can also refer to the minimal monetary cost to reduce hidden costs to a certain level given a costed portfolio of actual or potential abatement measures.[5]

External cost. A cost incurred by individuals or a community as a result of an economic transaction in which they are not directly involved. The difference between private costs and the total cost to society of a product, service or activity is called an external cost.[6]

Hidden cost. Any cost to individuals or society that is not reflected in the market price of a product or service. It refers to external costs (that is, a negative externality) or economic losses triggered by other market, institutional or policy failures.

Private cost. Any cost paid by a consumer to purchase a good or by a firm to purchase capital equipment, hire labour or buy materials or other inputs. These costs are included in production and consumption decisions.[6]

Social cost. The decrease in economic value to society from a capital change. It is estimated in monetary terms by an economic valuation of the decrease.[5]

Cost–benefit analysis. A process for calculating and comparing the benefits and costs of a given policy or project, based on assigning a monetary value to all the associated activities. It is used to evaluate the feasibility or profitability of projects and public policy interventions. It aggregates the costs and benefits in different periods to a single value using a discount rate, assigning lower weight to the costs and benefits as they happen further into the future.[2]

Cost-effectiveness analysis. A process used to compare the costs of two or more courses of action to achieve a certain target and to identify the least costly option for achieving that target.[2]

Decision-makers. Those who determine or influence which, when, where and how levers, such as policies and investments, are activated.

They include key private, public and civil society agrifood systems actors, as well as donors, governments, local authorities, international organizations and academia.

Dietary pattern. The combination of foods that form diets in context and time. Dietary patterns are contextual, driven by factors of food access and affordability but also by culture, traditions, values, preferences and other considerations.

Healthy dietary patterns or **healthy diets.**[a] Those that: 1) start early in life with early initiation of breastfeeding, exclusive breastfeeding until six months of age, and continued breastfeeding until two years of age and beyond combined with appropriate complementary feeding; 2) are based on a great variety of unprocessed or minimally processed foods, balanced across food groups, while restricting highly processed food and drink products; 3) include wholegrains, legumes, nuts and an abundance and variety of fruits and vegetables; 4) can include moderate amounts of eggs, dairy, poultry and fish, and small amounts of red meat; 5) include safe and clean drinking water as the fluid of choice; 6) are adequate (i.e. reaching but not exceeding needs) in energy and nutrients for growth and development and meet the needs for an active and healthy life across the life cycle; 7) are consistent with WHO guidelines to reduce the risk of diet-related non-communicable diseases and ensure health and well-being for the general population; and 8) contain minimal levels or none, if possible, of pathogens, toxins and other agents that can cause foodborne disease. According to WHO, healthy diets include less than 30 percent of total energy intake from fats, with a shift in fat consumption away from saturated fats to unsaturated fats and the elimination of industrial trans fats; less than 10 percent of total energy intake from free sugars (preferably less than 5 percent); consumption of at least 400 g of fruits and vegetables per day; and not more than 5 g per day of salt (to be iodized).[8]

Unhealthy dietary patterns or **unhealthy diets.** Do not meet one or more of the principles of healthy diets. They are one of the primary drivers of all forms of malnutrition, and related morbidities. For the purpose of this report, the focus is on a specific set of unhealthy dietary patterns, which are typically low in fruits, vegetables, nuts, wholegrains, calcium and protective fats, and high in sodium, sugar-sweetened beverages, saturated fats and processed meat. These diets are associated with obesity and non-communicable diseases, leading to productivity losses.

Flow. A cost or benefit derived from the use of various capital stocks.[2]

Functional unit. The unit of analysis used in true cost accounting assessments. The functional unit of an assessment determines the actor(s) for which results are most relevant and who can use the assessment to steer better impact.[9] In the context of agrifood systems, there are five commonly used functional units: agrifood systems (see definition above), dietary patterns, investment, organization and product.[10]

Dietary patterns unit. Captures different forms of diets (e.g. vegetarian) and is appropriate for examining policy interventions aimed at realizing certain diets, such as healthier and more sustainable diets.[10]

Investment unit. Typically refers to investments made by organizations or investors and, in the context of policymaking, to public investment and expenditure.[10]

Organization unit. Suited to describing the impacts of a given entity, typically a commercial organization.[10]

Product unit. Typically used to assess the impacts of a given (food) product, ideally covering its entire life cycle.[10]

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[a] FAO is working closely with WHO to improve the definition of healthy diets. The pending definition defines healthy diets as meeting four core principles that maximize human health benefits and minimize human health risks. According to the four principles, food intake: (i) is adequate, without excess of macro- and micronutrients; (ii) is balanced in energy from protein, fat and carbohydrate sources; (iii) is diverse across and within food groups; and (iv) involves moderate consumption of unhealthy foods. These principles are universal (i.e. they apply equally to all humans).[7]

Institutional failure. When institutions – governments, markets, private property and communal management[11] – fail to provide the necessary framework for development. From a sustainability perspective, it has been defined in terms of the inability of institutions to conserve resources.[12] Institutional failures manifest in a variety of ways:

Conflict between bureaucracies. Where one part of a government undermines efforts by another part to save resources.[11, 13]

Corruption. The abuse of entrusted power for private gain.[14] It takes many forms, varying from small-scale bribes and fraud (e.g. administrative corruption), to high-level abuse of government power and political positions (e.g. political corruption).[15]

Dispersed governance. Where the subnational level has some degree of separate political authority, which can reduce the degree of consistency in the delivery of policies formulated at national level but implemented at subnational level.[16, 17]

Free-riding. Enjoying the benefits of collective action without incurring the associated costs.[18] This can occur when groups are large, where boundaries cannot be enforced, and where people do not bear the consequences of their actions.[11]

Inexistent or ill-defined property rights. A situation where legal ownership and use of resources are not clearly defined or established. An example is open-access resources, where access to resources is unrestrictive and non-excludable and there is rivalry in consumption, leading to overexploitation.[19]

Lack of transparency and accountability. Transparency ensures that information (e.g. where funds go) is available. In this sense, transparency serves to achieve accountability, which is the capacity to sanction or compensate institutions for their actions.[20] Without transparency and accountability, trust will be lacking between institutions and those relying on them.

Life cycle assessment (LCA). A systematic set of procedures for quantifying the environmental impacts directly attributed to the inputs and outputs of materials and energy used in all the processes, activities and resources used throughout the life cycle of a product, a production system or a service system. For each step of the life cycle, an inventory is made of the used material and energy and their impacts on the environment, which are, in most cases, reported in physical units and not converted into monetary terms.[2, 21, 22]

Market failure. A situation in which the allocation of goods and services by a free market is not efficient, often leading to a net loss of economic value to society, that is, the full benefits of the use of social resources are not realized. There are many types of market failure including the following:

Demerit good. A good or service considered undesirable because its consumption has negative effects on the consumer.[23] The consumption of unhealthy diets is an example: consumption does not affect other parties, but results in health damages to the consumer and a cost to public health systems. The distinction between "externalities" and "demerit goods" is important, because the action needed for the two can vary.[24]

Externality. A positive or negative consequence of an economic activity or transaction that affects other parties without this being reflected in the price of the goods or services transacted.[2]

Market power. The relative ability of an actor to manipulate the price of an item in the marketplace by manipulating the level of supply, demand or both.[25] Market concentration measures the extent to which market shares are concentrated between a small number of firms and is often taken as a proxy for the intensity of competition.[26]

Missing market. The economic situation in which there is no market for a certain product because private actors see no prospect of profit, even though the exchange of such an item would be beneficial to society as a whole.[27, 28]

Public goods. Products that one individual can enjoy without reducing the amount available to others (e.g. roads, public parks, clean air and other basic societal goods). In other words, they are non-rivalrous and non-excludable.[29] The private sector has little incentive to produce public goods, resulting in underproduction and market failure.

Materiality. Generally defined as a measure of how important a piece of information is when making a decision,[30] or the importance, worth or usefulness of something.[31] In the context of true cost accounting, it reflects significant economic, environmental and social impacts that substantially influence the assessments and decisions of stakeholders. An impact may be considered material if measurement and communication of the impact have the potential to alter decision-making processes.[31]

Double materiality. Applied to the private sector (that is, businesses and investors), it is the principle that businesses and investors must disclose not only how they are affected by sustainability issues, such as climate change ("outside in"), but also how their activities impact society and the environment ("inside out").[32]

Moderate poverty. Income below the international poverty line of 3.65 2017 purchasing power parity (PPP) dollars per day.[33]

Multicriteria analysis. A method to assess projects or policies against a variety of criteria, using both quantitative and qualitative indicators. It is used in cases where multiple objectives are being pursued. It can take into account various factors, such as public financing needs and implementation barriers, against multiple objectives, such as employment creation, emissions reduction and improving farming income. Its main limitations revolve around deciding which criteria to include and what weights to give to the different criteria, as they can greatly impact the results of the exercise.[2]

Nutritious foods. "Safe foods" that contribute essential nutrients, such as vitamins and minerals (micronutrients), fibre and other components, to healthy diets that are beneficial for growth, health and development and guard against malnutrition. In nutritious foods, the presence of nutrients of public health concern, such as saturated fats, free sugars and salt/sodium, is minimized, industrially produced transfats are eliminated and salt is iodized.[8]

Policy failure. When a policy, even if it is successful in some minimal respects, does not fundamentally achieve the goals that proponents set out to achieve.[34] Policy failures are dependent on the policy landscape, whose contours are shaped by fiscal policies, regulations and standards. Policy failures can take the following forms:

Distributional failure. A situation where public policies fail to guarantee for all the population a minimum level of decent income that can protect against different forms of deprivation, such as poverty, food insecurity and malnutrition, despite the availability of resources to do so.

Ill-informed policies. When policymakers make their decisions based on poor or partial information. This can lead to underestimating the time, costs and risks of delivery, and/or overestimating the benefits. In other words, by generating overly optimistic expectations, ill-informed policies, at best, undermine the value of resources and, at worst, lead to unviable interventions and investments.[16, 35]

Vagaries of political cycles. The idea that politicians are not held accountable for policy outcomes because they "either moved on or moved out".[16]

Prevalence of undernourishment. Percentage of the national population experiencing undernourishment, as calculated by FAO *et al.* (2022).[33, 36]

Scenarios. Representations of possible futures for one or more components of a system, including alternative policy or management options.[37]

Business-as-usual (BAU) scenario. A scenario for future patterns of activity which assumes that there will be no major changes in important parameters, such as technologies, institutions, or policies, so that current circumstances are assumed to continue unchanged. It serves as a benchmark in policy analysis to measure the impact of alternative scenarios that include a change in one or more parameters over a specific time span.[38]

Exploratory scenario. Examines a range of plausible futures, based on the potential trajectories of drivers – either indirect (e.g. sociopolitical, economic and technological factors) or direct (e.g. habitat conversion and climate change). Exploratory scenarios are particularly relevant in the agenda-setting stage of the policy cycle. They typically have strong qualitative and quantitative components and are often combined with participatory approaches involving local and regional stakeholders.[39]

Policy-screening scenario. *Ex ante* assessment to forecast the effects of alternative policy or management options (interventions) on environmental outcomes. In policy-screening scenarios, a policy, or set of policies, is applied and an assessment of how the policy modifies the future is carried out.[40]

Retrospective policy evaluation scenario. Policy evaluation scenario employed in *ex post* assessments. *Ex post* assessments are the present evaluations of past efforts to achieve policy goals throughout all stages of the policy cycle and decision-making context.[41]

Target-seeking scenario. A valuable tool for examining the viability and effectiveness of alternative pathways to the desired outcome. It starts with the definition of a clear objective or a set of objectives that can be specified either in terms of achievable targets (e.g. food self-sufficiency) or as an objective function to be optimized (e.g. minimal biodiversity loss).

Shadow prices (of a resource). The change in the value of an economic activity associated with one more unit of that resource.

Simulations. Quantified scenarios, generated using simulation models.[42]

Simulation models. Simplified representations of reality that use mathematical formulations to generate projections. Such projections can be used for backcasting (e.g. what policy mix is required to reach a stated objective) and forecasting (e.g. how close to the objective would a given policy mix deliver).[42]

Stock. The physical or observable quantities and qualities that underpin various flows within the system, classified as produced, natural, human or social (see also “capital”).[2]

True cost accounting (TCA). A holistic and systemic approach to measuring and valuing the environmental, social, health and economic costs and benefits generated by agrifood systems to facilitate improved decisions by policymakers, businesses, farmers, investors and consumers.[43]

Undernourishment. The condition in which an individual’s habitual food consumption is insufficient to provide the amount of dietary energy required to maintain a normal, active, healthy life. For the purposes of this report, hunger is defined as being synonymous with chronic undernourishment. The prevalence of undernourishment is used to measure hunger.[8]

CORE MESSAGES

1 The value of agrifood systems is not in doubt. They provide nourishment, sustain economies and shape cultural identities. However, one must also consider the environmental, social and health hidden costs associated with these systems.

2 True cost accounting allows the estimation of the hidden costs generated by market, institutional and policy failures. It provides decision-makers with the evidence needed to correct these failures and transform agrifood systems for the better.

3 True cost accounting for decision-making builds on a long tradition of economic valuation; however, a lack of availability of high-quality data, on both hidden costs and the costs of taking action, often limits its application.

4 This report proposes a two-phase assessment process, relying first on national-level true cost accounting assessments to raise awareness (presented in this report) and then moving towards in-depth and targeted evaluations to prioritize solutions and guide transformative actions (which will be the focus of the 2024 edition of the report).

5 This year's report presents a first attempt at a national-level assessment for 154 countries. Even with large uncertainty and excluding some impacts, there is a very high degree of confidence that the global quantified hidden costs of agrifood systems amount to 10 trillion dollars or more at 2020 purchasing power parity (PPP), revealing the urgent need to factor these costs into decision-making to transform agrifood systems.

6 Globally, the dominant quantified hidden costs are those arising from dietary patterns which lead to diseases and lower labour productivity. These health-related costs exhibit considerable variation across countries, but are most prominent in high- and middle-income countries.

7 The environmental hidden costs, while not exhaustive, constitute over 20 percent of the quantified hidden costs and are equivalent to almost one-third of agricultural value added. They are mostly associated with greenhouse gas (GHG) and nitrogen emissions and are relevant across all country income groups.

8 Hidden costs appear to be a greater burden in low-income countries, where they are estimated to amount, on average, to 27 percent of gross domestic product (GDP), compared with 11 percent in middle-income countries and 8 percent in high-income countries.

9 Addressing poverty and undernourishment remains a priority in low-income countries, as they account for about half of the total hidden costs quantified in these countries.

10 The new national-level estimates are a first step in raising awareness, even if they are incomplete and involve a high degree of uncertainty. Targeted true cost accounting assessments that also look at the cost of different abatement actions – the focus of next year's report – are needed to inform decision-makers on how to leverage policy, regulation, standards and private capital for a transition towards sustainable agrifood systems.

11 For true cost accounting assessments at scale, innovations in research and data, as well as investments in data collection and capacity building, are needed to scale the application of true cost accounting, especially in low- and middle-income countries, so that it can become a viable tool for informing decision- and policymaking in a transparent and consistent way.

EXECUTIVE SUMMARY

On a day-to-day basis, people, businesses and governments do not always know the impact of their decisions on the sustainability of agrifood systems – be they positive or negative. On the one hand, agrifood systems generate vital benefits to society, not least because they produce the food that nourishes us and provide jobs and livelihoods to over a billion people. Consequently, the value to society of agrifood systems is probably well beyond what is measured in GDP. On the other hand, market, policy and institutional failures underpinning agrifood systems contribute to hidden costs, such as climate change, natural resource degradation and the unaffordability of healthy diets. The question then becomes: how do we transform agrifood systems so that they deliver even greater value to society? In other words, how do we mitigate their hidden costs and enhance their hidden benefits?

This edition of *The State of Food and Agriculture* focuses on the true cost of agrifood systems. By introducing the concept of the hidden costs and benefits of agrifood systems and providing a framework through which these can be assessed, this report aims to initiate a process that will better prepare decision-makers for actions to steer agrifood systems towards environmental, social and economic sustainability.

FACTORING THE COSTS AND BENEFITS OF AGRIFOOD SYSTEMS INTO DECISIONS

Accounting for agrifood systems costs and benefits to achieve the Sustainable Development Goals

International consensus has grown around the idea that transforming agrifood systems – towards greater efficiency, resilience, inclusiveness and sustainability – is an essential condition for realizing the 2030 Agenda for Sustainable Development. In this regard, folding a holistic assessment of agrifood systems into the process of decision-making is critical to achieving many, if not all, of the Sustainable Development Goals (SDGs).

The interactions of agrifood systems with the environment, the economy, nutrition, health and society are ultimately connected to the SDGs. Of particular relevance is the impact agrifood systems transformation can have on SDG 1 (No Poverty), SDG 2 (Zero Hunger) and SDG 3 (Good Health and Well-being) as a result of the relevance of agrifood systems to agricultural productivity, rural livelihoods, health, food security and nutrition. The transition to sustainable agrifood systems arising from better decision-making also implies progress on SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 12 (Responsible Production and Consumption) and SDGs 13, 14 and 15 on Climate Action, Life below Water and Life on Land. This transition will rely on new technologies that can function as a catalyst for progress towards SDG 9 (Industry, Innovation and Infrastructure). By assessing how human capital is formed and treated, it can also contribute to decent work and economic growth (SDG 8) as well as reduce gender inequality (SDG 5).

True cost accounting in support of agrifood systems transformation

The true cost accounting (TCA) approach creates an unprecedented opportunity for such comprehensive assessments – it is defined as a holistic and systemic approach to measure and value the environmental, social, health and economic costs and benefits generated by agrifood systems to facilitate improved decisions by policymakers, businesses, farmers, investors and consumers.

This broad definition allows a variety of methods to be adopted, depending on a country's resources, data, capacity and reporting systems. True cost accounting is also not a new concept. Rather, it is an evolved and improved approach that goes beyond market exchanges to account for all flows to and from agrifood systems, including those not captured by market transactions.

While the TCA approach is aspirational, as covering all hidden costs and benefits of agrifood systems is a massively resource- and data-intensive exercise, the aim is for policymakers and other stakeholders to avoid making decisions without a full assessment. In this regard, TCA enables decision-makers to pragmatically leverage already available data and information for an initial understanding of agrifood systems, including the most important data gaps, to better guide interventions.

Unpacking the impacts and dependencies of agrifood systems on society and the natural environment

Agrifood systems are influenced by policy, business and consumer decisions. Their activities also depend on – as well as affect – natural, human, social and produced capitals, which form the foundation of human well-being, economic success and environmental sustainability. For example, natural capital contributes biomass growth and freshwater to agrifood systems. In return, agrifood systems can negatively affect natural capital with greenhouse gas (GHG) emissions and pollution. In contrast, if regenerative agriculture is used, production practices can contribute to ecosystem restoration. Social capital can contribute to agrifood systems through cultural knowledge and shape customs of access to resources such as land, while agrifood systems produce food security and nutrition (or food insecurity and malnutrition) in return, depending on their efficiency, resilience and inclusiveness. Produced capital contributes research and development, while agrifood systems generate income, profits, rent and taxes in return.

While these flows seem intuitive, little has been done to measure them and manage their impacts, with the exception of produced capital. Data that are commonly included in economic assessments pertain to the flows and impacts of produced capital and, to some extent, human capital (for example, labour and wages), which are transacted through market mechanisms and therefore easily observed, measured and quantified. Flows and impacts related to natural, social and (part of) human capital, in contrast, are not, so their inclusion in economic assessments is largely partial and not systematic. For example, while market-based inputs are directly reflected in the private production costs of producers, the inputs of ecosystem services (for example, clean freshwater and pollination) are not, despite being fundamental for agricultural productivity.

However, when decision-makers lack a full assessment of the activities of agrifood systems causing impacts on capital stocks and flows – for example, relating to ecosystem services – the resulting knowledge gap can hinder progress towards more sustainable agrifood systems. This is especially so because, although some positive progress has been made towards improved food security and nutrition, negative impacts have become increasingly significant. Negative impacts that are not reflected in the market price of a product or a service are referred to in this report as **hidden costs**. For the sake of simplicity – and given that most benefits are likely to be internalized by markets – the term "hidden costs" herein encompasses *net* hidden costs, thus also including hidden benefits expressed as *negative* hidden costs. An example of a negative hidden cost would be farmers converting pastureland/cropland to forestland, which reduces GHG emissions, but for which farmers do not receive compensation.

Barriers to integrating the hidden impacts of agrifood systems into decision-making

Given the wide range of effects associated with the economic activities of agrifood systems and the many different stakeholders affected, integrating all of the hidden costs and benefits into decision-making processes is not an easy task. Decision-makers face conflicting objectives, and addressing the hidden costs of agrifood systems can require significant changes to current production and consumption practices, which may be met with resistance from governments, businesses, producers and consumers, who may prefer the status quo for fear of high transition costs or changes in habits, culture or traditions.

Another reason for resistance to change is the fact that trade-offs may arise. For example, the use of agrochemicals to increase productivity can reduce poverty, but also lead to ecological degradation over time. This makes policy decisions more complicated. There is also a significant disparity between who receives the benefits of agrifood systems globally and who pays the costs, that is, the distributional impacts of the transition to new patterns of production and consumption. Transforming agrifood systems to address key environmental stresses and health problems can involve trade-offs with improvements in social equality.

Resistance to change can also be driven by a dearth of sufficient data and information. An associated challenge is quantifying the costs of policy change (that is, the abatement costs) and comparing them with the benefits of reducing hidden costs to help guide policy direction. This raises the issue of valuing costs in a way that is practical. There will be little progress on agrifood systems transformation if methods to improve abatement costing languish. Investing resources in achieving the disclosure of relevant information should be prioritized.

TRUE COST ACCOUNTING: AN OPPORTUNITY FOR UNDERSTANDING AGRIFOOD SYSTEMS

True cost accounting builds on the body of existing measurement work reflected in established international statistical standards. As far as produced and natural capital and associated flows are concerned, these standards include the System of National Accounts (SNA) for the measurement of produced assets and associated flows of production, income and consumption, and the System of Environmental-Economic Accounting (SEEA) for the measurement of environmental flows and assets.

Given the challenges of collecting the necessary data and quantifying all flows across the four capitals, the already available data and information take priority for an initial understanding of agrifood systems. Such initial analyses can be used to start a dialogue with relevant stakeholders on the most important challenges in agrifood systems and the most urgent data gaps that need to be filled to better guide interventions. In this regard, the principle of "materiality" will be key – defined as a measure of how important a piece of information is when making a decision. Materiality helps focus the scope of TCA assessments on the impacts and flows that have the potential to alter a decision-making process. This can determine which important data are unavailable and should be collected.

A proposed two-phase assessment using true cost accounting

Against this backdrop, this report proposes a **two-phase assessment** using TCA to provide decision-makers with a comprehensive understanding of agrifood systems and identify intervention areas to improve their sustainability. The **first phase** is to undertake initial national-level assessments that analyse and quantify as much as possible the hidden costs of agrifood systems across the different capitals using readily available data. The main role of the first phase is to raise awareness about the magnitude of the challenges.

The **second phase** is devoted to in-depth assessments targeting specific components, value chains or sectors of agrifood systems to guide transformational policy actions and investments in a specific country. The selection can be inspired by the results of the first phase, but can also be guided by country priorities per consultations with relevant stakeholders. The stakeholders involved may vary by context, but they are generally policymakers, research and accounting institutions (especially those with good knowledge of the country's major agrifood systems challenges) and representatives of key actors in agrifood systems, such as agricultural producers, processors and distributors.

PRELIMINARY ASSESSMENT OF THE HIDDEN COSTS OF AGRIFOOD SYSTEMS FOR 154 COUNTRIES

Hidden costs are undeniably substantial, even after accounting for uncertainty

To date, there have been various attempts to estimate the hidden costs associated with global agrifood systems. Two studies, by the Food and Land Use Coalition (FOLU) (2019) and Hendricks *et al.* (2023), in particular, conclude that the magnitude of hidden costs is sizeable relative to the value of food products transacted in markets. Despite their comprehensiveness, however, both studies are aggregate in nature and do not provide estimates at a national level.

Against this background, and as a starting point for the first phase of the two-phase process, a preliminary TCA analysis was conducted for this report to quantify the hidden costs of agrifood systems for 154 countries. It uses national-level data (from various global datasets) to model impacts and combines these with monetary estimates to value (monetize) the hidden costs. This enables the results to be aggregated and compared on different dimensions and geographical scales and to be used as a foundation for dialogue with decision-makers. In this exercise, both hidden costs *and* benefits are factored in as much as possible, with hidden benefits (for example, afforestation) expressed as *negative* hidden costs.

However, because food holds intangible value – for example, in terms of the cultural identity associated with agrifood systems – some benefits cannot be monetized, so are excluded from the analysis, despite their importance. In addition, some hidden costs have been omitted due to data gaps across the set of countries being analysed, for example, costs associated with child stunting, pesticide exposure, land degradation, antimicrobial resistance and illness from unsafe food.

This report estimates that the global **quantified hidden costs of agrifood systems were approximately 12.7 trillion 2020 PPP dollars** in 2020. This includes environmental hidden costs from GHG and nitrogen emissions, water use, and land-use change; health hidden costs from losses in productivity due to unhealthy dietary patterns; and social hidden costs from poverty and productivity losses associated with undernourishment. Both unhealthy dietary patterns and undernourishment result in productivity losses affecting national economies; however, because the drivers differ significantly – undernourishment is driven by extreme deprivation, while unhealthy dietary patterns by overconsumption – hidden costs from unhealthy dietary patterns are linked to the health dimension, while those from undernourishment are related to the social dimension alongside poverty.

While not monetizing all benefits and costs is a limitation, it does not necessarily restrict the ability of the exercise to guide improvements in agrifood systems. Indeed, the hidden costs covered are more than sufficient to highlight the need for action. When compared to the value of the world's economy, these are equivalent to almost 10 percent of global GDP PPP in 2020. Per day, these costs are equivalent to 35 billion 2020 PPP dollars.

These estimates take into account the large uncertainty in cost calculations resulting from a lack of data on various hidden costs, as well as for some countries and regions, by using probability distributions. An attractive feature of this exercise is that it allows for confidence intervals that reflect this uncertainty: it is estimated that global hidden costs have a 95 percent chance of being 10.8 trillion 2020 PPP dollars or higher. Uncertainty was largest for environmental hidden costs, due to a lack of knowledge about the impact of nitrogen emissions on ecosystem services. Yet, even the lower bound reveals the undeniable urgency of agrifood systems transformation. In other words, uncertainty should not be used as a reason to postpone action.

Hidden costs of agrifood systems vary substantially in magnitude and composition across country income levels

Aggregating the quantified hidden costs of agrifood systems at the global level hides significant variation across the income levels of countries that are key decision-makers in reducing these costs. The majority of hidden costs are generated in upper-middle-income countries (5 trillion 2020 PPP dollars, or 39 percent of total quantified hidden costs) and high-income countries (4.6 trillion 2020 PPP dollars, or 36 percent of total costs). Lower-middle-income countries account for 22 percent, while low-income countries make up 3 percent.

Hidden costs differ not only in their magnitude, but also in their composition by income level. In all country groups apart from low income, productivity losses from dietary patterns that lead to non-communicable diseases (NCDs) are the most significant contributor to agrifood systems damages, followed by environmental costs. In lower-middle-income countries, social hidden costs from poverty and undernourishment are relatively more significant, accounting for an average of 12 percent of all quantified hidden costs. Unsurprisingly, these social hidden costs are the main issue in low-income countries (more than 50 percent of all quantified hidden costs).

Presenting hidden costs as a share of GDP gives a better sense of the burden placed on national economies and provides an indication as to where to prioritize international resources to address these costs. Globally, the quantified hidden costs are equivalent, on average, to almost 10 percent of 2020 GDP in PPP terms. However, this share is far higher in low-income countries, at an average of 27 percent. This signals that improving agrifood systems in low-income countries will be instrumental in addressing these hidden costs, especially those related to poverty and undernourishment, which alone are equivalent to 14 percent of GDP. The ratio of hidden costs to GDP is 12 percent and 11 percent in lower- and upper-middle-income countries, respectively. However, social hidden costs are of notable relevance only in lower-middle-income countries. In upper-middle-income countries, the majority of hidden costs come from unhealthy dietary patterns. The same occurs in high-income countries, where the ratio of all quantified hidden costs is only 8 percent.

Quantifying hidden costs to inform the policy entry points that, in turn, can address them

The hidden costs described are meant to help identify entry points for the prioritization of interventions and investments. In this respect, the first step should be to identify where in a given agrifood system hidden costs are more significant and due to what activities. Starting with the environmental dimension, estimates suggest that these costs occur mostly in primary production, with pre- and post-production costs comprising less than 2 percent of total quantified hidden costs. In other words, the primary sector should be seen as the main entry point for effecting change in environmental pathways. Globally, hidden costs from agriculture – through environmental pathways – are equivalent to almost one-third of agricultural value added.

For some countries the focus will likely be on the vulnerable actors and specifically on the contribution of agrifood systems to moderate poverty – that is, the overall distributional failure of sufficient revenues and calories needed to ensure productive lives. The report finds that, to avoid distributional failure costs in agrifood systems, the incomes of the moderately poor working in agrifood systems need to increase, on average, by 57 percent in low-income countries and 27 percent in lower-middle-income countries.

Another area that emerged as clearly important is that of average productivity losses per person from dietary intake. Globally, this value is equivalent to 7 percent of GDP PPP in 2020; low-income countries report the lowest value (4 percent), while other income categories report 7 percent or higher.

Overall, the results suggest that the quantified hidden costs associated with agrifood systems are substantial for all countries, even after accounting for uncertainty. They reveal the magnitude of transformation required but do not measure the cost of mitigating or preventing the different challenges, nor do they express whether it is feasible to do so. Rather, they indicate the relative contributions of various activities or pollutants and highlight areas for further investigation in targeted assessments to fill data gaps and understand the abatement costs. Only with such targeted assessments is it possible to guide interventions by both public and private entities to transform agrifood systems for the better.

MOVING ON TO TARGETED TRUE COST ACCOUNTING ASSESSMENTS: THE SECOND PHASE OF A TWO-PHASE PROCESS

From initial estimation of hidden costs to identification of actions

The results of this stocktaking exercise of national estimates are preliminary and therefore need to be complemented with more accurate and disaggregated data from targeted assessments. This is enabled by the second phase of the assessment process, focusing on conducting targeted assessments to support decision-making to improve the sustainability of agrifood systems. The objective is to identify the potentially preferred transformational actions, comparing the costs and benefits of each – for example, through scenario analysis – in order to allocate resources to the most feasible and cost-effective ones, compare future options and manage trade-offs and synergies. This would then lead to implementation of levers to reform policies, investments and other interventions to address the concerns identified.

Defining the scope of targeted assessments

When setting up a targeted assessment, it is important to establish the boundary of analysis to keep the scope of the study feasible while allowing it to sufficiently meet its goal. This starts with choosing the *functional unit* of analysis, that is, what is being assessed and measured, which can be broken down into agrifood systems, dietary patterns, investment, organization and product. The chosen functional unit depends on the policy focus or research question. Generally, boundaries of analysis that incorporate the higher level of agrifood systems are most suitable for policymaking, as they are more holistic and consider the potential to steer systemic impact.

Activating levers for change usually requires analyses on a more granular level in order to be effective. This may require *product* or *investment* to be the functional units that inform concrete decisions. If the policy concern is to promote healthy diets, then choosing the *dietary patterns* level as the functional unit would be more appropriate. Choosing *organization* as the functional unit might also be suitable in certain cases. While it is mostly used for the private sector, *organization* as the functional unit can produce valuable insights if the policy goal is to identify areas in which businesses need support either to conduct TCA themselves or to reduce their negative impacts.

Policy and scenario analyses: their fundamental and complementary roles in targeted TCA assessments

Scenario analysis is a critical feature of any TCA exercise, regardless of the boundaries of the analysis. Whether the domain of a TCA application is national agrifood systems, a local diet, a public investment or a value chain, scenario analysis allows the comparison of potential future paths and assesses the impact and effectiveness of different policies and management options. Doing so is essential for identifying emerging issues from inaction, as well as synergies and trade-offs from action. Such trade-offs can then be carefully weighed to formulate stronger strategies and assess the effectiveness of different potential actions.

These scenarios can help to reframe the problem in order to set a policy agenda more effectively. They typically have both qualitative and quantitative components and are often combined with participatory approaches involving local and regional stakeholders. For example, population growth projections can be used to estimate expected land-cover changes when investigating trends in agricultural expansion or urbanization.

Results of scenario analysis can be interpreted using cost–benefit analysis that compares the benefits and costs of different interventions and determines their economic and financial viability. Alternatively a cost-effectiveness approach compares the costs of meeting a given objective when using different intervention options, such as the cost per tonne of avoided emissions through energy efficiency, renewable energy and reduced deforestation. The latter approach is particularly relevant when considering options for reducing hidden costs of agrifood systems that have not been quantified in monetary terms.

True cost accounting can help nudge agrifood business and investment towards sustainability

It is unlikely that all issues can be addressed through policy alone. Agrifood systems are, at their core, private-sector endeavours, and the private sector will have to take on some of the responsibility for minimizing hidden costs. True cost accounting provides a framework for businesses to assess and manage their impacts and dependencies more comprehensively and accurately. By integrating TCA into everyday decision-making and management strategies, agrifood businesses can monitor and unlock opportunities at different stages of the supply chain, achieve sustainable production, attract private investment and avail of government incentives. When adopted by policy and backed by laws and regulations, TCA redefines key performance indicators and changes the bottom line of business success by including human, social and natural capitals. In brief, it redefines the concept of "successful business".

Financial institutions such as banks and insurance companies can also use TCA to determine credit and insurance conditions based on better risk assessments, thus improving credit and insurance conditions for sustainable businesses. A comprehensive assessment of costs and benefits with TCA can also help businesses mobilize financial resources for the transition to sustainability, opening up opportunities for new investment and upscaling. True cost accounting can also help businesses respond to the growing demand for supply-chain transparency from consumers who are increasingly becoming conscious of the different aspects of production, including working conditions and environmental impacts. In this regard, TCA can also help businesses qualify for voluntary certifications (such as fair trade) and government incentives.

Faced with the growing urgency of quantifying the hidden costs of businesses, particularly those of agrifood products, various initiatives have taken the first steps. The existing initiatives cover a significant amount of ground when it comes to the business applications of TCA. However, there are still areas where further development is needed to fully realize the potential of TCA in the private sector. These include frameworks and standards, methods, corporate governance and strategy, and reporting guidelines.

MAINSTREAMING TRUE COST ACCOUNTING FOR AGRIFOOD SYSTEMS TRANSFORMATION: OPPORTUNITIES AND CHALLENGES

When based on TCA, levers can be used to improve agrifood systems sustainability

Different levers can influence the inner workings of agrifood systems and be strategically employed to propel systems to sustainability. Levers can affect the supply side (production and intermediaries), the demand side (consumption) and public goods supporting agrifood systems. No single lever is new, but the innovation lies in how they are used. When informed by targeted TCA assessments, existing levers in agrifood systems, such as agrifood subsidies, can be redirected or reformed to support and scale up promising and emerging strategies for sustainable businesses and investments. The choice of lever will depend on the results of scenario and policy analyses, context-specific needs, priorities and available resources. While governments have the broadest and most influential toolkit, other actors – research institutions, civil society organizations, businesses and financial institutions – also play significant roles in shaping the performance of agrifood systems. Likewise, other sectors outside agrifood systems (for example, the health care and energy sectors) need to be considered in the interim and in terms of synergies and trade-offs to create incentives that are coherent to this end.

Will addressing hidden costs raise the price of food?

A commonly asked question is whether addressing the hidden costs of agrifood systems will raise food prices. The report lays the foundations to answer this question. The basic premise is that it will depend on the hidden cost being addressed and the instruments being used. Considering the distinct categories of hidden costs being investigated is helpful: social hidden costs associated with distributional failures, which result in poverty and undernourishment; environmental hidden costs from damages linked to externalities; and health hidden costs due to dietary patterns that lead to obesity and NCDs. The way in which each of these categories is addressed has distinct implications for incomes and food prices.

Addressing the social hidden costs from distributional failure, for instance, could improve productivity in the food and agriculture sector, exerting downward pressure on food prices, broadly benefiting consumers. Conversely, if producers are made to pay for measures (polluter pays principle) – for example, through taxes or regulations stipulating less environmentally harmful practices – not complemented by advice on how to limit costs where a hidden cost occurs, then these will be passed down the value chain or on to consumers in the form of higher food prices.

The alternative is to apply the beneficiary pays principle, which places the burden of covering the true costs of agrifood systems activities on the beneficiaries – usually the public, but also specific groups particularly affected by activities in which they are not involved. In such cases, policies should not result in an increase in the price of food. One example is payment for environmental services, where the beneficiary pays the parties whose activities may be damaging to the environment to modify their behaviour.

One set of policies involving a mixture of the polluter pays principle and the beneficiary pays principle is the repurposing of agricultural subsidies. Shifting underperforming agricultural subsidies to protect and restore degraded farmland can better support local communities and help countries achieve their climate, biodiversity and rural development goals. If carefully designed and targeted, it also has the potential to increase the availability and the affordability of healthy diets, and in particular those that are environmentally sustainable. However, subsidy-based schemes place a burden on already scarce fiscal resources and competing objectives might lead to trade-offs. The choice between the policy instruments will depend on equity implications, which, in turn, depend on who the beneficiaries are. Priority should be given to situations where synergies exist.

Targeted TCA assessments can inform the design of taxation and repurposing schemes to change relative food prices in favour of more nutritious and sustainable options. When tax revenues are directed to promote healthy and sustainable diets, household food budgets might remain unchanged. In the long term, improvements in public health leading to increased productivity could translate into higher household incomes. In this case, even if healthier diets may be costlier, the increase in incomes could help offset this additional expense. However, more research is needed to understand the costs involved.

Creating an enabling environment to scale TCA for agrifood systems transformation

Scaling up the adoption of TCA cannot be achieved by a single set of actors; it requires complementary contributions from different stakeholders that influence the functioning of agrifood businesses. Governments, with their policies, funds, investments, laws and regulations, play the central role in creating a conducive environment for the scaling up of TCA to transform agrifood systems. Research organizations and standard setters are also key for advancing methodologies and setting standards for data to be collected and used in TCA assessments. This is essential to guarantee the transparency of the true costs and benefits of agrifood systems. The applications of TCA studies will largely be facilitated by accounting firms and business consultancies, which advise and support agrifood producers, businesses and other relevant stakeholders in their sustainability transition. Financial institutions and credit rating agencies could be instrumental if they favour sustainable production, business and investment. Ultimately, it is the producers, businesses and consumers – and the alliances they create – that will make the change and implement new standards, in particular, voluntary standards.

For this to happen on a large scale, especially in middle- and low-income countries, two major barriers must be overcome: data scarcity and lack of capacity.

FOR THE FIRST TIME EVER, FAO WILL DEDICATE TWO CONSECUTIVE EDITIONS OF *THE STATE OF FOOD AND AGRICULTURE* TO THE SAME THEME

By dedicating two editions to this topic, FAO is investing in the disclosure of relevant information to guide decision-making in agrifood systems towards sustainability. In this year's report, novel findings of the preliminary national assessments have been presented, creating an unprecedented opportunity to support decision-makers worldwide in pinpointing the broad (hidden) challenges faced by their systems and initiate a process to construct a joint vision for agrifood systems transformation. These preliminary results, to be improved and updated, emphasize the importance of repurposing current public support and of laws, regulations and standards that influence the behaviours of other actors, such as consumers. Private capital – amounting to about 14 times global public support – also plays an important role in shaping sectoral sustainability, as do financial institutions, by further influencing, advising and supporting actors in their sustainability transition.

Next year's report will emphasize how targeted assessments can be tailored based on the priorities of policymakers in specific contexts. The aim will be to showcase the flexibility of TCA in its application to different scopes, from an entire agrifood system down to a single product. Regardless of analysis scope, TCA can be used to compare different policy and management choices. As a continuation of the work started in this report, scenario and policy analyses will feed into TCA, examining a range of plausible futures, including the outcomes and effectiveness of various policy or management options to guide the transformation of agrifood systems for the better. ■

MYANMAR
People buying food in a market in Mandalay.
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CHAPTER 1

FACTORING THE COSTS AND BENEFITS OF AGRIFOOD SYSTEMS INTO DECISIONS

KEY MESSAGES

➔ The unsustainability and lack of resilience of agrifood systems are major concerns, exacerbated by market, institutional and policy failures that generate losses to society and inhibit much-needed transformation towards sustainability.

➔ To improve outcomes, decision-makers need a comprehensive understanding of agrifood systems costs and benefits for all stakeholders, including under-represented groups and future generations, which are not being systematically and consistently measured.

➔ A comprehensive understanding would enable available levers – from fiscal support and regulations to voluntary standards – to be better realigned and used more effectively towards more nutrition-, gender- and environmentally sensitive investment and policy actions.

➔ True cost accounting (TCA) is a powerful approach to uncovering the hidden costs generated by current agrifood systems, underscoring their unsustainability and guiding the use of available levers to improve their outcomes.

➔ True cost accounting requires large amounts of data, however, which can be a challenge, especially in low- and middle-income countries. Therefore, already available data need to be used to the greatest extent possible to avoid inaction.

➔ This report proposes a two-phase assessment process that relies on TCA, starting with wider, initial national-level assessments to raise awareness and moving towards in-depth and targeted evaluations to prioritize solutions and guide transformative action.

There are two sides to the story of agrifood systems. Both are true.

The first is that agrifood systems generate considerable benefits to society, not least because they produce the food that nourishes us. Agrifood systems are also the world's biggest employer, providing jobs and livelihoods to over a billion people.[1] Many farmers are also environmental stewards, supplying environmental services to society. Through sustainable practices, such as agroforestry, agrifood systems also generate public benefits, including biodiversity conservation, carbon storage and sequestration, and watershed regulation. As such, the value to society of agrifood systems is likely well beyond what is measured in gross domestic product (GDP). The other side is that, due to market, policy and institutional failures, agrifood systems are fragile and unsustainable, contributing to climate change and natural resource degradation while failing to provide healthy diets to all. With our existence relying on just one planet and fragile agrifood systems, we need to tread carefully.

Agrifood systems have been evolving since the beginning of agriculture, thousands of years ago. Thanks to technological change and innovation in the last 70 years, agricultural productivity has increased tremendously. Meanwhile, food trading has grown enormously, especially in the last three decades. These factors have helped feed a population that has tripled and become more urbanized. Consequently, the share of the population employed in agriculture has declined, while jobs have been created in upstream and downstream value chains and other sectors.

Today's agrifood systems have access to a new generation of automated technologies with the potential to enhance productivity and resilience and address environmental sustainability challenges.[2] Detailed socioeconomic and environmental data are increasingly available, giving agrifood producers and firms, as well as policymakers, the opportunity to make data-driven decisions relating to production, supply chains, trade, social protection and so on. With the rising challenges agrifood systems face, the growing means of gathering data and information provide an unprecedented opportunity to strategically fill knowledge gaps so that decision-makers are better prepared to transform agrifood systems towards economic, social and environmental sustainability.

How do we make decisions that will amplify the benefits of agrifood systems while addressing the key challenges that hamper their transformation? How do governments know which programmes to sponsor and which stakeholders to support? How do agricultural producers ensure that the natural resources on which they depend will renew for subsequent seasons? How can retailers promote nutritious foods? How can consumers be induced to use their purchasing power to support healthy and sustainable diets? And will these decisions affect the costs of production and, ultimately, food prices?

On a day-to-day basis, we do not have all the answers, but people, businesses and governments make decisions, nonetheless. To these, there are consequences – both good and bad – that are not always visible. This edition of *The State of Food and Agriculture* aims to initiate a process that aspires to analyse the complexity and interdependencies of agrifood systems and how they affect the environment, society, health and the economy through true cost accounting (TCA). Doing so will reveal their hidden impacts and inform actions that contribute to their transformation towards efficiency, inclusiveness, resilience and sustainability. ■

UNPACKING THE IMPACTS AND DEPENDENCIES OF AGRIFOOD SYSTEMS

Agrifood systems are dynamic, from their layered composition to their interactions with the resources that underpin nature and society. They are also influenced by policy, business and consumer decisions. Figure 1 illustrates a conceptual framework depicting the inner workings of agrifood systems, their effects on resources (and vice versa) and the levers available to transform them. The framework helps to break down the numerous impacts and interdependencies of agrifood systems, as well as the opportunities for decision-makers to steer them for the better.

The yellow rectangle in Figure 1 represents agrifood systems, showing how they comprise agricultural production and food supply chains, consumer behaviour, diets and interconnections with other systems, such as environmental and health systems. Agricultural production includes crop and livestock production, aquaculture, fisheries and forestry. Overlapping with food supply chains, consumer behaviours and diets are food environments, which refer to the physical, economic, sociocultural and policy conditions that shape access, affordability, safety and food preferences.[3–5] The arrows flowing in and out of agrifood systems demonstrate how their activities depend on – as well as affect – natural, human, social and produced capitals. These form the foundation of human well-being, economic success and environmental sustainability, and are defined as:[6]

- **natural capital**: the stock of renewable and non-renewable natural resources that combine to yield a flow of benefits to people;
- **human capital**: the knowledge, skills, competencies and attributes embodied in individuals that contribute to improved performance and well-being;
- **social capital**: the networks, together with shared norms, values and understanding, that facilitate cooperation within and among groups; and
- **produced capital**: the human-made goods and financial assets that are used to produce goods and services consumed by society.

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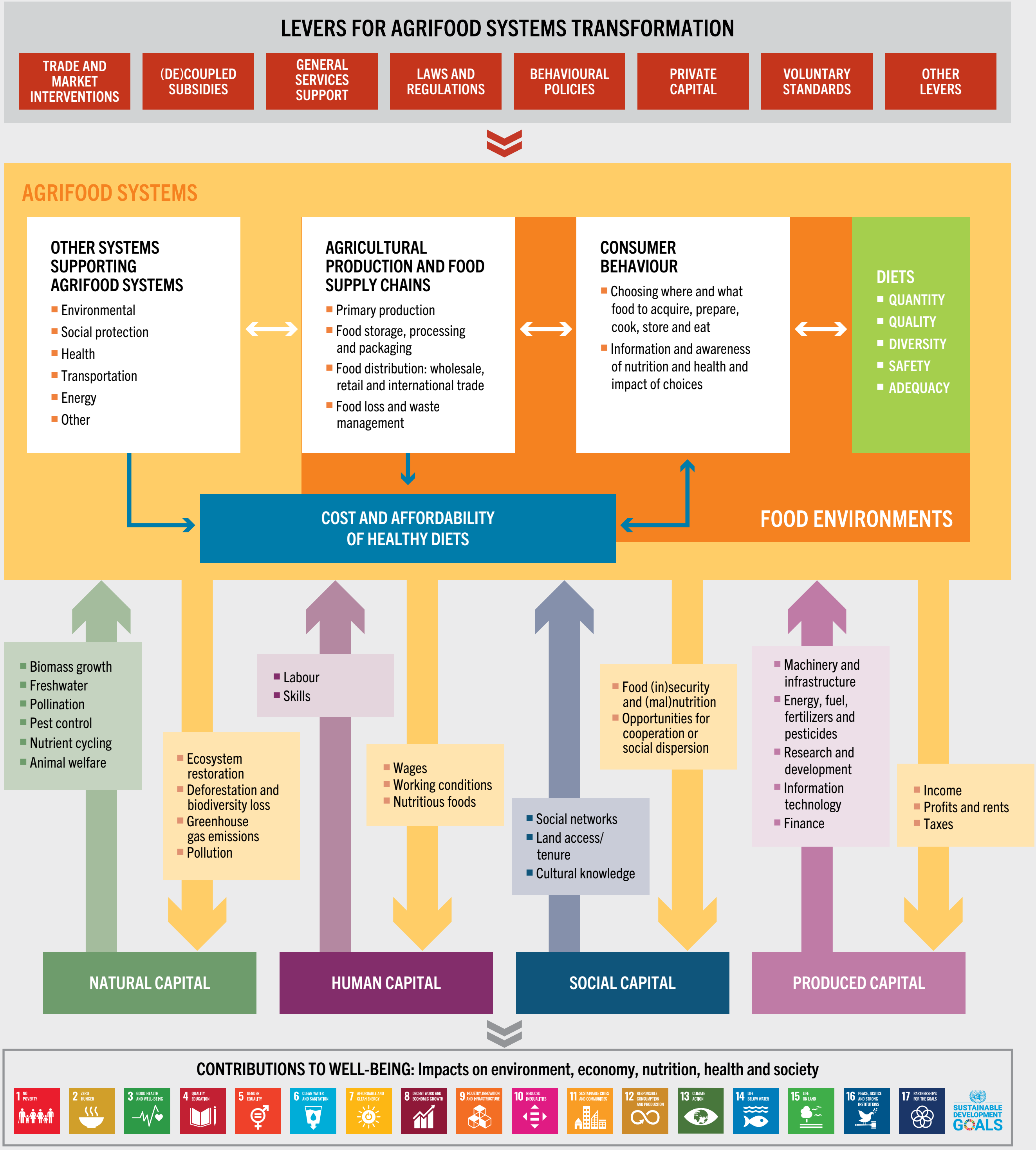
FIGURE 1 HOW ASSESSMENTS OF CAPITAL FLOWS CAN INFORM LEVERS FOR AGRIFOOD SYSTEMS TRANSFORMATION



SOURCES: Adapted from FAO, IFAD, UNICEF, WFP & WHO. 2022. *The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable*. Rome, FAO. https://doi.org/10.4060/cc0639en; TEEB. 2018. *TEEB for Agriculture & Food: Scientific and Economic Foundations*. Geneva, Switzerland, UN Environment. https://teebweb.org/wp-content/uploads/2018/11/Foundations_Report_Final_October.pdf

» The activities of agrifood systems cause changes (impacts) in the capitals through inward and outward flows. The large arrows represent those impacts and dependencies, with colours corresponding to the respective capital. The capital flows of agrifood systems can be akin to symbiotic relationships in many contexts. For example, natural capital contributes biomass growth and freshwater to agrifood systems (the green arrow pointing up to "agrifood systems"). In return, agrifood systems can negatively affect natural capital with greenhouse gas (GHG) emissions and pollution (the yellow arrow pointing down to "natural capital"). In contrast, if regenerative agriculture is used, production practices can contribute to ecosystem restoration. Human capital sends in labour and skills and agrifood systems return wages and decent working conditions. Social capital can contribute to agrifood systems through cultural knowledge and shape customs of access to resources such as land, while agrifood systems produce food security and nutrition (or food insecurity and malnutrition) in return, depending on their efficiency, resilience and inclusiveness. Produced capital contributes research and development, among other things, and agrifood systems generate income, profits, rent and taxes in return. While these flows seem intuitive, little has been done to measure them and manage their impacts, with the exception of produced capital.

At the top of the figure, the red rectangles showcase the available tools, or levers, for influencing agrifood systems actors, activities and impacts. These levers are not new and are currently used by decision-makers, including governments and other stakeholders, who determine or influence which, when, where and how they are engaged. The following paragraphs describe the main categories of levers, which can be quite numerous and diverse. However, the section does not aim to be exhaustive and other potential levers may exist.

Many, but not all, levers are enacted and administered by governments and local authorities to influence agrifood systems actors and steer them towards objectives considered important by policymakers. They include trade and market interventions, subsidies, laws and regulations, general services support, and behavioural policies.[7]

Governments generate price incentives or disincentives through **trade and market interventions**. These generally consist of border measures (such as import tariffs or quotas, export bans or subsidies) and/or market price regulations (such as domestic price fixation policies). These interventions create a gap between the domestic and international prices of targeted products and/or help to curb demand for targeted foods.

Subsidies granted to individual producers or consumers can aim to correct issues such as limited availability of credit or to induce a behaviour considered desirable by policymakers. In the case of producers, these can be "coupled" (that is, tied to the level of production or to the use of inputs or other factors of production) or "uncoupled" (that is, not linked to production decisions). When coupled, subsidies can greatly influence which commodities are produced and marketed and which inputs are used and how. As for consumers, these can take the form of food subsidies, cash transfers, in-kind food transfers or school feeding programmes as a way of improving access to food.[7]

Such public policies are enacted and shaped by **laws and regulations**. These mandatory frameworks are used to set standards and targets, which directly affect the decisions of agrifood actors. Examples include when governments restrict imports of certain commodities or products by imposing non-tariff barriers or when they ban the use of a specific agricultural input that has proved harmful to human health or the environment.

To improve the performance of agrifood systems, governments provide **general services support**. The specific support depends on the context, but can include investments in agricultural research and development, including monitoring systems and the production of relevant data; knowledge transfer services (such as training, technical assistance and other extension services); inspection and control with regard to agricultural product safety, pests and diseases to ensure that food products conform to regulations and product safety norms; infrastructure development and maintenance; public stockholding, including maintaining and managing reserves through market purchase intervention; and food and agricultural marketing services and promotion.[7] Such investments create an enabling environment for agrifood systems transformation.

Governments and other stakeholders can use policies based on insights from behavioural sociology and psychology studies to address the underlying causes of certain behaviours, such as the consumption of unhealthy processed foods.[8] These insights are referred to in this report as **behavioural policies** and they differ from other policies, such as taxes and subsidies, in that they do not reduce people's freedom of choice or impose any significant costs on them to induce a change in behaviour. Instead, they operate by changing the contexts or environments in which decisions are made. In the context of food consumption dominated by unhealthy processed foods, for instance, behavioural policies may focus in establishing or promoting a conducive environment that promotes the supply and the consumption of nutritious foods (see Glossary). They can provide insights to governments on regulating the food environment to achieve certain objectives, such as promoting the consumption of healthy diets that are also environmentally friendly. For example, behavioural policies can try to nudge consumers towards better food choices, such as placing nutritious food options in locations around school cafeterias that make them easier to reach.[9] They can also regulate the behaviours of food businesses (such as supermarkets) to better promote healthy eating.

Some levers can also be administered by private and civil society agrifood actors, as well as donors and international organizations. For example, **private capital** from businesses, financial institutions and even consumers is one of the most significant levers in agrifood systems, amounting to as much as USD 9 trillion yearly.[10] Different studies have concluded that private capital plays a successful role in improving agricultural production techniques and technologies.[11] Another lever is **voluntary standards**, which are non-mandatory rules, guidelines or characteristics about a product or a process developed by private-sector actors, representatives of civil society, or public-sector agencies. Voluntary standards are a means for producers, processors and retailers to share information with consumers, enabling them to influence production processes, methods and practices with their consumption choices.[12] While private capital and voluntary standards are not enacted by policymakers, governments still play an important role in shaping their functioning and impact by providing the enabling environment and oversight.

Lastly, Figure 1 shows how folding a holistic assessment of agrifood systems into the process of decision-making is critical to achieving many, if not all, of the Sustainable Development Goals (SDGs). The bottom section, entitled "Contributions to well-being", connects agrifood systems impacts with the 2030 Agenda for Sustainable Development, a plan of action for people, planet and prosperity. Of particular relevance is the impact this can have on SDG 1 (No Poverty), SDG 2 (Zero Hunger) and SDG 3 (Good Health and Well-being) as a result of the relevance of agrifood systems to agricultural productivity, rural livelihoods, health, food security and nutrition. The transition to sustainable agrifood systems arising from better decision-making also implies progress on SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 12 (Responsible Production and Consumption) and SDGs 13, 14 and 15 on Climate Action, Life below Water and Life on Land. This transition will rely on new technologies that can function as a catalyst for progress towards SDG 9 (Industry, Innovation and Infrastructure). By assessing how human capital is formed and treated, it can also improve workers' access to education (SDG 4), reduce gender inequality (SDG 5) and contribute to decent work and economic growth (SDG 8).

Levers can steer systems in the right direction, but better accounting of agrifood systems is needed

When decision-makers lack a full assessment of the capital stocks and flows, the resulting knowledge gap can hinder progress towards more sustainable and resilient agrifood systems. For instance, it is estimated that, on average, governments spent almost USD 630 billion per year over 2013–2018 on food and agricultural support, of which 70 percent targeted individual producers through price incentives and subsidies.

However, a significant proportion of this support distorts market prices and is unsustainable.[7] Box 1 provides an overview of the state of public support for food and agriculture and its impact on agrifood systems.

With more information on the impacts and dependencies of agrifood systems on the capitals, policymakers will be better able to use public support for food and agriculture as a transformative tool for directing agrifood systems towards sustainability, resilience and inclusiveness. The same principle applies to other stakeholders, including agricultural producers and businesses, whose levers can bring about greater system-wide change if they are equipped with more information on their impacts. Therefore, an important first step for stakeholders, including governments, businesses, farmers and citizens, is to gather available information on capital flows and impacts.

Data that are usually available and commonly included in economic assessments pertain to produced capital and, to some extent, human capital (for example, labour and wages). These capital flows and impacts are transacted and observed through market mechanisms, so are easily measured and quantified. Flows and impacts related to natural, social and (part of) human capital, in contrast, are not, so their inclusion in economic assessments is largely partial and not systematic. For example, while incomes and taxes are captured by GDP, the distribution of these outcomes across gender and social classes (and the consequences for food security and nutrition, that is, for social capital) are less visible. Similarly, while market-based inputs are directly reflected in the private production costs of producers, the inputs of ecosystem services (for example, pollination) are not, although they are fundamental for agricultural productivity. Not accounting for these services may hinder the capacity of ecosystems to deliver them in the future, an important measure of sustainability.[14]

However, quantifying capital flows and impacts can be complicated by a lack of data or by the flows being qualitative in nature. This can be seen in Figure 2, which provides a schematic representation of the four capitals and a selection of their flows along a spectrum of ease of quantification, from very high to very low. For example, quantifying the impact of agrifood systems on food security and nutrition is possible, but requires large amounts of data and significant capacities. For other social capital flows, such as social networks and cultural knowledge, this is even more challenging, if not impossible. Natural capital flows are generally easier to quantify than social capital flows, but in some cases, this can still be very challenging (for example, pollination and habitat loss). In reality, the ease of quantification for each capital flow will depend on resources and capacities, ranging from, among other things, mobilizing resources and developing valuation methods to designing surveys and collecting and analysing data. Advances in technology and evaluation approaches are increasingly expanding the options available and reducing the resources needed to store, communicate, validate and process information.[15] And even where important flows are not quantified, they can still be considered in a qualitative manner.

Decisions based exclusively on flows observed through markets tend to lead to the suboptimal allocation of resources, also known as "market failure". Recognizing that markets cannot address problems of inequality and social justice, or of environmental sustainability, governments and other stakeholders establish policies and create institutions to address them. However, when they fail to do so or lack the capacity to intervene, a form of "institutional" or "policy failure" may also arise. The next section inspects these failures in more detail and acknowledges that an approach to assessing agrifood systems in a comprehensive and transparent manner is needed in order to address them. Such an approach is introduced later in the chapter. ■

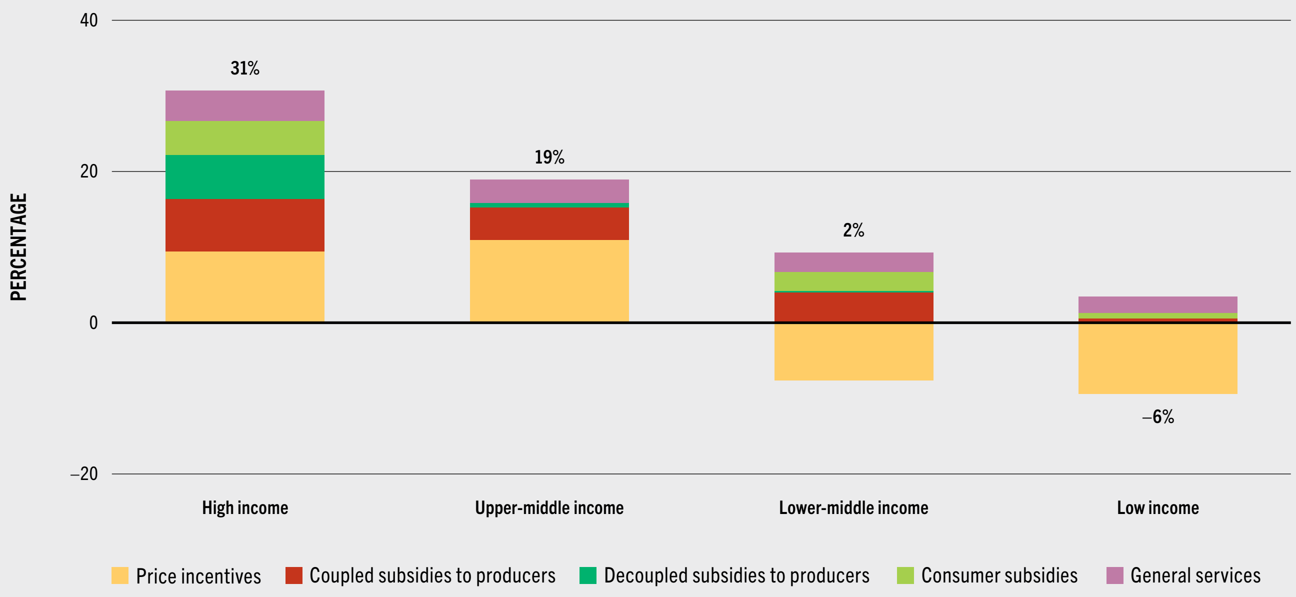
BOX 1 PUBLIC SUPPORT FOR FOOD AND AGRICULTURE IS STILL HIGHLY DISTORTIVE

Governments support the multifaceted objectives of agrifood systems in the economic, social and health realms by shaping production and consumption choices, as well as by affecting food supply-chain dynamics and food environments. However, evidence shows that most of the support used is highly distortive and can lead to undesirable outcomes, such as negative environmental consequences or health problems.[7]

The figure shows how food and agriculture support as a share of production value is divided by income group and type of support (average 2013–2018). In absolute terms, high-income countries and upper-middle-income countries accounted for the bulk of support, averaging USD 313 billion and USD 311 billion, respectively, compared with USD 11 billion in lower-middle-income countries and USD –6 billion in low-income countries (the negative value means the group is penalized overall). As a share of production value, price incentives and subsidies to producers were the most important form of support in high-income countries (22 percent) and upper-middle-income countries (16 percent). In both income groups, but especially in upper-middle-income countries, the majority of subsidies were linked to production, input use or other factors of production (in other words, they were coupled). This strong reliance on coupled subsidies has the potential to distort prices and discourage the production of nutritious foods that do not receive the same level of support. Similarly, evidence shows that in these countries, commodities with the largest carbon footprint, such as beef, milk and rice, were among those most supported by price incentives.[7]

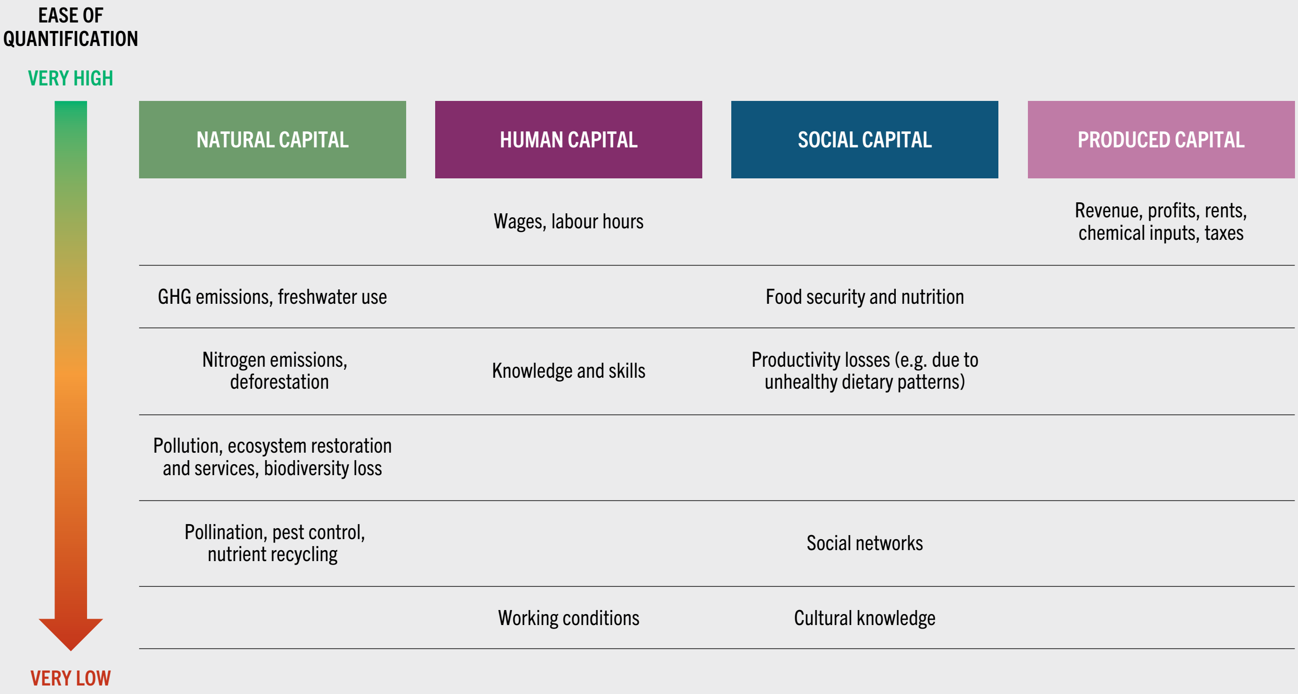
In lower-middle-income countries, and especially in low-income countries, policies commonly protect consumers rather than producers. Farmers face disincentives that keep domestic prices low, implicitly penalizing the farming sector, and this is shown by the negative values associated with price incentives in the figure. Low-income countries rarely grant fiscal subsidies to producers (they account for just 0.6 percent of the total value of production), while in lower-middle-income countries, some farmers receive support through input subsidies. Spending on general services is a small share of total support for food and agriculture, despite its potential to boost long-term productivity and lower food prices, including for nutritious foods.[7] Despite these challenges, evidence from 13 sub-Saharan African countries over 2004–2018 indicates that, following recent reforms, some input subsidy programmes have been downsized, increasing the fiscal space to allocate more funds to general services and public goods, which generate more sustainable and broad-based impacts.[13] Programmes supporting consumers also have the potential to increase the consumption of nutritious foods, especially when they target the most vulnerable. The same review on sub-Saharan Africa has shown that, as a result of recent reforms, subsidies to consumers in the form of cash transfers, in-kind transfers and school meal programmes have also increased.

FIGURE SUPPORT FOR FOOD AND AGRICULTURE AS A SHARE OF PRODUCTION VALUE, BY INCOME GROUP AND TYPE OF SUPPORT, AVERAGE 2013–2018



SOURCE: Adapted from FAO, IFAD, UNICEF, WFP & WHO. 2022. *The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable*. Rome, FAO. https://doi.org/10.4060/cc0639en

FIGURE 2 EASE OF QUANTIFICATION FOR SELECTED CAPITAL FLOWS ALONG A SPECTRUM



NATURAL CAPITAL	HUMAN CAPITAL	SOCIAL CAPITAL	PRODUCED CAPITAL
	Wages, labour hours		Revenue, profits, rents, chemical inputs, taxes
GHG emissions, freshwater use		Food security and nutrition	
Nitrogen emissions, deforestation	Knowledge and skills	Productivity losses (e.g. due to unhealthy dietary patterns)	
Pollution, ecosystem restoration and services, biodiversity loss			
Pollination, pest control, nutrient recycling		Social networks	
	Working conditions	Cultural knowledge	

SOURCE: Authors' own elaboration.

MARKET, INSTITUTIONAL AND POLICY FAILURES UNDERPIN THE UNSUSTAINABILITY OF AGRIFOOD SYSTEMS

As seen in Figure 1, the activities of agrifood systems cause changes in the capitals through inflows and outflows. Some of these changes have certainly been positive, such as the provision of food security and nutrition and livelihoods to many. However, negative impacts have become an increasingly significant issue, driven in most cases by markets, institutions and policies falling short of the ideal – in other words, market, institutional and policy failures (see Glossary). These failures generate losses to society that are not reflected in the market price of a product or a service, or are not included in GDP – referred to in this report as **hidden costs**. These failures inhibit the proper functioning of agrifood systems and, if left unaddressed, can hinder the transition towards sustainable, resilient and inclusive agrifood systems.

Markets are supposed to facilitate the efficient allocation of resources, but there are many cases of market failure in which they fail to do so.[16] These are missed opportunities to improve people's lives without negatively impacting others. Take the case of water pollution from pesticides and fertilizers: their use can be avoided or reduced with the right practices, but polluting farmers may not be aware that current techniques lead to water pollution or they may not know which alternatives to use. The presence of such imperfect information prevents farmers from making an optimal decision from a social point of view.[17] Another driver of such polluting behaviour is the fact that avoiding pollution may come at a private cost that they prefer to externalize to avoid reducing profit.[17] This choice reduces the quantity of safe water, with negative consequences for human health and the environment. Further, water pollution affects people's human rights, including their rights to adequate food, water and sanitation. Box 2 discusses various types of market failure, giving examples of how they affect the functioning of agrifood systems.

Institutional and policy failure can also drive the hidden costs of agrifood systems. These failures are interlinked and can overlap depending on the context. **Institutional failures** refer to when institutions – governments, markets, private property and communal management[24] – fail to provide the necessary framework for development, whereas **policy failures** refer to when a policy, even if it is successful in some minimal respects, does not fundamentally achieve the goals that proponents set out to achieve.[25]

Institutional failures, for example, inhibit the provision of public goods. For instance, for food safety to be guaranteed, there must be institutions and authorities that set standards and enforce them. A **lack of transparency and accountability** in such entities – a type of institutional failure – reduces the response time from the discovery of contaminated foods, making it slow and difficult to recall unsafe food products.[26]

Similarly, **corruption** – the abuse of entrusted power for private gain[27] – creates various degrees of inefficiency in resource use and injustice in the distribution of benefits. For example, the prevalence of corruption in institutions handling land titling creates a high informal cost for those trying to register or transfer land, making land administration services inaccessible to those unable to afford the illegal costs.[28, 29]

Inexistent or **ill-defined property rights** are another prominent type of institutional failure, as they discourage investment and can lead to unsustainable resource use. For instance, farmers may have few incentives to invest in soil-preserving techniques if the land they work is not their own or can be taken from them at any moment.[17] Similarly, open-access resources can lead to the depletion of resources as a result of inexistent property rights. Fish are a case in point: they can be sustainable and replenished as long as the rate at which they are harvested is lower than the rate at which they reproduce. Without controls, every fishing vessel has an incentive to take as much fish from the ocean as it can, often at a faster rate than the fish can naturally replenish.[17] Policies and institutional arrangements are needed to guarantee proper implementation, however. If quotas do not reflect the right rate of replenishment or if institutions lack the capacity to implement them, institutional and policy failure will ensue.

Free-riding behaviour can also cause institutional failure, for example, when individual farmers who are not members of a cooperative benefit from the efforts of that cooperative to improve their position in the market, but without contributing to cooperative efforts.

Institutional failures can also be driven by **dispersed governance**, where the subnational level has some degree of separate political authority and can reduce the degree of consistency in policy delivery, as well as its effectiveness, leading to policy failure.[30, 31] For example, land and natural resource governance is often fragmented and contested by different actors, institutions and legal frameworks at local, national and global levels. This can result in conflict, insecurity, dispossession and degradation of land and natural resources, with disproportionately negative impacts on the most vulnerable.

Conflict between bureaucracies is another driver of institutional failure, which occurs when one part of the government undermines efforts by another to save resources,[24, 32] creating distrust between institutions, with negative implications for their capacity to deliver and achieve their objectives in a timely manner.

Other factors can cause policy failures, including **overly optimistic expectations** by policymakers. This happens when policymakers underestimate the time, costs and risks involved in achieving certain objectives and/or overestimate the benefits of specific policies.[30, 33] These **ill-informed policies** may not be based on robust scientific assessment. An example is when policymakers

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BOX 2 MARKET FAILURES AND AGRIFOOD SYSTEMS: DEFINITIONS AND EXAMPLES

Externalities – the effects of transactions on third parties – are a form of market failure that may negatively affect human and/or environmental health. For example, water pollution from pesticides and fertilizers can be avoided or reduced by limiting and optimizing the type, amount and timing of applications.[18] Such optimization can come at a cost to producers, however, who may choose profit over water quality.[17] This reduces the quantity of water that is safe to use, with negative consequences for society and the environment, generating hidden costs that are not reflected in the price of the goods or services produced.[19] Therefore, negative externalities – including air and water pollution, soil erosion, antimicrobial resistance and emissions of greenhouse gases – are not accounted for in GDP.

Externalities can also be positive when certain practices, such as regenerative agriculture or agroforestry, have public benefits, such as a clean environment and biodiversity. Such benefits, however, are likely to be internalized into other economic activities. For example, a clean environment can stimulate tourism, while biodiversity can spur greater crop productivity. Therefore, unlike the hidden costs arising from negative externalities, the effects of positive externalities are likely to be reflected, at least partly, in a country's GDP. Consequently, addressing positive externalities is likely to be more of a distributional issue, as those producing them may not be reaping the benefits.

Imperfect information is another form of market failure and can lead to suboptimal levels of investment in nutritious foods. It can also facilitate fraud or other forms of misrepresentation.[20] This can lead consumers to unknowingly consume ingredients that are harmful to their health or the environment. Poor information can also drive polluting behaviour by farmers who are unaware that certain techniques pollute water, for instance, or who are unfamiliar with alternative techniques that avoid pollution.

Demerit goods, such as highly processed foods of minimal nutritional value, are linked to externalities and poor information. These market failures have negative impacts on consumers, but these impacts may be unknown due to imperfect information. Sometimes, consumers ignore the negative impacts due to the satisfaction derived from consuming them.[21] They feature heavily in unhealthy diets (such as those lacking diversity and rich in fats and sugars and low in nutritional value) and can affect human health through their well-established link to obesity, malnutrition and non-communicable diseases. Consequently, they create hidden costs in the longer term, mostly in the form of labour productivity losses, and can generate externalities if the health system is sustained by taxpayers, putting a direct burden on society as a whole. Governments can discourage the consumption of demerit goods in a similar way to addressing externalities, for example, through awareness campaigns or taxes. However, there is generally less agreement on regulatory or fiscal actions to limit the consumption of demerit goods than there is on typical externalities.[19]

Market power – the relative ability of an actor to manipulate the price of a product or input[22] – is associated with market concentration and can also cause losses to society. An example is when agricultural inputs are provided by one or only a few companies, allowing them to set input prices above their marginal costs. Another example is when many farmers need to sell their outputs through a very limited number of traders, say, in wholesale markets, where wholesalers can set the output price below the marginal benefit. In both cases, market power puts agricultural producers at an economic disadvantage and can contribute to their economic marginalization, pushing them into poverty. Furthermore, social well-being is reduced, as agricultural producers are forced to operate at a suboptimal level of output, in this case, affecting food availability, an important dimension of food security in any society.

Missing markets, or market failure driven by the complete absence of a product or service, can also cause social losses, especially to vulnerable groups, increasing their marginalization. For example, in many low-income and middle-income countries, insurance and credit markets are often lacking or fail to function for smallholder producers. This affects their investment decisions and forces them to operate at a suboptimal level, with direct negative consequences for their food security and livelihoods. It also has broader implications for society in terms of lower-than-optimal output. Moreover, they do not have the opportunity to finance the adoption of technologies that enhance environmental sustainability.

Public goods are goods and services that are desired and appreciated by society, but which markets fail to provide. The government, therefore, needs to step in with support or regulation. Public goods generally have a high degree (at least) of non-rivalry and non-excludability, leaving little or no incentive for private actors to provide them. Prominent examples in the context of agrifood systems are food security and food safety. Although food itself is a private good, ensuring food security and nutrition (the continuous availability, accessibility and affordability of nutritious food) is a public good, as guaranteeing it requires public support. The same goes for food safety, which requires a public authority to set standards and enforce them.[23] Clean water, clean air and biodiversity are further examples of public goods, as adequate provision requires public support and regulation.

» act on the assumption that aquaculture can continue to grow at its present rate or even faster, so there is no need to worry about sustaining wild fish stocks, as global fish demand can be met through fish farming.[34]

Vagaries of political cycles can also create certain policy failures. Policymakers may not be held accountable for policy outcomes, as they have "either moved on or moved out".[30] However, developing sustainable and resilient agrifood systems requires investments that take time until their impact is felt on the ground, for example, in agricultural research, integrated value-chain services, and smart and green production technologies. The vagaries of political cycles can result in these investments being at lower-than-optimal levels and more aligned with shorter-term objectives.[13]

A central type of policy failure in this report – particularly in Chapter 2 – is **distributional failure**. It refers to a situation in which public policies fail to guarantee for all the population a minimum level of decent income that can protect against different forms of deprivation, such as poverty, food insecurity and malnutrition, despite the availability of resources to do so. For example, many agrifood systems workers are poor despite an abundance of profits downstream in food supply chains. What is more, around 735 million people suffer from undernourishment despite the availability of sufficient calories in global agrifood systems.[35]

In sum, market, institutional and policy failures are interlinked and can overlap depending on the context. It is essential that the hidden costs of agrifood systems – many of them rooted in market, institutional and policy failures – are analysed, assessed and valued through rigorous accounting, and that this information is used to reduce or avoid them while maximizing the benefits.[36] The consideration of evidence must, therefore, become integrated into the decision-making of governments, businesses and consumers, so that these costs to society can be managed and mitigated. The key challenge will be making this pairing part and parcel of day-to-day activities and transactions throughout agrifood systems. ■

BARRIERS TO INTEGRATING THE HIDDEN IMPACTS OF AGRIFOOD SYSTEMS INTO DECISION-MAKING

Given the wide range of effects associated with the economic activities of agrifood systems (see Figure 1) and the many different stakeholders affected, integrating all of the hidden costs and benefits into decision-making processes is not an easy task. First, there is a **lack of political will** and **resistance to change**. Decision-makers face conflicting objectives, and addressing the hidden costs of agrifood systems can require significant changes to current production and consumption practices, which may meet with resistance from governments, businesses, producers and consumers, who may prefer the status quo for fear of high transition costs or changes in habits, culture or traditions. Policymakers may also have vested interests in maintaining the status quo.

Another reason for resistance to change is the fact that trade-offs may arise. For example, the use of agrochemicals to increase production can reduce poverty, but also lead to ecological degradation over time.[37] This makes policy decisions even more complicated. There is also concern about the distributional impacts of the transition to new patterns of production and consumption. The fear that marginalized and poorer groups will be disproportionately affected could make such changes unpopular among policymakers who want to prioritize the reduction of poverty and food insecurity.[38] Already, these groups bear the greatest burdens of climate change and biodiversity loss,[39, 40] of health problems[41] and of scarcity of resources.[42, 43] Therefore, transforming agrifood systems to address key environmental stresses and health problems can involve trade-offs with improvements in social equality.

A lack of political will and resistance to change can also be driven by a dearth of sufficient data and information. As shown in Figure 1 and Figure 2, flows and impacts are numerous and many of them are difficult to quantify, while others are qualitative in nature. There is, thus, the problem of **data availability** and **quality**. A related issue is **under-reporting**, such as that of exploited labour along the value chain (for example, incarcerated and undocumented individuals), which causes estimates of underpayment and child labour to be particularly low.[44] Even if there is a willingness to tackle such problems, collecting such data requires resources, skills and capacities that are often not available.

An associated challenge is quantifying the costs of policy change, in other words, estimating the abatement costs for comparison with the benefits of reducing hidden costs.[45] Generally, the policy change is justified when the abatement costs are lower than the benefits of the change, so knowing the abatement cost is important to help guide policy direction, as this may be used to inform who will bear the costs. This raises the issue of valuing costs in a way that is practical, so that busy decision-makers – especially policymakers – can move beyond a short-term focus and adopt them at scale. However, estimating abatement costs can be an expensive exercise, as such estimates typically have a high degree of uncertainty, especially when it comes to the distributional impacts (who will pay the costs and who will reap the benefits, either directly or indirectly). Therefore, such analysis is often not performed in the first place, or if it is, it is not given much weight in decision-making, as it is hard to make a robust decision based on data with a high degree of uncertainty.

Another challenge in accounting for the hidden costs and benefits of agrifood systems is the **scope**, which relates to the geographical, temporal and product boundaries. Agrifood systems encompass complex networks of suppliers, processors and distributors, which makes it difficult to trace the origin of impacts along the way and, hence, those accountable for them. The costs generated can also relate to multiple resources (natural, human, social and produced), which, in turn, have critical interdependencies between them. This poses the challenge of **which indicators to use** to assess hidden costs and benefits. Many flows and impacts, such as biodiversity loss and social networks, are difficult to quantify (Figure 2), and therefore difficult to incorporate into valuation and decision-making. The impact of many of these hidden costs will also depend on the socioeconomic, spatial and temporal context. For example, the impact of agrifood systems on freshwater will depend on the level of water scarcity or on the water source.

Addressing these challenges will require the use of recent advances in technology and evaluation approaches, which have expanded options and reduced the resources needed to store, communicate, validate and process information.[15] It is important to invest in data collection to reduce the degree of uncertainty and improve robustness. Reporting on uncertainties can be insightful in terms of where more information and data are needed to shore up results, to make them more reliable for decision-making. There will be little progress on agrifood systems transformation if methods to improve abatement costing languish. Investing resources in achieving the disclosure of relevant information should also be prioritized.[46] ■

LEVERAGING TRUE COST ACCOUNTING: A TWO-PHASE ASSESSMENT

Assessing the performance of – and the main risks and challenges faced by – agrifood systems will be critical to guiding structural change towards agrifood systems that deliver affordable healthy diets to all while respecting environmental sustainability.[45] For such an assessment, collaboration between political, economic and social actors, including the research community, is required.[47] The challenge is to co-assess current agrifood systems to collectively rethink their future, identify possible trade-offs and synergies, devise alternative options and steer the systems onto a sustainable track, given the aforementioned barriers.

Recent advances in evaluation and accounting frameworks create an unprecedented opportunity for such comprehensive assessments through the TCA approach, which is:

a holistic and systemic approach to measure and value the environmental, social, health and economic costs and benefits generated by agrifood systems to facilitate improved decisions by policymakers, businesses, farmers, investors and consumers.[48]

The definition of TCA is broad and a variety of methods can be adopted,[b] depending on a country's resources, data, capacity and reporting systems. True cost accounting is not a new concept. Rather, it is an evolved and improved approach that goes beyond market exchanges to measure and value all flows to and from agrifood systems, including those not captured by market transactions (Figure 2). Valuation can be either qualitative or quantitative, including monetary. The four dimensions covered – environmental, social, health and economic – are reflected in the four capitals: natural, human, social and produced.

While the TCA approach is aspirational, as covering all hidden costs and benefits of agrifood systems is a massively resource- and data-intensive exercise, the aim is for policymakers and other stakeholders to avoid making decisions without a full assessment.

In this regard, the principle of "materiality" will be key (see Glossary). Generally defined as a "measure of how important a piece of information is when making a decision",[49] materiality helps focus the scope of TCA assessments on the impacts and flows that have the potential to alter a decision-making process.[37] A key application of the principle of materiality is in choosing indicators, as this is an exercise often constrained by time, resources and available data, so should be limited to those indicators that are *material* to the decision-making process.[50]

Given the challenges of collecting the necessary data and quantifying all flows across the four capitals (Figure 1 and Figure 2), already available data and information take priority for an initial understanding of agrifood systems. Such initial analyses can be used to initiate a dialogue with relevant stakeholders as to the most important issues in agrifood systems and the most urgent data gaps that need to be filled to better guide interventions. The materiality principle should then be used to determine the most important and significant impacts for which data are unavailable, so they can be collected. This can substantially reduce the quantity of unavailable data that need to be collected. The principle of materiality is particularly relevant for low-income countries and middle-income countries, where data and overall capacity are lacking and policymakers need to make decisions in the face of conflicting objectives.

With its broad capital accounting framework, TCA builds on the body of existing measurement work reflected in established international statistical standards. As far as produced and natural capital and associated flows are concerned, these standards include: (i) the System of National Accounts (SNA) and the balance of payments for the measurement of produced assets and associated flows of production, income and consumption, and (ii) the System of Environmental-Economic Accounting (SEEA) for the measurement of environmental flows (for example, water, energy and emissions) and environmental assets (for example, land, soil, timber and fish). The latter also includes extensions in terms of Experimental Ecosystem Accounting for measuring ecosystem assets, ecosystem services and biodiversity, and the recently published SEEA for Agriculture, Forestry and Fisheries (SEEA AFF) for measuring environmental assets and flows in the context of agricultural activity (see Box 3).

Initiating a two-phase process of TCA assessments

Against this backdrop, this report proposes a **two-phase assessment** using TCA to provide decision-makers with a comprehensive understanding of current and future agrifood systems and intervention areas to improve

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[b] The definition of TCA is based on that developed by a consortium of organizations, comprising the Global Alliance for the Future of Food, the United Nations Environment Programme (UNEP), which hosts The Economics of Ecosystems and Biodiversity (TEEB), and the Capitals Coalition.[48] Alternative definitions can be found in the literature (see de Adelhart Toorop *et al.* [2023] for an overview).[37]

BOX 3 TRUE COST ACCOUNTING BUILDS UPON THE WORK OF THE SYSTEM OF ENVIRONMENTAL-ECONOMIC ACCOUNTING FOR AGRICULTURE, FORESTRY AND FISHERIES

The System of Environmental-Economic Accounting for Agriculture, Forestry and Fisheries (SEEA AFF) is particularly relevant to this report, as the primary activities it analyses depend directly and have an impact on the environment and its resources. It was developed in coordination with the United Nations Statistics Division, the Organisation for Economic Co-operation and Development, the Statistical Office of the European Union (EUROSTAT), the World Bank and other partners, and was endorsed by the United Nations Committee of Experts on Environmental-Economic Accounting in 2016. The SEEA AFF focuses on the integration of data required to describe how biophysical and management information relevant to agriculture, forestry and fisheries (AFF) production can be integrated into internationally recognized statistical frameworks.

Its coverage includes monetary and biophysical data across ten primary data domains (see the table). The ten domains were selected on the basis of the AFF products according to the International Standard Industrial Classification of all Economic Activities (ISIC), the environmental assets of direct relevance to AFF activities, and the main physical flows associated with AFF activities – water, energy, greenhouse gas emissions, fertilizers, nutrient flows and pesticides – as well as data related to the production and investment activity of AFF activities within the System of National Accounts (SNA).

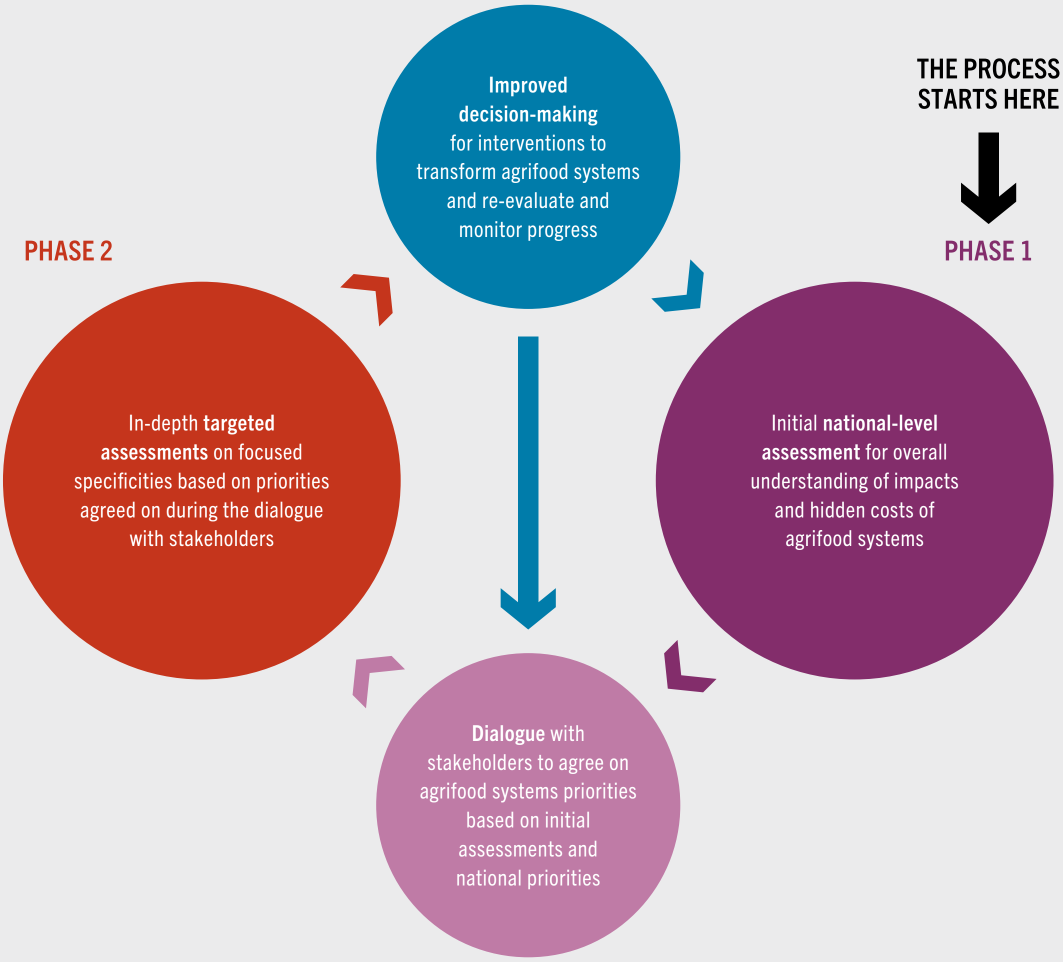
The System of Environmental-Economic Accounting (SEEA) and true cost accounting (TCA) are quite similar in spirit, in the sense that they aspire to provide an internally consistent framework to take into account flows that are not explicit in monetary flows as currently reported under the SNA. However, there is a major difference between SEEA and TCA, as set out in this report: TCA encompasses a broad range of environmental, social, health and economic outcomes and impacts. Securing these outcomes is directly related to the stock of all forms of capital – natural, human, social and produced. SEEA is more focused on produced and natural capital.

TABLE SEEA AFF: DATA DOMAINS, SCOPE OF ACTIVITIES CONSIDERED AND BASE ACCOUNTS

	Data domains	Scope by ISIC category (where relevant)	Base accounts
1	Agricultural products and related environmental assets (ISIC 01)	011 Growing of non-perennial crops 012 Growing of perennial crops 013 Plant propagation 014 Animal production 015 Mixed farming (crops and animals) 016 Support activities to agriculture and post-harvest crop activities 017 Hunting, trapping and related activities	Physical flow account for crops Physical flow account for livestock products Asset account for livestock Asset account for plantations
2	Forestry products and related environmental assets (ISIC 02)	021 Silviculture and other forestry activities (forestry) 022 Logging 023 Non-wood forest products 024 Support services to forestry	Physical flow account for forestry products Asset account for forestry Asset account for timber resources
3	Fisheries products and related environmental assets (ISIC 03)	031 Fishing 032 Aquaculture	Physical flow account for fish and aquatic products Asset account for fish and other aquatic resources
4	Water resources		Asset account for water resources Physical flow account for water abstraction Physical flow account for water distribution and use
5	Energy		Physical flow account for energy use
6	Air emissions		Physical flow account for air emissions
7	Fertilizers, nutrient flows and pesticides		Physical flow account for fertilizers Physical flow account for pesticides
8	Land		Asset account for land use Asset account for land cover
9	Soil resources		Asset account for soil resources
10	Other economic data		Monetary supply and use table for AFF products Extended production and income account for AFF activities

NOTES: ISIC = International Standard Industrial Classification of all Economic Activities; AFF = agriculture, forestry and fisheries.
SOURCE: FAO & UN. 2020. *System of Environmental-Economic Accounting for Agriculture, Forestry and Fisheries (SEEA AFF)*. Rome. https://doi.org/10.4060/ca7735en

FIGURE 3 TWO-PHASE AGRIFOOD SYSTEMS ASSESSMENT PROCESS



SOURCE: Authors' own elaboration.

» their sustainability. The assessment process is schematized in Figure 3. The cyclical depiction of the process is intended to emphasize its continuous nature, whereby improved decision-making can be viewed as the final objective, but also as the start of a new cycle of monitoring and evaluation to ensure continuous positive results. The process can be described as follows:

The **first phase** is to undertake initial national-level assessments that quantify and analyse as much as possible the hidden costs of agrifood systems across the different capitals using readily available data. The main role of the first phase is to raise awareness about the magnitude of the challenges and it can be used as a starting point to break down the hidden costs of national agrifood systems to feed discussions and dialogues with stakeholders in a certain country. This phase helps to link the hidden costs to the most urgent national priorities, such as reducing hunger or preserving scarce natural resources. It also serves to identify hidden cost categories that may be important, but which are not yet quantified, and considers the data needed to fill such gaps.

Chapter 2 of this report presents results that serve as an input to the first phase. It provides an initial national-level assessment that quantifies as far as possible the hidden costs of national agrifood systems, in a consistent and comparable way, for 154 countries. The results presented in Chapter 2 depend on the assumptions made and the data integrated into the assessment, and should not be viewed as a definitive assessment, but rather as a starting point to stimulate debate and dialogue. These results help us see the big picture of the hidden costs and their structure and dimensions. With input from in-country stakeholders and experts, the initial preliminary quantification and analysis can be improved based on country-specific information. This informs the planning for the more in-depth tailored analysis of the second phase.

The **second phase** is devoted to in-depth assessments targeting specific components, value chains or sectors of agrifood systems to guide transformational policy actions and investments in a specific country. The selection of the target sectors can be inspired by the results of the first phase, but can also be guided by country priorities per consultations with relevant stakeholders. The stakeholders involved may vary from context to context, but they are generally policymakers and research and accounting institutions (especially those with good knowledge of the country's major agrifood systems challenges), as well as representatives of key actors in agrifood systems, such as agricultural producers, processors and distributors.

Chapter 3 and Chapter 4 provide more detailed guidance on this phase, expounding how to conduct targeted assessments that would guide the actions required to address the hidden costs and improve the outcomes of agrifood systems. This second phase is not just an accounting exercise, as it requires the continuous involvement of the relevant stakeholders, from the starting step of framing the main challenges, to the implementation of any transformational plan or project. This is critical in order to collect the requisite data, validate assumptions and results, and account for the distributional impact of any consequent action to guarantee the inclusiveness of the transformation process. Therefore, consultations on priorities and sequence of interventions and their costs (that is, abatement costs), as well as who will bear them, are fundamental to this phase. Depending on the granularity of the data available, the level of detail of the analysis will vary, with qualitative analysis playing a greater role to accommodate important experiences and variables for which quantitative data are poor, unavailable or non-quantifiable.

In sum, the first phase of the assessment process proposed in this report relies on estimates obtained using a transparent and well-established methodology based on national-level open-access data, available through institutions such as the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Environment Programme (UNEP). The estimated hidden costs are expressed in monetary terms, that is, they are comparable across different capital flows, impacts and countries. They can provide comparable results across impact categories within and between countries. This can then be aggregated at global, regional and country-income levels to obtain the overall magnitude of the problem on various scales. These initial national assessments, however, are incomplete and suffer from uncertainty due to data scarcity on aspects that can be important in certain contexts. Thus, the results provided in Chapter 2 are preliminary and should be considered work in progress. The results are intended to raise awareness about the hidden costs of agrifood systems. However, to go further and be used as an input in guiding priorities at the national level, the estimates need to be evaluated by country experts, in order to reduce uncertainty in estimates and include material aspects not covered in the initial estimates of the hidden costs presented in Chapter 2.

Knowing the hidden costs is only one of the inputs needed to prioritize resources, investments and policy actions to transform agrifood systems. Guiding transformative actions requires knowing to what extent the hidden costs are avoidable or what the cost of avoiding them might be. The cost of policy change (that is, the abatement cost) requires a different type of analysis based on local information and data and should, therefore, be at the core of the second phase of the assessment.

BOX 4 THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY (TEEB): TEEBAgriFood IN A NUTSHELL

Launched in 2018, the TEEBAgriFood Evaluation Framework was designed to understand the impacts of agrifood systems and their interdependencies with the environment, society and human health.[14] It was designed with the input of more than 100 researchers, with a view to including the full range of costs, impacts and dependencies across agrifood value chains. The applications of the framework can vary depending on which costs and benefits are covered, how these are valued (for example, monetary or non-monetary) and for what purpose.[19]

Amid a shift towards multi-capital reporting among companies and finance institutions, the *TEEBAgriFood Operational Guidelines for Business*[51] support such organizations in implementing the TEEBAgriFood Evaluation Framework, so that they can understand and act on their impacts and dependencies across the four capitals. This is an important stepping stone in mainstreaming natural, social and human capital into decision-making in diversified value chains and geographies. Through assessment approaches and, in some cases, reporting, companies and finance institutions are better able to understand and manage their impacts and dependencies.

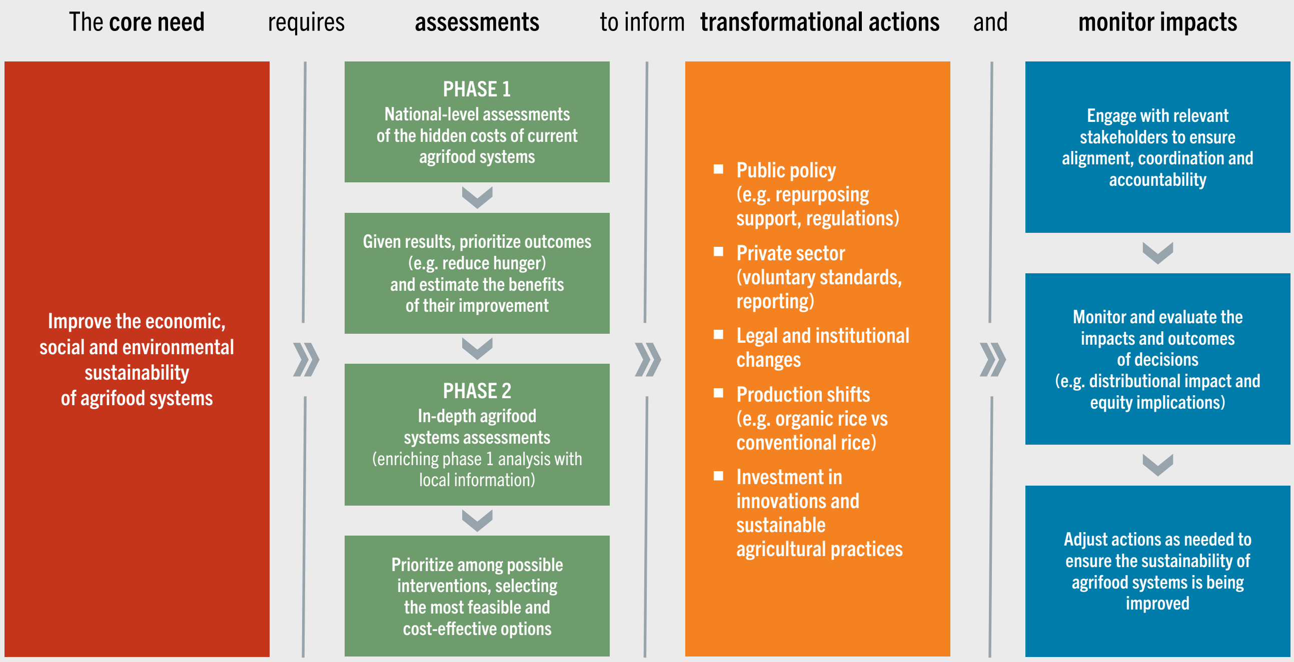
The general rule of thumb for decision-making in such contexts is that policy changes or investments are justified when the associated costs are lower than the expected benefits of reducing the damages of the current status. However, costs and benefits may be difficult to express in monetary terms in the case of environmental and social dimensions. Monetization of these dimensions can facilitate the cost–benefit analysis; however, it has its limitations and may not be the right tool to evaluate costs and benefits and make decisions. In this respect, the TEEBAgriFood Evaluation Framework is widely recognized as the most comprehensive method of applying TCA in the agrifood sector, and it is used as the overall reference for the two-phase assessment proposed in this report. See Box 4 for a brief overview of the framework.

Guiding principles of the two-phase assessment process

Figure 4 breaks down the different elements of the two-phase process for informed agrifood systems transformation. Starting from the core need to improve the economic, social and environmental sustainability of agrifood systems (red column), fulfilling this need requires assessments (green column) to help policymakers prioritize actions (orange column) that will transform agrifood systems. The assessment first involves measuring agrifood systems performance at national level, usually using indicators that have data available for a wide range of countries. This will allow decision-makers to identify the most important desirable outcomes (for example, lower obesity) and to quantify the benefits of achieving them. The second phase of the process is to conduct more targeted assessments at a sectoral or subnational level. The assessment identifies the different transformational actions needed, comparing the costs and benefits of each in order to allocate resources to the most feasible and cost-effective ones.

Careful monitoring of actions will be needed (blue column), using indicators that reflect the environmental, social, health and economic dimensions. This way, decision-makers can assess the distributional impact and equity implications, such as who will benefit, and who will bear the costs of change. Engagement with relevant stakeholders to ensure alignment of interests, coordination of actions and accountability of results will be key. Lastly, actions should be adjusted to ensure their closest possible alignment with the initial core need. ■

FIGURE 4 PROCESS OF INFORMED AGRIFOOD SYSTEMS TRANSFORMATION



SOURCE: Authors' own elaboration.

LAYING OUT THE SCOPE OF THE REPORT

This chapter has highlighted the importance of assessing the impacts of agrifood systems to generate evidence and trigger processes to transform agrifood systems and make them (economically, socially and environmentally) sustainable, and to ensure food security and nutrition for all. Special attention needs to be paid to providing and safeguarding decent livelihoods and incomes for all. On the environmental side, it highlights the need to transform the ways in which we produce, process, store, distribute, consume and dispose of foods. To this end, the chapter presents a conceptual framework that clarifies how agrifood systems impact and depend on natural, human, social and produced capitals, and how and which policy levers can be used to better influence them.

It recognizes that it is an aspiration to be able to assess all hidden costs and benefits, as this is an incredibly resource- and data-intensive exercise. Instead, a two-phase process that gradually moves from preliminary national-level agrifood systems assessments towards more targeted evaluations is more realistic and advisable. This is particularly true for low- and middle-income countries, where data and overall capacities are lacking and policymakers need to make decisions amid conflicting objectives.

Against this backdrop, the chapter recognizes TCA as a fitting approach to assessing the impacts of agrifood systems. However, to achieve agrifood systems transformation, accounting is just part of the process. The transformational process further involves the realignment and/or deployment of levers – such as price incentives, regulations and voluntary standards – that influence the inner workings of agrifood systems. Decisions should involve relevant stakeholders to ensure the alignment of interests, the coordination of actions, and accountability.

The rest of the report is organized as follows: Chapter 2 provides national-level estimates of the hidden costs of agrifood systems for 154 countries as an input to phase one of the two-phase assessment process. The results are preliminary, thus, a starting point for raising awareness and initiating a dialogue with national policymakers. Given the substantial hidden costs identified in Chapter 2, Chapter 3 provides guidance on how to move towards more targeted assessments that are action oriented and which take into account country-specific information from stakeholders and experts (that is, the second phase of the assessment process). The focus of Chapter 4 is on how to scale up the use of TCA and how policymakers and other stakeholders can leverage TCA results to employ different transformational levers and drive change towards more sustainable agrifood systems.

With this report, FAO is paving the way for agrifood systems assessments to be part and parcel of decision-making, with a positive effect on sustainability. It will raise awareness of their centrality to agrifood systems transformation and mobilize resources to scale up their application.

The 2024 edition of *The State of Food and Agriculture* will build on this and aim to catalyse action and agrifood systems transformation by providing concrete examples of the targeted assessments, showcasing how these affect agrifood systems change. Notably, it will provide insights into how TCA can be a useful complementary tool to support decision-making across a range of value chains and countries, even in data- and resource-constrained contexts. ■

UKRAINE
Combine harvester at work in a wheat field near Krasne village.
©FAO/Anatolii Stepanov

CHAPTER 2

UNCOVERING THE HIDDEN COSTS OF AGRIFOOD SYSTEMS FROM NATIONAL TO GLOBAL SCALE

KEY MESSAGES

➔ A novel true cost accounting analysis of 154 countries provides preliminary estimates of the "quantified hidden costs" of agrifood systems. Referring to them as "quantified" acknowledges the data gaps in many countries that prevent the estimation of all hidden costs, such as those associated with pesticide exposure and land degradation.

➔ The analysis finds that the global (environmental, social and health) quantified hidden costs of agrifood systems were approximately 12.7 trillion dollars at purchasing power parity (PPP) in 2020, equivalent to almost 10 percent of world GDP in PPP terms.

➔ Even taking uncertainty into account, global quantified hidden costs have a 95 percent chance of being 10 trillion 2020 PPP dollars or more, highlighting the undeniably urgent need to factor these costs into decision-making to transform agrifood systems.

➔ Globally, 73 percent of the quantified hidden costs in 2020 were associated with dietary patterns that led to obesity and non-communicable diseases (NCDs), causing labour productivity losses.

➔ The quantified environmental hidden costs from agriculture, accounting for more than 20 percent of quantified hidden costs, are equivalent to almost one-third of agricultural value added.

➔ On the social side, it is estimated that the incomes of the moderately poor working in agrifood systems need to increase by, on average, 57 percent in low-income countries and 27 percent in lower-middle-income countries, to ensure they are above the moderate poverty line, thus reducing food insecurity and undernourishment.

➔ Finding that unhealthy dietary patterns are the main contributor to global hidden costs should not steer attention away from the environmental and social hidden costs. Rather, it emphasizes the importance of repurposing support to transform agrifood systems to deliver healthy and environmentally sustainable diets to all.

➔ The quantified hidden costs pose a greater burden relative to national income in low-income countries, where they are equivalent, on average, to 27 percent of GDP (in large part due to poverty and undernourishment), compared with 11 percent in middle-income countries and 8 percent in high-income countries. Addressing poverty and undernourishment remains a priority in low-income countries.

➔ These preliminary results suggest there is considerable variation from country to country in the relative importance of environmental, social and health hidden costs, underscoring the need to produce national estimates of hidden costs and improve them with country-specific information, so they can be a useful input in decision- and policymaking processes.

As mentioned in Chapter 1, underpinning the unsustainability of agrifood systems are costs that are hidden behind price tags and go unaccounted for by agrifood systems actors. These hidden costs – including water pollution, biodiversity loss and NCDs – are driven by negative externalities and other market failures (or their spillovers), as well as by policy and institutional failures. The key to transitioning agrifood systems towards sustainability is to measure and value these hidden costs across the environmental, social and health dimensions.

Economic costs pertaining to produced capital, in contrast, are commonly included in economic assessments, so are already visible. Accounting for hidden costs requires a comprehensive approach that captures the complexity and interdependence of agrifood systems actors, activities and impacts. Chapter 1 introduces **true cost accounting (TCA)** as a fitting approach to identify these hidden costs. However, such an approach is often hampered by data gaps, methodological limitations and institutional barriers. Moreover, there are insufficient common metrics and indicators to enable comparison and aggregation at different dimensions and geographical scales (local, national, regional and global).

To counter these challenges, Chapter 1 proposes a two-phase process for analysing and quantifying the hidden costs of agrifood systems across the different capitals (see Figure 3). This chapter serves as a starting point for the first phase of this two-phase process by conducting preliminary national-level quantification of the hidden costs of agrifood systems for 154 countries. It uses various national-level datasets – including FAO's Corporate Database for Substantive Statistical Data (FAOSTAT), the World Bank's World Development Indicators, the Global Burden of Disease database and the Ecosystem Services Valuation Database.[c]

Quantification involves combining impact modelling with monetary estimates to value (monetize) the hidden costs. This enables the results to be aggregated and compared at different dimensions and geographical scales and to be used as a foundation for dialogue with decision-makers. In this exercise, both hidden costs *and* benefits are factored in as much as possible. For simplicity, the term "**hidden costs**" refers to *net* hidden costs in a given dimension, with hidden benefits expressed as *negative* hidden costs. An example of a negative hidden cost in the climate change dimension would be a farmer's conversion of pastureland or cropland to forestland: while this reduces GHG emissions, the farmer does not receive compensation for it.

It is important to note that, despite their importance in generating national dialogue, the estimates presented in this chapter are just a first step in facilitating the two-phase process. These preliminary estimates of the hidden costs of national agrifood systems are only one possible starting point for the first phase, which aims to create an understanding of the big picture of how agrifood systems function and the challenges they face. Such an understanding is advisable before moving to the second phase, which is dedicated to more in-depth national (and subnational) analysis. Depending on the context, phase two assessments may be conducted without an initial quantification of hidden costs across all capitals at national level. This quantification, however, creates an unprecedented opportunity to support decision-makers worldwide in pinpointing the broad (hidden) challenges faced by their systems and initiate a process to construct a joint vision for agrifood systems transformation.

Despite the value of monetization in revealing the relative magnitude of hidden costs across different agrifood systems outcomes and in expressing the (upper bound of the) benefits of improving those same outcomes[d] – for example, reducing hunger, malnutrition, obesity, food waste, GHG emissions and biodiversity loss – monetary valuation also poses multiple challenges and limitations. First, some aspects of human well-being or natural capital are intangible, priceless or irreplaceable, so it is impossible or undesirable to assign a monetary value to them. Examples include cultural identity, recreation and social relations. Furthermore, valuing the loss of an individual human life raises a moral dilemma. What seems more defensible is to value the loss of productivity and income arising from illness or decreased life expectancy, thus valuing the "economic component" – and the economic component alone – of health outcomes, for example.[3]

With regard to food's intangible value, such as cultural identity associated with agrifood systems, the report acknowledges that such benefits are important, even if not monetized. The value to society of agrifood systems is probably

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[c] See **Annex 1** and Lord (2023)[1] for a complete description.

[d] It is an upper bound because the marginal cost of abating hidden costs will increase as the situation improves. For example, the cost of reducing food loss increases as less food is lost along the value chain, making it very difficult (if not impossible) to completely eradicate food loss.[2]

well beyond that measured as its value added to GDP. However, the focus here is on how to transform agrifood systems so that they deliver even greater value to society. The challenge, therefore, lies in how to transform agrifood systems so as to mitigate the hidden costs and enhance the benefits that can be quantified. Accounting for the hidden impacts of these systems is a first crucial step.

Against this backdrop, this chapter provides a first estimate of the (environmental, social and health) hidden costs of national agrifood systems for 154 countries. It further clarifies the ways in which the estimates presented here are an improvement on existing studies, while recognizing that current estimates are still preliminary and partial, in that they do not capture all the impacts and interdependencies of agrifood systems. Rather, they provide an indicative and illustrative picture of the magnitude and distribution of hidden costs at global, national and income levels and are, therefore, a potential starting point for dialogue with relevant decision-makers. For transparency, the hidden costs estimated herein are referred to as "quantified hidden costs" to acknowledge the data limitations involved. ■

AN IMPROVED METHODOLOGY FOR ESTIMATING THE HIDDEN COSTS OF AGRIFOOD SYSTEMS

The hidden costs of agrifood systems affect the well-being of current and future generations and are often borne by those who do not benefit from the economic activities responsible for those costs. By taking a TCA approach, it is possible to make these hidden costs visible and accelerate the transformation of agrifood systems for the better.

Previous studies have attempted to estimate hidden costs at a global level, using values from existing literature. However, combining estimates from different studies with very different underlying assumptions and methodologies – from different future trajectory assumptions to different discount rates, ecosystem service values, disease costs and measures of well-being – comes at the expense of economic rigour and consistency, and only provides estimates at the global level, thus preventing a comparison of national economies.

This year's *The State of Food and Agriculture* proposes an improved methodology to value the hidden costs of agrifood systems, based on a model developed by Steven Lord at the University of Oxford Environmental Change Institute for the Food System Economics Commission (FSEC).[e, 1] The model was paired with FAOSTAT and other global sources that contain data for multiple countries and time periods on, for example, GHG and nitrogen emissions, land use, the burden of disease from dietary patterns, and poverty. The model thus estimates the annual hidden costs of national agrifood systems across various dimensions for a total of 154 countries.

The estimates of the different hidden cost categories are based on a common set of national growth rates, costs of burden of disease, future economic and demographic conditions, and ecosystem service values; this improves consistency and the ability to perform a sensitivity analysis of costs at different discount rates and costs of disease. Hidden costs are presented as a monetary measure of losses attributable to declines in productivity or to environmental damages that are comparable with GDP PPP, which is based on market transactions. As the modelling is at national level, it allows the aggregation of results at global, regional and income levels.

However, valuing the hidden costs of agrifood systems involves making several assumptions and choices that can affect results and their interpretation. Before analysing the magnitude of the problem, it is necessary to lay out the key assumptions that need to be made for valuing hidden costs and ensuring comparability across cost categories and countries. This is done in the next section, followed by a discussion on how the estimates presented in this report differ –

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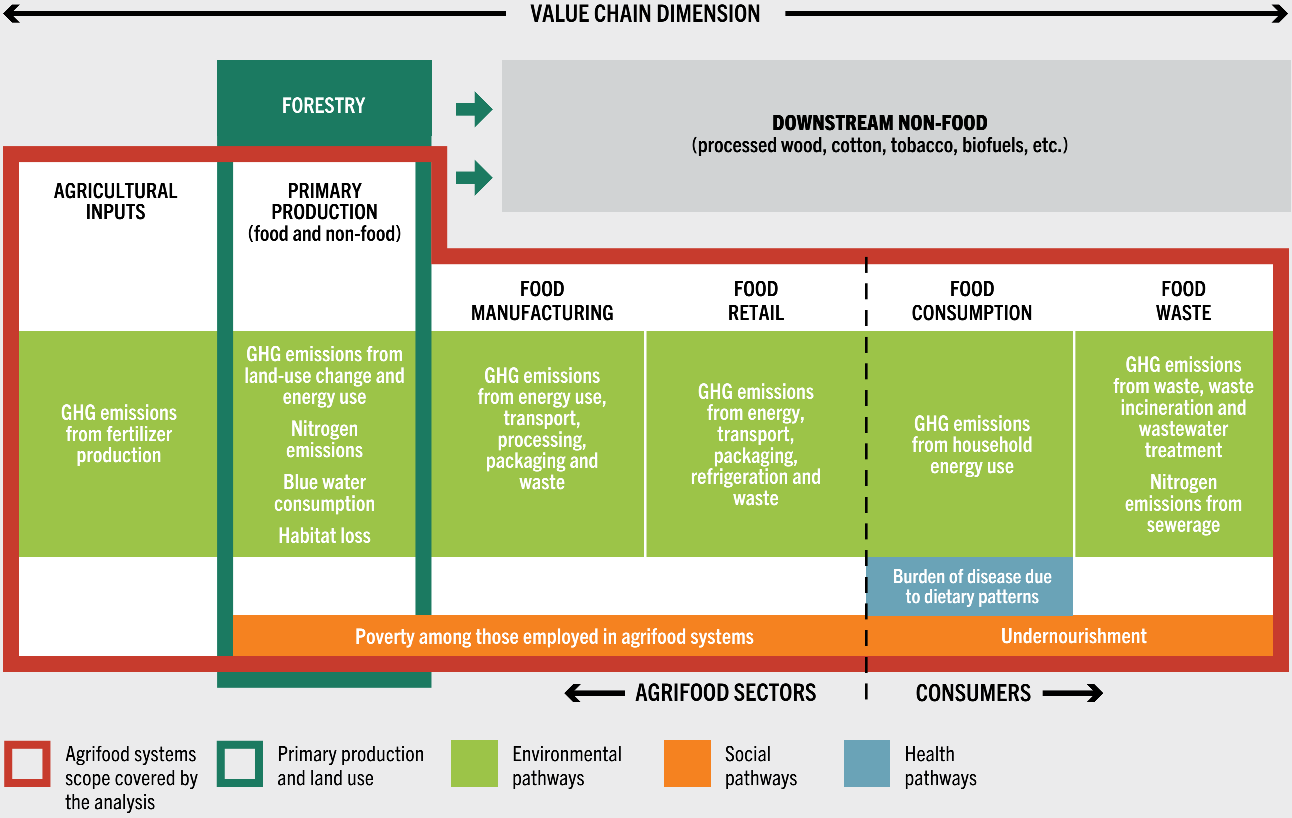
[e] FSEC is an independent academic commission set up to equip political and economic decision-makers with tools and evidence to shift food and land-use systems.[4]

FIGURE 5 SCOPE OF THE ANALYSIS: AGRIFOOD SYSTEMS STAGES AND PATHWAYS THROUGH WHICH HIDDEN COSTS MANIFEST



NOTES: GHG = greenhouse gas. For more information on the scope of the analysis, data sources and valuation, see **Annex 1**.
SOURCE: Lord, S. 2023. *Hidden costs of agrifood systems and recent trends from 2016 to 2023 – Background paper for The State of Food and Agriculture 2023*. FAO Agricultural Development Economics Technical Study, No. 31. Rome, FAO.

and expand on – previous efforts to estimate the hidden costs of agrifood systems.

Defining the scope of the analysis

The first assumption concerns what parts of agrifood systems and their impacts are included in the analysis and how different economic actors come into play, by either imposing costs on society or bearing them. Figure 5 illustrates the scope of agrifood systems covered by the analysis, as well as the hidden costs considered. The definition of agrifood systems follows that of FAO (2021)[5] (see Glossary), with the exception of the inclusion here of (non-food) input supply chains, such as fertilizer. The latter are included to the extent that they produce environmental externalities.

The scope of the study is defined in the figure by the solid red border. Beyond agricultural input supply chains, it further includes the stages of primary food production, manufacturing, retail, consumption and waste. Non-food supply chains downstream of primary production (grey box) are excluded from the definition of agrifood systems used herein and, thus, from the analysis. The processing of forestry and non-food products is accounted for in other sectors of the economy, as indicated by the green arrow.

BOX 5 HALTING FOREST DEGRADATION IS CRUCIAL TO ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS, BUT IT IS DIFFICULT TO QUANTIFY

Forest degradation reduces the provision of forest goods and services, biodiversity values, productivity and health. It may also negatively affect other land uses (for example, by causing a loss of downstream water quality and affecting groundwater recharge) and be the source of greenhouse gas (GHG) emissions. Consequently, halting forest degradation is a crucial element in reversing the drivers of climate change, biodiversity loss, land degradation, desertification and threats to human health.[6]

A recent study estimated that, between 2003 and 2019, degradation accounted for 44 percent of forest carbon losses in the Brazilian Amazon, compared with 56 percent from deforestation.[7] Human activities including logging, fire, mining and oil extraction – many of them occurring illegally – are increasingly significant drivers of forest degradation and, consequently, emissions in the region. These are being compounded by natural disturbances and the indirect impacts of deforestation. Another study looked at the drivers of forest degradation in developing countries and identified timber extraction and logging as the largest drivers of degradation in Asia and Latin America, responsible for more than 70 percent of all forest degradation. In Africa, in contrast, fuelwood collection and charcoal production are the main sources of degradation, while they are of small to moderate importance in Asia and Latin America.[8]

Preventing forest degradation is, therefore, important to reducing GHG emissions and preserving vital goods and ecosystem services. Despite its significance, however, it is undervalued in economic assessments, partly because a widely applied definition of forest degradation is unavailable and data are scarce.[6] More data are needed to fully assess the costs and benefits of restoration policies and actions. The Global Forest Resources Assessment is a first step towards this goal, with countries asked to indicate the definition of forest degradation they use in assessing the extent and severity of forest degradation.[9] Mainstreaming this accounting exercise and making the estimates publicly available will be the next step in ensuring that forest degradation is included in future comprehensive true cost accounting analysis, such as the one done for this report.

Forestry (dark green box) is also a primary production sector within agrifood systems, which contributes both wood and non-wood forest products. However, it is outside the scope of the analysis, as estimates of the hidden costs associated with forestry-related economic activities, such as logging or the harvesting of non-wood products, were not available. Although this is a limitation, it is not a major one, as in most cases, the changes in the natural capital associated with forests are associated with land-use change, which is included in the analysis. Consequently, in the analysis, deforestation – that is, the conversion of forest to other land use,[6] such as pasture – is accounted for as a hidden cost and afforestation as a hidden benefit. The transition between unmanaged and managed forest is not considered, as these are not identified separately in satellite data on land use. This implies, for example, that forest degradation – that is, the long-term reduction of the overall supply of benefits from forests – associated with human activities is not taken into account, even if it is probably increasing and a significant source of emissions (see Box 5).

That being said, the analysis covers costs from GHG emissions, nitrogen emissions, blue water use, land-use transitions, and poverty, as well as productivity losses from dietary patterns, and undernourishment. Due to data gaps, pesticide exposure and land degradation are not considered. It is important to note that hidden costs differ from abatement costs; the latter refer to the costs incurred to avoid or reduce hidden costs, while hidden costs estimate the costs of inaction. Even though both hidden and abatement costs are needed for informed decision-making to transform agrifood systems, due to the difficulty of envisioning abatement actions for a large number of countries and costing them in a comparable and consistent manner, only the former are partially included in this analysis.

The quantified hidden costs presented in this report are generated by agrifood systems activities through three main pathways, identified using different colours in Figure 5:

- **Environmental** (green box) – as a result of (i) GHGs emitted along the entire food value chain from food and fertilizer production and energy use, which contribute to a changing climate and, consequently, agricultural losses; (ii) nitrogen emissions at primary production level and from sewerage; (iii) blue water use, causing water scarcity and, in turn, agricultural losses and labour productivity losses from resulting undernourishment; and (iv) land-use change at farm level, causing ecosystem degradation and destruction and, thus, loss of environmental services.
- **Social** (orange box) – associated with (i) distributional failures of available food supply, resulting in undernourishment in national populations (as defined by FAO *et al.* [2022]),[10] leading to labour productivity losses as estimated by the World Health Organization (WHO);[11] and (ii) moderate poverty among agrifood workers due to distributional failures in agrifood systems. Recalling Chapter 1, a distributional failure captures a situation where public policies fail to guarantee a minimum level of decent income despite the availability of resources to do so. It can be interpreted as the amount society would pay for the elimination of the economic damages of poverty, assuming such a payment were cost effective up to the international moderate poverty line.
- **Health** (blue box) – as a result of consuming unhealthy diets, which are typically low in fruits, vegetables, nuts, wholegrains, calcium and protective fats, and high in sodium, sugar-sweetened beverages, saturated fats and processed meat.[f] These diets are associated with obesity and NCDs, leading to productivity losses, negatively impacting the economy.[1]

  Consumption of unhealthy diets may be due to constrained economic and/or physical access to a variety of nutritious foods. For example, estimates from 2019 find that healthy diets were out of reach for approximately 3 billion people and up to 1 billion people are at risk of losing access to healthy diets if a shock to real incomes occurs.[12, 13] Consumption may also be influenced by a variety of individual (for example, preferences, knowledge, motivations), social (for example, traditions, social norms and pressures) and commercial (for example, food promotion, placement and advertising, cultural factors) considerations.[10]

It is important to distinguish pathways from impacts. A pathway captures the drivers of an impact and can therefore provide entry points for action to address said impact. To illustrate, a hidden cost may be generated through an environmental pathway but its negative consequences manifest beyond the environment. Water pollution is a case in point: it negatively impacts the environment through the loss of ecosystem services, but also health through burden of disease from intake of polluted water. These two negative impacts, however, are considered environmental hidden costs because both are generated through an environmental pathway, and therefore the entry point for addressing them remains within the environmental domain.[g]

For this reason, unhealthy dietary patterns and undernourishment are considered health and social hidden costs, respectively, despite both relating to diet and food consumption. For the purpose of this analysis, unhealthy dietary patterns indicate the combination of foods associated with increased obesity and NCDs.[14] Diets that do not meet the minimum caloric intake and result in energy–protein malnutrition are instead captured through the hidden costs from undernourishment.[h] Both result in productivity losses affecting national economies, but the drivers differ significantly. Undernourishment is driven by extreme

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[f] For the purpose of this report, the focus is on this specific set of unhealthy diets. More broadly, unhealthy diets are defined as diets that do not meet one or more of the principles of a healthy diet (see Glossary).

[g] For this reason, hidden costs referred to herein are categorized as environmental, social or health *hidden* costs, as opposed to *hidden* environmental, social or health costs.

[h] The estimate of hidden costs from undernourishment is likely an underestimate, as it leaves out issues arising from inadequate micronutrient content.

deprivation, limiting access to even a basic energy-sufficient diet due to distributional failures. The hidden costs generated by unhealthy dietary patterns, on the other hand, are due to the consumption of too many calories – or of calories in the wrong proportions – a behaviour that is driven by a combination of economic, social, cultural and individual factors. For this reason, hidden costs from unhealthy dietary patterns are linked to the health dimension, while those from undernourishment fall under the social dimension, alongside poverty, which is also a result of distributional failure. For example, a recent analysis of 136 countries shows that addressing undernourishment can be achieved through income distributional policies, as the cost of an energy-sufficient diet is far below the average per capita disposable income for food in almost all countries.[13] However, addressing unhealthy dietary patterns requires a range of transformative actions in agrifood systems.

It is also important to note that direct costs, such as treatment costs, whether caused by unhealthy dietary patterns or undernourishment, are excluded. These are typically visible economic exchanges within the economy and, therefore, not considered a hidden cost.

In sum, agrifood systems activities lead to hidden costs that place a burden on national economies and that can be compared with GDP. These hidden costs are evaluated as agricultural losses, productivity losses and losses of ecosystem services through three different pathways. The hidden costs along the food value chain refer to both physical attribution and financial distribution failures. The former is exemplified by where the environmental impacts occur (Figure 5, in green) along a value chain, while an example of the latter is the income shortfall to the moderate poverty line for agrifood workers, despite substantial downstream profits for wholesalers, processors and retailers of food products. Along the same lines is the distributional failure leading to caloric deficiency of the undernourished, despite large surpluses in available global calories (Figure 5, in orange). As noted before, some important parts of these hidden costs are not captured in the analysis due to data constraints. This has implications for the interpretation of the results, as presented and discussed later in the chapter.

It needs to be stressed that the hidden costs quantified here are only part of the story, so overall hidden costs will tend to be underestimated. For example, the hidden costs generated by food consumption are captured by unhealthy dietary patterns only. In other words, the analysis covers only the burden of disease resulting from the consumption of unhealthy diets. Hidden costs generated by, for example, zoonotic diseases or the consumption of unsafe food (food containing microbiological, chemical or physical hazards that cause illness or even death) are not covered due to the lack of a globally harmonized set of figures with national data. However, such costs may be substantial. A recent study suggests that there could be as much as USD 95.2 billion of productivity losses due to unsafe food in low- and middle-income countries. This number is likely to be underestimated because it does not include losses triggered by disruptions to food supply chains due to food safety hazards, when discovered.[15]

Social hidden costs, or the costs experienced by social capital, are also likely to be underestimated in this report – as expressed by the income gap of the moderately poor plus the productivity losses resulting from the burden of disease caused by undernourishment. For example, the hidden costs generated by birth defects, infant mortality, low birth weight and infectious disease morbidity driven by undernutrition are not covered – despite representing a clear loss to society – as these are challenging to fit into an economic framework focused on economic flows. These unquantified hidden costs can be substantial, especially in low-income countries and some lower-middle-income countries, but only manifest themselves in economic flows once children are grown. Box 6 describes some of these important assumptions, such as those on measurements of well-being, discounting and other aspects of the analysis for this report. For a more comprehensive description of the model, data sources and assumptions undertaken in this analysis, see **Annex 1**.

Overall, the work prepared for this report should be seen as part of a broader process, whereby the estimates presented should be considered preliminary and serve mostly to

BOX 6 WHAT IS BEHIND THE NUMBERS IN THIS REPORT?

Estimating the global and national hidden costs of agrifood systems requires clear assumptions, particularly as regards scenarios; discounting to account for future generations; measuring well-being in monetary terms for a reference year to ensure comparability and aggregation; data; and valuation factors.

Discounting helps to account for hidden costs that future generations will bear. The model used to estimate the hidden costs for this report – known as the SPIQ-FS model[16] – assumes a business-as-usual socioeconomic pathway (also known as SSP2 – second shared socioeconomic pathway).[17] To compare different hidden costs, the data are converted to a common monetary measure of societal welfare loss due to productivity losses. Monetary values are measured in GDP based on PPP for the year 2020, enabling comparability and the aggregation of results across cost categories and economies. This improves the ability to examine trade-offs between cost categories, such as environmental and health costs.

Another central assumption concerns which valuation factors to use, such as how to monetize the impacts of agrifood systems activities. The difference between market prices and shadow prices is important. Market prices are based on visible economic activities and exchanges, while shadow prices reflect the change in the value of an economic activity associated with one more unit of a resource. In this report, shadow prices are used for the marginal valuation of hidden costs, such as water pollution, nitrogen emissions, obesity and malnutrition. These are then compared with national GDP.

Different studies will make different assumptions as to how to value a dimension such as social harm, which is connected to who bears the cost. Here, social hidden costs are expressed as a combination of the impact on productivity of lost labour days associated with undernourishment and the financial transfers that would be needed to avoid moderate poverty of people working in the agrifood sector. The rationale is that these are quantities that are relatable to the economic flows measured by GDP. An alternative used in Food and Land Use Coalition (FOLU) (2019)[18] is to measure the impact of undernutrition as proxied by a loss in global disability-adjusted life years (DALYs) related to child growth failure and multiply it by the global average GDP per capita, which is an indirect way of imputing productivity losses.

The most important limitation of this analysis is that data may be incomplete or uncertain for some countries, regions and types of cost. This is especially true for ecosystem services valuations and nitrogen costing, involving large uncertainty, and for the economic consequence of reduced environmental flows, for which a lack of global data limits the estimation of costs of blue water use. In some cases, the modelling of issues such as soil erosion and antimicrobial resistance is not available, making the analysis less comprehensive in the costs considered.

Ultimately, the assumptions used in true cost accounting analyses, such as those on well-being, discount rates, and reference year, alongside the use of different data sources, will invariably result in a fundamental variation in estimates of hidden costs of agrifood systems. Yet, the model used for this report relies on shared assumptions about national growth rates, costs of burden of disease, future economic and demographic conditions, and ecosystem service values, allowing for better consistency and an ability to perform sensitivity analyses at different discount rates and disease costs. Furthermore, the historical cost data used in the model allow the expression of the inherent uncertainty in hidden costs as probability distributions and the reflection of the range of possible values and outcomes.

contribute to the first phase of the proposed two-phase assessment. Even if preliminary and incomplete, they should help spark a dialogue with decision-makers about the magnitude of the hidden costs of agrifood systems and how these relate to countries' priorities.

Comparing the newer estimates with previous studies of the hidden costs of agrifood systems

There have been various attempts to estimate the hidden costs associated with global agrifood systems. A previously mentioned 2019 study by the World Bank estimated the hidden costs of foodborne diseases (from unsafe food) in low- and middle-income countries and found these to amount to USD 95.2 billion.[15] Another prominent study by Springmann (2020),[19] developed as a background paper for FAO *et al.* (2020),[14] estimated health- and climate-related hidden costs by the year 2030 and 2050. The study used dietary patterns as a lens and considered four alternative healthy dietary patterns to measure by how much hidden costs would be reduced compared with current dietary patterns. Neither study, however, covers all hidden cost dimensions (environmental, social and health). Springmann (2020), for example, despite covering 157 countries, excluded the social dimension, as well as important environmental and health hidden costs.

To date, only two other studies have attempted to estimate the hidden costs of global agrifood systems in a more comprehensive way and are, thus, the focus of this section: FOLU (2019)[18] and Hendriks *et al.* (2023).[20] Table 1 compares the two relevant studies with the methodology used for this report. It details the different cost categories and how these were estimated, reports the total quantified hidden costs obtained and indicates whether a measure of well-being and future projection were specified. By highlighting which hidden costs are quantified in the studies, the table also allows for transparency with regard to which costs are excluded from the analyses.

Although a comparison across the three studies is not completely straightforward, Table 1 illustrates how the three studies differ in scope, methods, assumptions and, ultimately, results. Looking only at the final estimate of the total quantified hidden costs of agrifood systems, it might appear that this report and FOLU (2019) adopted a similar methodology, given their similar results of around USD 12 trillion, when, in reality, there are important differences.

To begin with, this report recognizes the great level of uncertainty in its estimates – that is, the possible variation of the estimated hidden costs – and provides a range for that uncertainty, which FOLU (2019) does not. Specifically, it models uncertainty in environmental external costs, poverty and productivity losses from dietary patterns, and undernourishment. FOLU (2019) is the most comprehensive assessment of the three in terms of dimensions covered. However, this broad coverage comes at the expense of economic rigour: the study relies on combining estimates from different studies with very different underlying assumptions and methodologies. It also relies on global averages for costs with significant regional variations or marginal effects. It further includes about USD 2 trillion in non-marginal damage estimates for pollinators and AMR, which are not suitable for the counterfactual (scenario) analysis needed for subsequent decision-making (discussed in Chapter 3).[i] Lastly, FOLU attributes all obesity costs and a substantial rural poverty gap valuation to agrifood systems without considering how these are affected by outside factors, such as socioeconomic status and metabolic factors in current obesity rates, or the role of other sectors of the economy in affecting poverty. In contrast, this report attributes only half of obesity costs to agrifood systems, uses a lower poverty threshold, and attributes poverty gaps that are borne by people employed in the agrifood sector (not necessarily rural).

Hendricks *et al.* (2023) report the highest estimate of hidden costs – about USD 19 trillion – and an even larger range of uncertainty. The study is more focused than the FOLU study, but its estimates remain at the global level and do not consider important hidden costs, such as those associated with poverty and undernourishment. The monetization of environmental hidden costs is based on valuation factors for restoration and compensation costs presented in Galgani *et al.* (2021),[21] while the loss of human life and loss of health are valued using a single median and average global value, respectively. Unlike its counterpart, the study also considers mortality, which further explains its higher valuation of health costs relative to those estimated for this report. Indeed, this report only considers productivity losses associated with forgone labour and informal care and adjusts these to GDP PPP.[j]

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[i] For example, in FOLU, the value of pollinators is provided by the value of all crops that rely on pollinators. This does not allow the estimation of the value of avoiding, for example, a 10 percent decrease in the number of pollinators, which is what would interest policymakers.

[j] The advantage of estimating productivity losses relative to GDP PPP – as opposed to the willingness-to-pay-for-health valuations in the other two studies – is that these can be directly compared with current and future potential GDP and, therefore, with other potential investments. They can also be compared with other impacts that are costed in GDP terms (such as GHG emissions).

TABLE 1 COMPARING EXISTING STUDIES ON THE GLOBAL HIDDEN COSTS OF AGRIFOOD SYSTEMS

Dimension	Hidden cost or benefit	FOLU (2019)	Hendriks *et al.* (2023)	Lord (2023) for *The State of Food and Agriculture*
ENVIRONMENTAL				
	GHG emissions	Global emissions from food systems (includes deforestation) multiplied by global average abatement cost (USD 100/tonnes CO_2e)	Contribution to climate change	Economic damages of climate change assuming optimal future abatement
	Air pollution (NH_3 and NOx) – health impact	Includes air pollution based on loss of productive life due to overall particulate matter and ozone pollution (assumes food-related nitrogen emissions to have same share as food GHG emissions) and loss in DALYs due to cooking fuels of agricultural origin	Mortality and disability (from NH_3 only)	Productivity losses in the country of emission due to burden of disease from particulate matter formation from farm-gate nitrogen emissions
	Air pollution (NH_3 and NOx) – environmental impact		–	Agricultural and ecosystem service losses from nutrient imbalance and acidification from terrestrial and aquatic deposition affecting biodiversity; uses ESVD data
	Water pollution (nitrates) – health impact	–	–	Productivity losses in the country of emission due to burden of disease from human nitrate intake (from fertilizer runoff and human sewerage)
	Water pollution (nitrates) – environmental impact	Water contamination and biodiversity costs from eutrophication caused by fertilizer runoff	Biodiversity loss	Riverine and coastal ecosystem service losses from acidification, eutrophication, and biodiversity loss (from fertilizer runoff and human sewerage); uses ESVD data
	Phosphorous water pollution	–	Biodiversity loss	–
	Pesticide exposure	Loss of productive life measured by DALYs caused by application of pesticides; valued at global average GDP per capita	–	–
	Blue water scarcity	25 percent of total global annual freshwater withdrawals is unsustainable and is valued at global average annual scarcity cost of water (USD 1.15 per m³)	Depletion of scarce water	Agricultural losses and productivity losses due to burden of disease from protein–energy malnutrition in the present and future in NPV, due to water deprived from economic use
	Land use	Global average of economic value (per hectare) of ecosystem services multiplied by amount of land use change; uses ESVD data	Biodiversity, ecosystem services: cost to restore or compensate costs depending on reversibility of damage	NPV of present and future returned ecosystem services lost from habitat loss, or from habitat return (e.g. abandoned agricultural land); uses ESVD data
	Land degradation	Total global area of degraded land multiplied by loss in value of production based on global estimates of yield loss	–	–
	Antimicrobial resistance (AMR)	Total global annual GDP loss attributable to AMR (NPV 2010–2050)	–	–
	Overexploitation of biological resources	Includes total annual economic cost of over-fishing beyond maximum global sustainable yield and economic loss from global average yield reduction from loss of pollinators	–	–

TABLE 1 (Continued)

Dimension	Hidden cost or benefit	FOLU (2019)	Hendriks *et al.* (2023)	Lord (2023) for *The State of Food and Agriculture*
SOCIAL				
	Poverty	Cost in PPP terms of global income shortfall below the 5.55 2011 PPP dollar poverty line in rural areas; global poverty headcounts multiplied by global mean income shortfall	–	Cost in PPP terms of national income shortfall below the 3.65 2017 PPP dollar poverty line of the poor employed in agrifood systems; national poverty headcount multiplied by mean income shortfall
	Undernourishment	Productivity losses associated with undernutrition (including micronutrient deficiencies); proxied by global DALYs related to child growth failure multiplied by global average GDP per capita	–	Productivity losses due to burden of disease from protein–energy malnutrition (lost working days from illness or informal care); calculated from the national PoU
	Food loss and waste	Savings from not purchasing wasted food calculated by global share of food loss and waste multiplied by the value of global agricultural production	–	–
	Fertilizer leakage	Savings from not purchasing over-applied fertilizer; estimated leakage of fertilizers multiplied by their global average price	–	–
HEALTH (through dietary patterns)				
	Contribution to cardiovascular diseases, diabetes mellitus (type 2) and cancers	Productivity losses due to burden of disease from high BMI; DALYs valued at global average GDP per capita	Mortality medical costs, informal care, lost working days	Productivity losses from unhealthy diets leading to obesity (DALYs valued at national GDP per capita) and NCDs (lost working days from illness or informal care costed at GDP per labourer)
Total global estimate of hidden costs		USD 12 trillion	USD 19 trillion (range USD 7.2 trillion to USD 51.8 trillion)	Expected value 12.7 trillion PPP dollars (95 percent chance of being ≥ 10.8 trillion PPP dollars and 5 percent chance of being ≥ 16 trillion PPP dollars)
Measure of well-being		Unspecified	Unspecified	Overall economic losses of GDP PPP in 2020 PPP dollars
Future		Assumes IPCC-SSP2 scenario	Unspecified	Assumes IPCC-SSP2 scenario
Coverage		Global (single value)	Global (single value)	Global, regional and national (values for 154 countries)

NOTES: AMR = antimicrobial resistance; BMI = body mass index; CO_2e = CO_2 equivalent; DALY = disability-adjusted life year; ESVD = Ecosystem Services Valuation Database; GDP = gross domestic product; GHG = greenhouse gas; IPCC = Intergovernmental Panel on Climate Change; NCD = non-communicable disease; NH_3 = ammonia; NOx = nitrogen oxides; NPV = net present value; PoU = prevalence of undernourishment; PPP = purchasing power parity; SSP2 = second shared socioeconomic pathway.

SOURCES: Adapted from Lord, S. 2023. *Hidden costs of agrifood systems and recent trends from 2016 to 2023 – Background paper for The State of Food and Agriculture 2023*. FAO Agricultural Development Economics Technical Study, No. 31. Rome, FAO; FOLU (Food and Land Use Coalition). 2019. *Growing Better: Ten Critical Transitions to Transform Food and Land Use. Annex B: Technical Annex*. London. https://www.foodandlandusecoalition.org/wp-content/uploads/2019/09/FOLU-GrowingBetter-TechnicalAnnex.pdf; Hendriks, S., de Groot Ruiz, A., Acosta, M.H., Baumers, H., Galgani, P., Mason-D'Croz, D., Godde, C. *et al.* 2023. The True Cost of Food: A Preliminary Assessment. In: J. von Braun, K. Afsana, L.O. Fresco & M.H.A. Hassan, eds. *Science and Innovations for Food Systems Transformation*, pp. 581–601. Springer, Cham. https://doi.org/10.1007/978-3-031-15703-5_32

» The methodology used in this report is an improvement on the other two studies in various other aspects. One of the most important advantages is the fact that it provides a common monetary measure that can be compared with GDP PPP and, therefore, with market transactions. Another key advantage is its use of a discount rate that assumes a continuation of "business as usual" in a future broadly equivalent to the second shared socioeconomic pathway (SSP2),[17] as a way to account for hidden costs affecting future generations. It also provides more recent estimates, and at national level rather than global, while being transparent about the uncertainty of the estimated hidden costs. It uses a marginal damage approach to value productivity losses and environmental damages, adjusting for national variations in price and income.

In terms of consumers, the analysis undertaken for this report accounts for these through productivity losses from dietary patterns that contribute to obesity and NDCs. Direct costs, such as treatment costs, are hereby excluded: either they are visible economic exchanges within the economy and, therefore, not considered a hidden cost, or estimates of the inefficiency in GDP terms associated with these direct costs are not available. Other impacts, such as the release of GHG and nitrogen emissions, also generate productivity losses through a changing climate and human exposure to air pollution, respectively. The analysis excludes consumers' economic losses from food that goes to waste, however, as well as producers' economic losses from nitrogen overuse.[k]

In brief, all three studies provide different perspectives on the hidden costs of agrifood systems. Each has its strengths and weaknesses and none captures all the nuances and uncertainties involved in estimating hidden costs; furthermore, none of them account for all hidden costs. However, they all support the hypothesis that the magnitude of hidden costs is sizeable relative to the value of food products transacted in markets. This is an important conclusion that can be used to raise awareness about the damages associated with our agrifood systems at a global level; however, it falls short of providing guidance on what actions need to be taken at the regional, national and subnational levels.

In this regard, this report is an improvement, in that it assesses hidden costs of agrifood systems at the national level using marginal hidden costs that are consistent in terms of the economic measures used, the use of a common social discount rate, and the separation of hidden costs from abatement costs. Next, this chapter describes in more detail the scope of the results presented here and what the assumed boundaries of agrifood systems are. ■

HIDDEN COSTS OF AGRIFOOD SYSTEMS AT THE GLOBAL LEVEL

This report estimates the expected value of the global hidden costs of agrifood systems in 2020 – from GHG and nitrogen emissions, water use, land-use change, unhealthy dietary patterns, undernourishment and poverty – at **12.7 trillion 2020 PPP dollars**. This value is almost 10 percent of global GDP PPP in 2020. Per day, these costs are equivalent to 35 billion 2020 PPP dollars. As likewise evidenced by previous analyses,[l] these results point to the alarming environmental, social and health consequences our agrifood systems impose on society and call for urgent transformation towards sustainability across all dimensions.

An attractive feature of the TCA analysis underpinning the results presented here is that it allows for confidence intervals that reflect the uncertainty of the hidden costs of agrifood systems. These estimates use probability distributions to take into account the large uncertainty in cost calculations; this uncertainty results not only from a lack of data on various hidden costs (such as the impact on ecosystem

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[k] These economic losses are not hidden costs, as consumers and producers have already paid for food and fertilizer, respectively, and it is irrelevant that they then make potentially suboptimal decisions. These losses, once avoided, can be counted as benefits of transforming to an alternative agrifood system. For example, in the case of consumers, they may enjoy new goods and services purchased with the income saved from avoiding food waste. In a cost–benefit analysis this would be counted as a benefit of agrifood systems transformation alongside its costs.

[l] See, for example, the studies referenced in the previous section.

BOX 7 UNCERTAINTY IN THE GLOBAL ESTIMATES OF THE HIDDEN COSTS OF AGRIFOOD SYSTEMS

Shedding light on and acknowledging uncertainty is a key step in decision-making, as it allows the identification of appropriate strategies that perform well over a wide range of conditions faced now and potentially in the future. Costing the hidden impacts of agrifood systems involves a large degree of uncertainty, made clear in this report by the large spread of the estimates: hidden costs range between 10 trillion and 16 trillion 2020 PPP dollars, or potentially higher, with 12.7 trillion 2020 PPP dollars the expected outcome. Looking at the individual cost categories allows us to break down the uncertainty and understand for which impacts of agrifood systems the data constraints are more severe. The figure illustrates the contribution of each cost category to total quantified hidden costs, as well as the inherent uncertainty as a probability distribution. The top probability distribution combines all quantified hidden costs.

Costs associated with nitrogen emissions and unhealthy dietary patterns have the highest expected values, followed by greenhouse gas (GHG) emissions and land-use change costs. However, nitrogen costs have the highest uncertainty, as illustrated by the long orange tail. This is due to the lack of knowledge concerning the value of ecosystem services, the absence of spatially explicit data on the damage to ecosystem productivity from nitrogen loading, and the compounding uncertainty along the nitrogen cascade. Overall, the transfer of ecosystem service marginal values using national-level statistics, despite using the most extensive selection of studies available, results in high uncertainty in extrapolating values to ecosystem services in other countries.[22] As a result, the expected value of the hidden costs of nitrogen emissions are higher than the expected costs associated with GHG emissions, although, in reality, the economic effects are probably of the same magnitude, as the two probability distributions are quite similar, except for the long nitrogen tail.

The range of estimates is also robust to the uncertainty inherent in hidden costs coming from interactions between environmental, social and health hidden costs (for a sensitivity analysis, see Lord [2023]).[1]

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services), but also from incomplete data from some countries and regions. Therefore, the estimates can be presented as ranges rather than point estimates to reflect this uncertainty. When accounting for this uncertainty, it is estimated that global hidden costs have a 95 percent chance of being 10.8 trillion 2020 PPP dollars or higher, and a 5 percent chance of being 16 trillion 2020 PPP dollars or higher (see Box 7 for more details).[1] Yet, even the lower bound of 10.8 trillion 2020 PPP dollars reveals the undeniable urgency of agrifood systems transformation for minimizing the sizeable challenge faced by the planet and its population. In other words, uncertainty should not be used as a reason to postpone action.

Figure 6 breaks down the quantified hidden costs associated with agrifood systems by cost category (left) and subcategory (right). Out of the total 12.7 trillion 2020 PPP dollars in quantified hidden costs in 2020, more than 9 trillion 2020 PPP dollars (or 73 percent) were due to health-related costs from dietary pattern-induced productivity losses. Environmental costs, which are likely underestimated, have an expected value of nearly 2.9 trillion 2020 PPP dollars, corresponding to about 20 percent of total quantified hidden costs caused by agrifood systems. Of these, more than half pertained to nitrogen emissions (mostly from runoff to surface waters and ammonia emissions to air), in part due to the large degree of uncertainty (see Box 7). These were followed by the contributions of GHG emissions to climate change (30 percent), land-use change costs (14 percent) and water use (4 percent). Social hidden costs associated with poverty and undernourishment were smaller, accounting for just 4 percent of total quantified hidden costs, mostly driven by moderate poverty in the agrifood sector.

The finding that unhealthy dietary patterns leading to obesity and NDCs are the main contributor to global hidden costs may be surprising to many, especially given the

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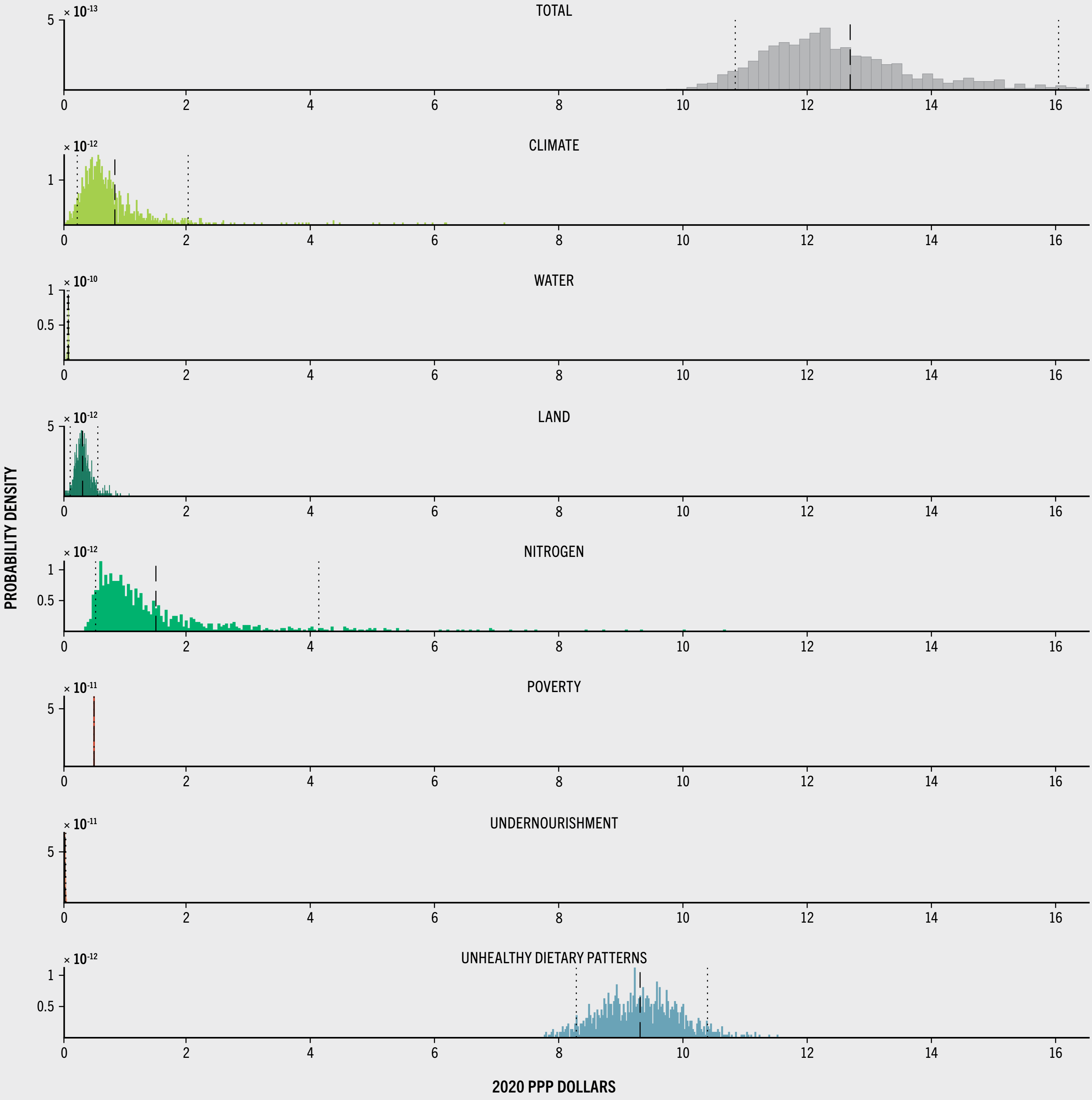
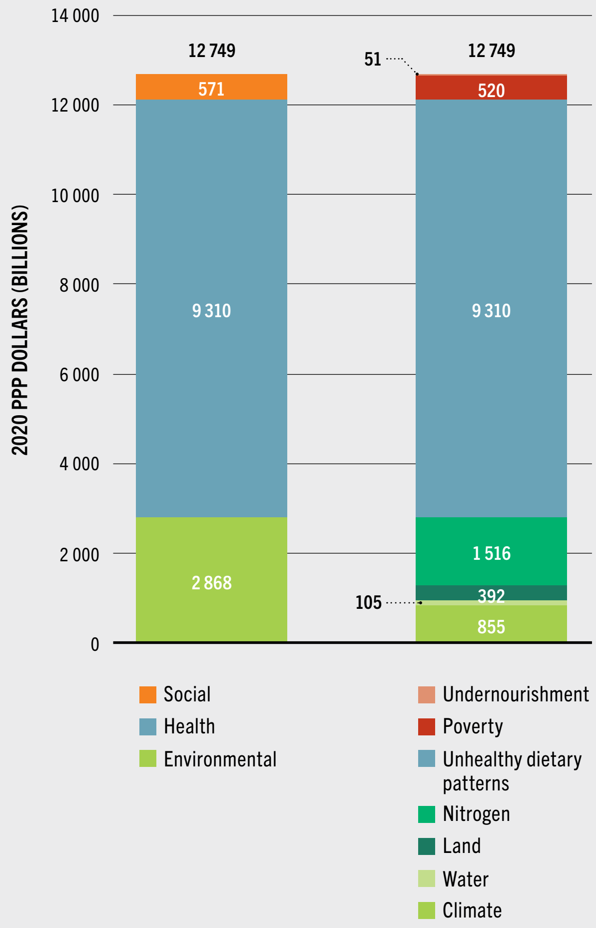
BOX 7 (Continued)

FIGURE GLOBAL QUANTIFIED HIDDEN COSTS OF AGRIFOOD SYSTEMS, WITH UNCERTAINTY, BY COST CATEGORY, 2020



NOTE: Excepted values are represented by the black dashed line.
SOURCE: Lord, S. 2023. *Hidden costs of agrifood systems and recent trends from 2016 to 2023 – Background paper for The State of Food and Agriculture 2023*. FAO Agricultural Development Economics Technical Study, No. 31. Rome, FAO.

FIGURE 6 QUANTIFIED HIDDEN COSTS OF AGRIFOOD SYSTEMS BY COST CATEGORY (LEFT) AND SUBCATEGORY (RIGHT), 2020



NOTE: All values are expected values.
SOURCE: Lord, S. 2023. *Hidden costs of agrifood systems and recent trends from 2016 to 2023 – Background paper for The State of Food and Agriculture 2023*. FAO Agricultural Development Economics Technical Study, No. 31. Rome, FAO.

» historical emphasis of the impact of agrifood systems on the natural environment. This finding should not, however, steer attention away from the environmental consequences of agriculture and food production. Rather, it emphasizes the importance of repurposing current public support for food and agriculture and current food environments towards the production of nutritious and diverse foods that go to make up healthy diets and, in parallel, empower consumers to choose these diets with complementing agrifood systems policies.[10] The urgency of promoting these diets is further justified by the positive impacts they will have not only on consumers' health, but also on the environment. Past evidence has shown that the adoption of healthier and more sustainable dietary patterns reduces costs related to climate change by up to 76 percent.[19] Furthermore, were health and environmental costs to be included in the cost of diets, healthier and more sustainable dietary patterns would have lower wholesale costs, on average, than current diets. In other words, a fuller cost accounting increases the cost of current (unhealthy) dietary patterns, but also makes healthier and more sustainable dietary patterns relatively more affordable.[19] ■

THE HIDDEN COSTS OF AGRIFOOD SYSTEMS DIFFER BY INCOME GROUP

Aggregating the quantified hidden costs of agrifood systems at the global level hides significant variation across the income levels of countries that are key decision-makers in reducing these costs. In reality, the relative importance of hidden costs across different categories – environmental, social and health – will vary depending on a number of factors, such as average income level, geography and level of urbanization. Among these, the average income level of a country is particularly informative, because it correlates to how agrifood systems are organized, the role of these systems in the overall economy, and the level of urbanization. Understanding these variations is a first step towards identifying areas of intervention that need to be prioritized in each country.

Figure 7 breaks down total quantified hidden costs by main category and country income group. Hidden costs differ not only in their magnitude, but also in their composition by income level. The majority of hidden costs are generated in upper-middle-income countries (5 trillion 2020 PPP dollars, or 39 percent of total quantified hidden costs) and high-income countries (4.6 trillion 2020

PPP dollars, or 36 percent of total costs). Lower-middle-income countries account for 22 percent, while low-income countries make up 3 percent. In all country groups apart from low-income nations, productivity losses from dietary patterns that lead to NCDs are the most significant contributor to agrifood systems damages, followed by environmental costs. In lower-middle-income countries, social hidden costs from poverty and undernourishment are relatively more significant, accounting for an average of 12 percent of all quantified hidden costs. Unsurprisingly, these social hidden costs are the main issue in low-income countries (more than 50 percent of all quantified hidden costs).

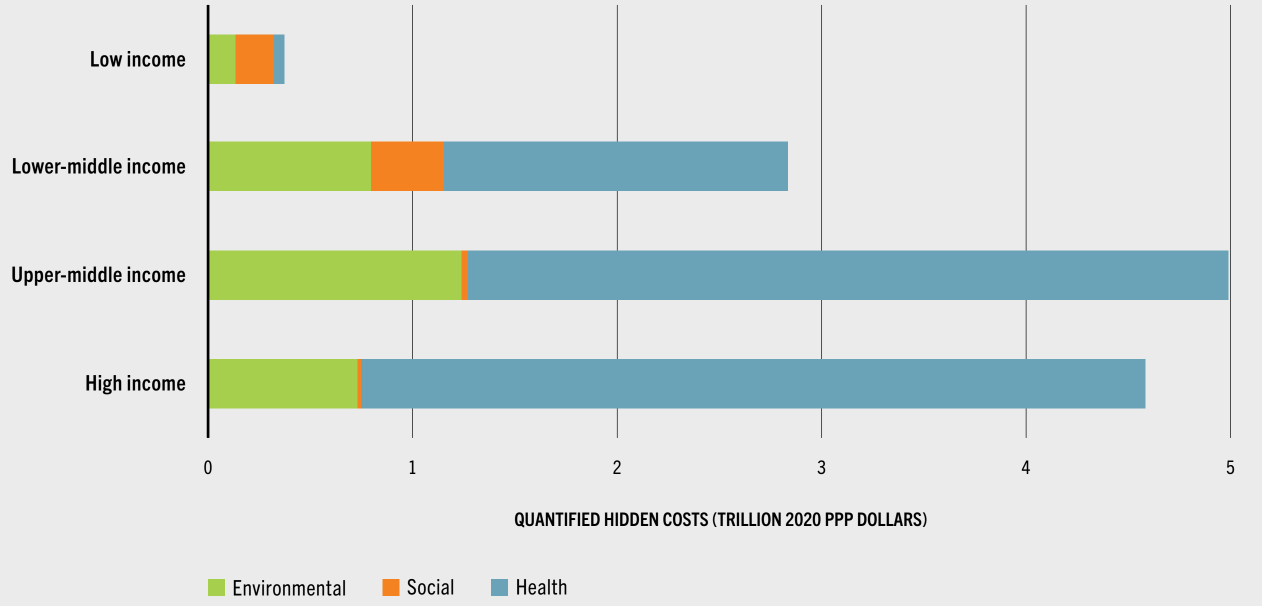
Presenting hidden costs in total monetary terms gives a general sense of the magnitude of the problem; however, these country groups vary substantially in their economic size and development. It is, therefore, useful to anchor the monetary estimates to the size of transaction that takes place in the economy, expressed as a share of GDP PPP in Figure 8. This gives a sense of the burden these hidden costs place on national economies and provides an indication as to where to prioritize international resources to address these costs. Globally, the quantified hidden costs are equivalent, on average, to almost 10 percent of 2020 GDP in PPP terms. However, this share is far higher in low-income countries, at an average of 27 percent. This signals that improving agrifood systems in low-income countries will be instrumental in addressing these hidden costs, especially those related to poverty and undernourishment, which alone are equivalent to 14 percent of GDP. The ratio of hidden costs to GDP is, on average, 11 percent in middle-income countries (or 12 percent and 11 percent in lower- and upper-middle-income countries, respectively). However, social hidden costs are of notable relevance only in lower-middle-income countries. In high-income countries, the ratio of all quantified hidden costs is, on average, only 8 percent, the majority of which come from unhealthy dietary patterns.

Country income groups can also deviate substantially in terms of population size. It is, therefore, useful to compare hidden costs with the size of the population. Hidden costs per capita are shown to the right of the bars in Figure 8 and can be interpreted as the amount of hidden costs generated by an average individual. Important differences across income categories emerge – not least that hidden costs increase as countries develop. Consequently, populations in high-income countries generate the highest indirect costs, at an average of 3 800 2020 PPP dollars per person, followed by upper-middle-income countries, where each person generates, on average, 2 000 2020 PPP dollars in hidden costs. This number is noticeably lower in lower-middle-income countries (around 850 2020 PPP dollars) and even lower in low-income countries (575 2020 PPP dollars). The main reason the average person in a high-income country generates almost double the costs of a person in an upper-middle-income country is that the productivity losses from unhealthy dietary patterns are also double, due to higher labour productivity per capita. In other words, a given number of workdays lost in high-income countries can create hidden costs higher than the same number of workdays in upper-middle-income countries. In contrast, environmental costs per capita are relatively similar across the two income categories.

In conclusion, the analysis presented in Figure 7 and Figure 8 suggests that the majority of the quantified hidden costs are generated in high- and upper-middle-income countries. If these costs are distributed evenly throughout the population, it becomes clear that an average individual generates higher hidden costs as their income level increases. However, a note of caution is needed, as this can be in part explained by higher labour productivity as country income level increases. Consequently, this trend does not suggest a relatively higher burden on countries with higher per capita hidden costs. This is evident when looking at the shares of quantified hidden costs to GDP, which clearly show that the highest burden placed on the economy is in low-income countries.

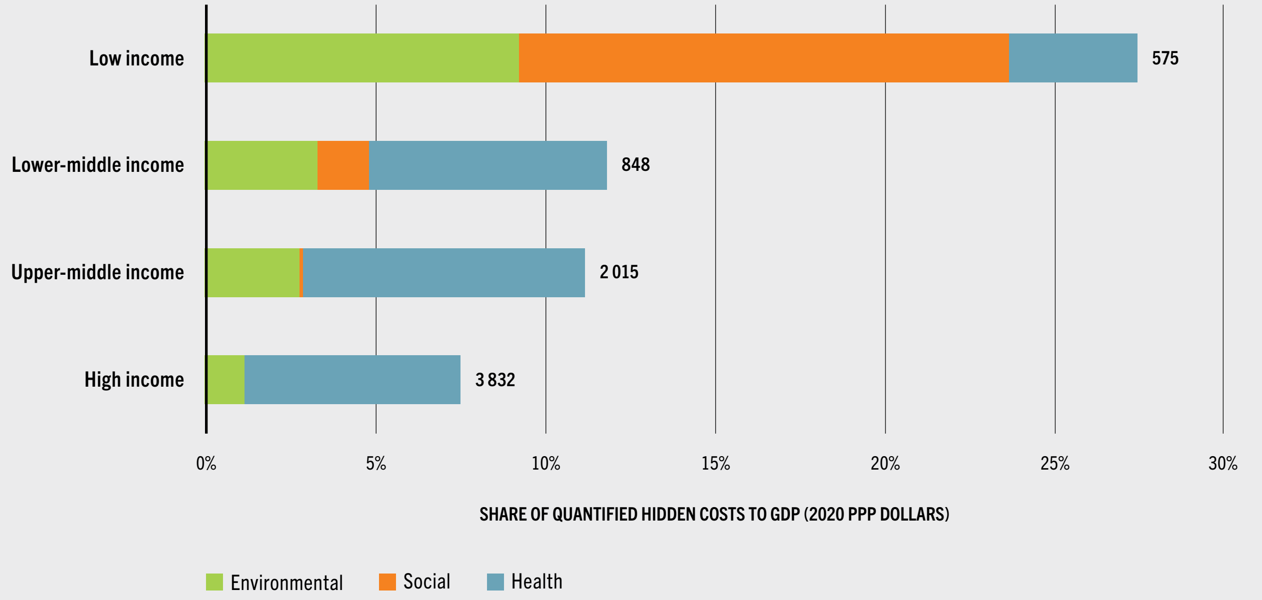
Projecting values up to 2023 and looking at the evolution of hidden costs since 2016 can also provide important insights, including in relation to the role played by dietary patterns. Box 8 breaks down this trend and looks at the evolution of hidden costs by category and country income group. According to the box, these are estimated »

FIGURE 7 TOTAL QUANTIFIED HIDDEN COSTS OF AGRIFOOD SYSTEMS BY INCOME GROUP



NOTE: Health hidden costs are captured by unhealthy dietary patterns only.
SOURCE: Adapted from Lord, S. 2023. *Hidden costs of agrifood systems and recent trends from 2016 to 2023 – Background paper for The State of Food and Agriculture 2023*. FAO Agricultural Development Economics Technical Study, No. 31. Rome, FAO.

FIGURE 8 SHARE OF QUANTIFIED HIDDEN COSTS OF AGRIFOOD SYSTEMS TO GDP BY INCOME GROUP (HIDDEN COSTS PER CAPITA ON THE RIGHT-HAND SIDE)



NOTE: Health hidden costs are captured by unhealthy dietary patterns only.
SOURCE: Adapted from Lord, S. 2023. *Hidden costs of agrifood systems and recent trends from 2016 to 2023 – Background paper for The State of Food and Agriculture 2023*. FAO Agricultural Development Economics Technical Study, No. 31. Rome, FAO.

BOX 8 QUANTIFIED HIDDEN COSTS OF AGRIFOOD SYSTEMS OVER TIME – AN OVERVIEW OF RECENT TRENDS

The quantified hidden costs of agrifood systems can be projected for 2021–2023 by extrapolating data from 2016–2020. Figure A illustrates the evolution of hidden costs over 2016–2023 at the global level. Overall, quantified hidden costs show an upward trend, moving from approximately 12.1 trillion 2020 PPP dollars to more than 13 trillion 2020 PPP dollars in 2023 (Figure A, left panel). The upward trend is mostly driven by increasing health-related hidden costs from unhealthy dietary patterns, which increase 14 percent between 2016 and 2023 (Figure A, right panel). Environmental hidden costs remain more stable, as the increase in nitrogen and GHG emissions is cancelled out by the downward trend in land-use changes due to a decrease in deforestation and an increase in agricultural land abandonment. Social hidden costs have also remained stable, despite an increase due to the COVID-19 pandemic in 2020, as costs resumed a long-term downward trend after 2021.

Figure B shows this breakdown by country income group. Hidden costs driven by dietary patterns are the only cost category that is on the rise across all income groups. It is also the most costly category, except for in low-income countries, accounting for 62 percent of all quantified hidden costs in lower-middle-income countries and for 75 percent in high- and upper-middle-income countries in 2023.

Total quantified hidden costs from environmental sources in lower-middle-income countries surpassed those for high-income countries in 2018, and this difference is expected to become even more pronounced in 2023, as costs in the latter start to decrease. Upper-middle-income countries, in contrast, account for almost twice the environmental costs of lower-middle-income and high-income countries, but seem to be stabilizing.

Social hidden costs, driven by moderate poverty and undernourishment, saw an increase in all income groups in 2020, especially in lower-middle-income countries, but are likely to have resumed their previous downward trend from 2021. The exception is low-income countries, for which social hidden costs remain the major challenge and which report a fairly static trend due to the concentration of extreme poverty.

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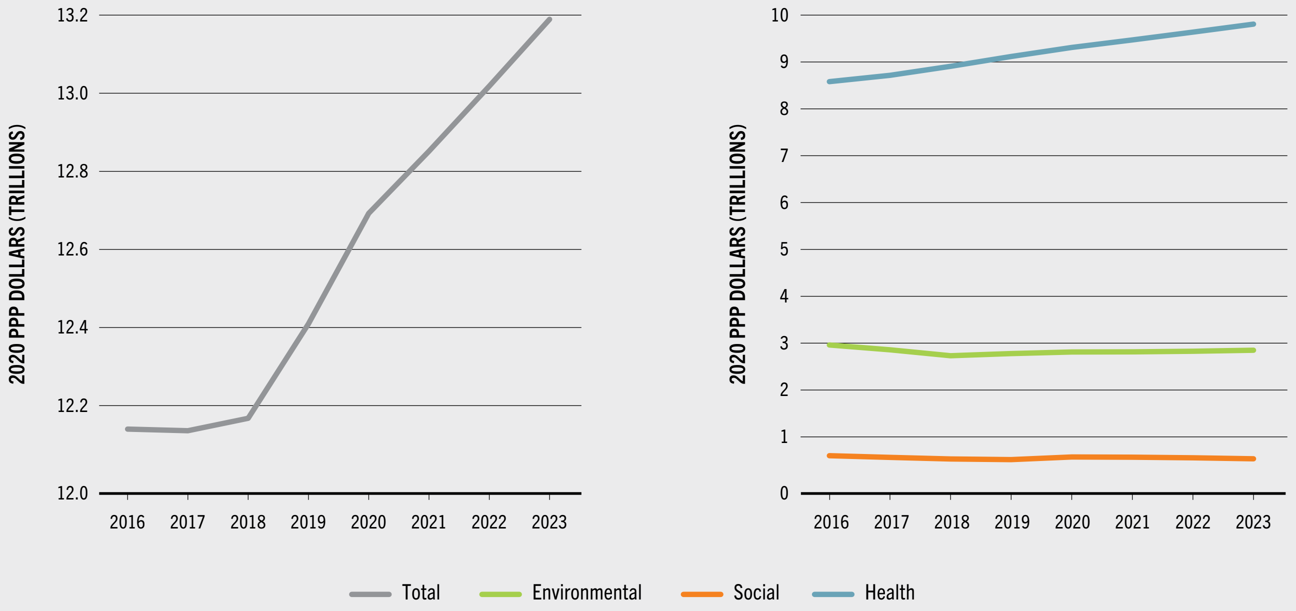
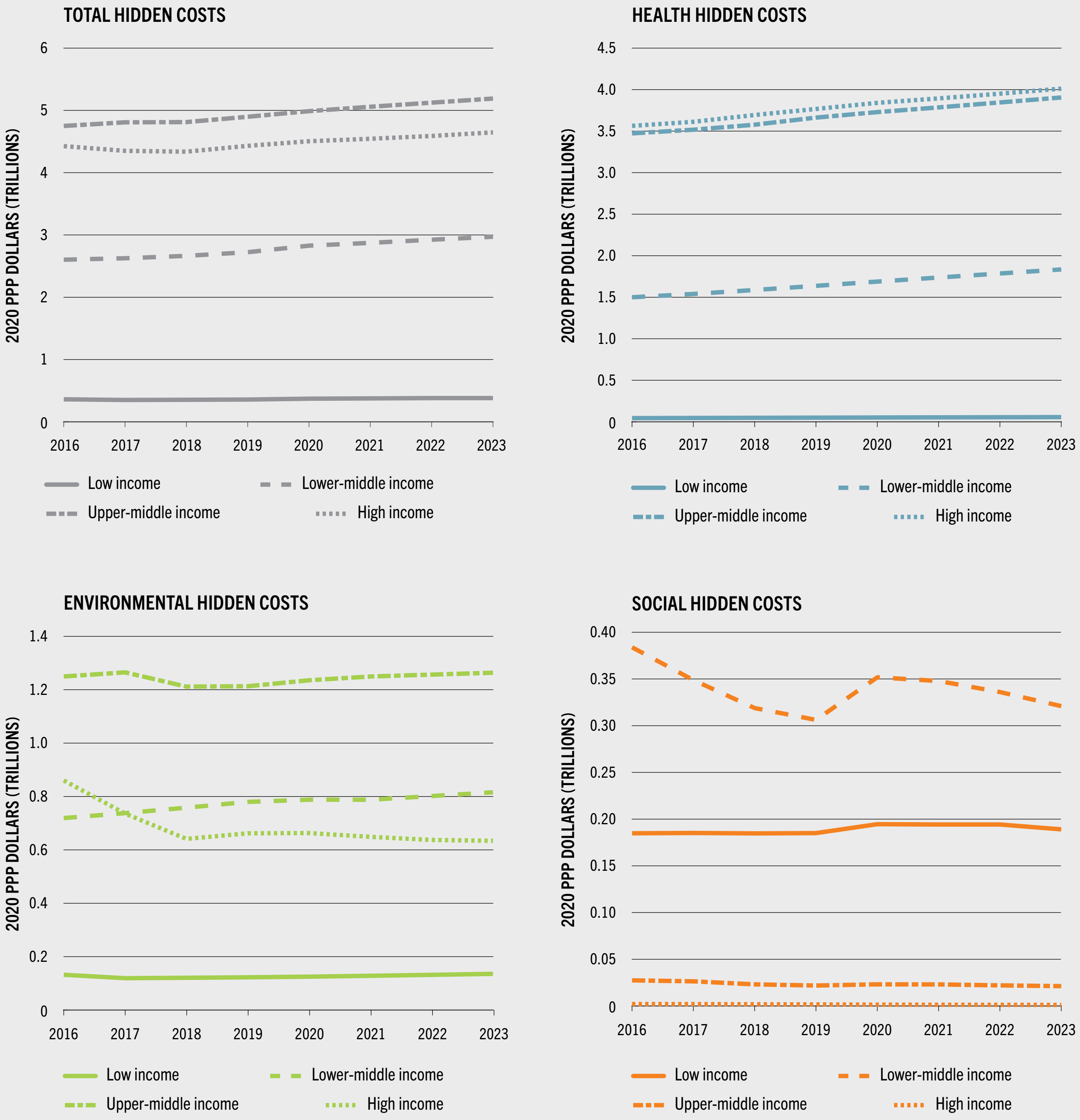
FIGURE A QUANTIFIED HIDDEN COSTS OF GLOBAL AGRIFOOD SYSTEMS, 2016–2023: TOTAL (LEFT) AND BY CATEGORY (RIGHT)



NOTES: All values are expected values. Health hidden costs are captured by unhealthy dietary patterns only.
SOURCE: Lord, S. 2023. *Hidden costs of agrifood systems and recent trends from 2016 to 2023 – Background paper for The State of Food and Agriculture 2023*. FAO Agricultural Development Economics Technical Study, No. 31. Rome, FAO.

BOX 8 (Continued)

FIGURE B QUANTIFIED HIDDEN COSTS OF AGRIFOOD SYSTEMS BY COUNTRY INCOME GROUP, 2016–2023: TOTAL (TOP LEFT) AND BY CATEGORY


TOTAL HIDDEN COSTS

HEALTH HIDDEN COSTS

ENVIRONMENTAL HIDDEN COSTS

SOCIAL HIDDEN COSTS

NOTES: All values are expected values. Health hidden costs are captured by unhealthy dietary patterns only.
SOURCE: Lord, S. 2023. *Hidden costs of agrifood systems and recent trends from 2016 to 2023 – Background paper for The State of Food and Agriculture 2023*. FAO Agricultural Development Economics Technical Study, No. 31. Rome, FAO.

» to have increased 9 percent and trended upwards, with productivity losses from unhealthy dietary patterns the main culprit – estimated to have increased 14 percent in the same period. ■

DIFFERENT COUNTRY PROFILES DRIVE DIFFERENT HIDDEN COSTS

There can be considerable variation within an income group. Examining this variation is necessary to devise agrifood systems interventions towards sustainability that are suited to country-specific contexts. This is true even for countries with similar hidden costs in relation to GDP, where the drivers – environmental, social or health – of hidden costs can differ by country. Figure 9 shows this breakdown of hidden costs by subcategory for selected countries within each income category, with the bars and total quantified hidden costs as a share of GDP reported on the right-hand side. Variation between cost subcategories is particularly visible in middle-income countries, where, as average income increases, the social dimension of hidden costs decreases, while that of health increases, though not to the level of high-income countries. One should, however, be mindful that the relative importance of social, environmental and dietary pathways may vary if omitted hidden costs are included – for example, child stunting, pesticide exposure, AMR or illness from unsafe food – amid a lack of global databases reporting these dimensions at country level.

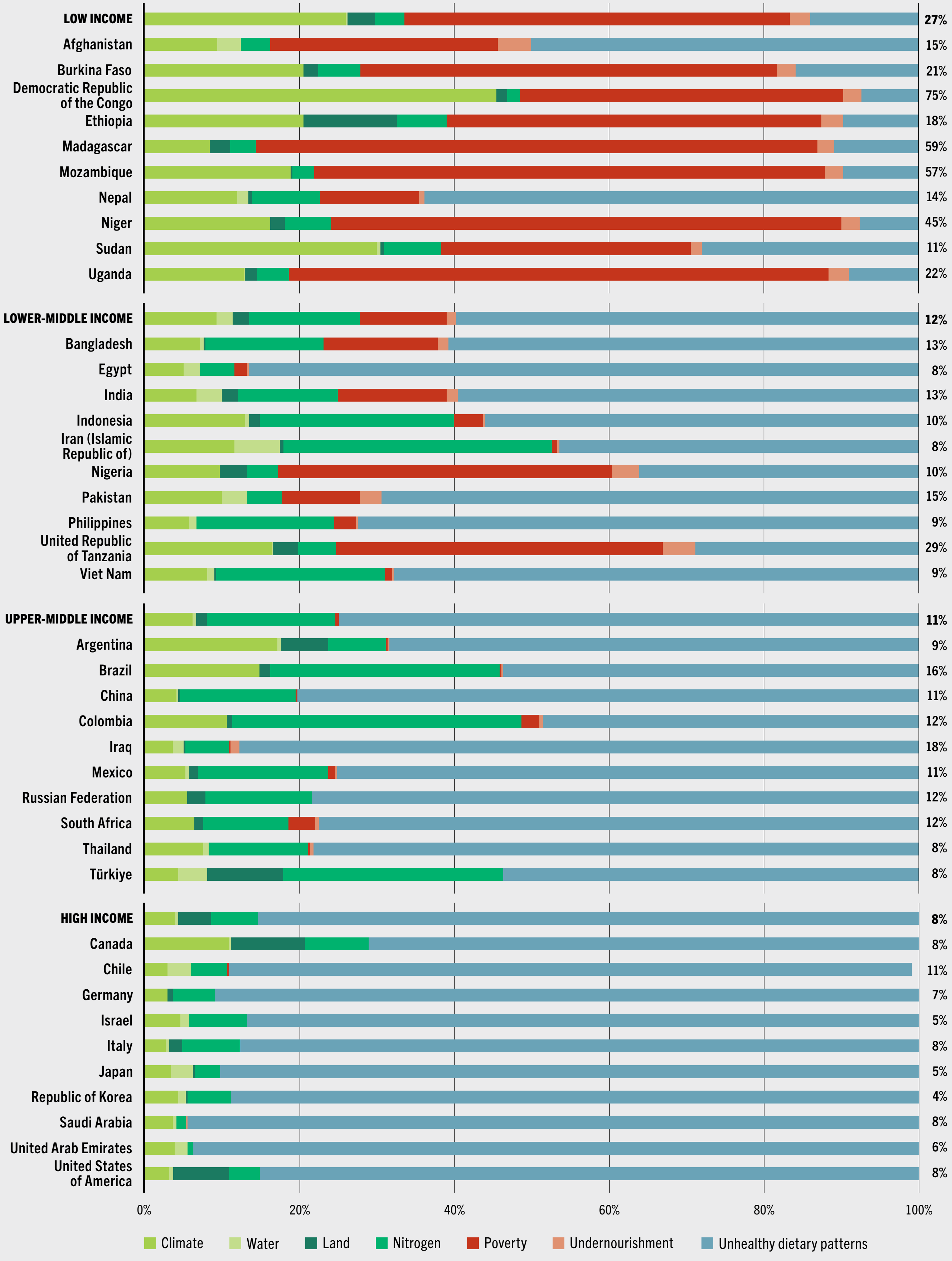
Lower-middle-income countries show the highest variation in the distribution of quantified hidden costs. For instance, in Nigeria and the United Republic of Tanzania, social hidden costs associated with poverty and undernourishment dominate, while in Pakistan, Viet Nam and particularly Egypt, it is those from unhealthy dietary patterns causing obesity and NDCs, as more commonly seen in high-income countries. Pakistan also faces major challenges associated with poverty and undernourishment, whereas in Viet Nam, nitrogen emissions are a greater concern.

Upper-middle-income countries present differences in cost distribution, despite some apparent similarities. For example, Colombia and Mexico are found to have similar total quantified hidden costs as a share of GDP, but there is variation in the drivers: while both nitrogen and diet-related factors are significant issues in Colombia, followed by climate change, those associated with dietary patterns are more dominant in Mexico. This is seen in other upper-middle-income countries. Brazil and Iraq have relatively high total quantified hidden costs as a share of GDP, with Brazil having higher costs associated with nitrogen and climate change – the latter driven by GHG emissions linked to deforestation – and Iraq bearing hidden costs mostly related to unhealthy dietary patterns.

High-income countries, in contrast, do not show much variation, as health costs driven by productivity losses due to dietary patterns dominate in every country, followed by different environmental issues. This points to the need to promote healthier diets and environmental stewardship in high-income countries. In many of these countries, policies and investments already target environmental issues, but there is much less focus on diets, as these often come down to personal choice and preference, which are more difficult to regulate or shift.

Low-income countries present mainly social hidden costs (see Figure 7 and Figure 8) in the form of poverty and productivity losses from undernourishment. This is especially true for countries such as Madagascar, the Niger and Uganda. However, other hidden costs can emerge in these countries, such as climate change-related costs in the Democratic Republic of the Congo (likely due to deforestation) and diet-related costs in Afghanistan and Nepal. In Ethiopia, multiple environmental concerns, such as climate change, land-related ecosystem service costs and nitrogen emissions, collectively contribute to hidden costs. In low-income countries, the priority might be for policies and investments that improve livelihoods, while acknowledging that, as these countries develop, productivity losses from changing diets are likely to increase, as seen in higher-income country groups. »

FIGURE 9 QUANTIFIED HIDDEN COSTS OF AGRIFOOD SYSTEMS BY SUBCATEGORY FOR SELECTED COUNTRIES BY INCOME LEVEL (SHARE OF HIDDEN COSTS TO GDP [2020 PPP DOLLARS] ON THE RIGHT-HAND SIDE)



NOTES: Countries were selected based on population size and geographical coverage. See **Annex 2** for the results of the full set of countries.
SOURCE: Adapted from Lord, S. 2023. *Hidden costs of agrifood systems and recent trends from 2016 to 2023 – Background paper for The State of Food and Agriculture 2023*. FAO Agricultural Development Economics Technical Study, No. 31. Rome, FAO.

» It is also important to note that, should currently excluded hidden costs be included in the analysis, the relative contribution of each dimension to total hidden costs would probably change by income group. For instance, should hidden costs associated with infant mortality and low birth weight be included, the social dimension of the hidden costs would probably become bigger, relatively speaking, especially in low-income countries, where these problems prevail.[23]

Unsurprisingly, the countries with the highest net hidden costs are the world's largest food producers and consumers, with the United States of America accounting for 13 percent of total quantified hidden costs, the European Union 14 percent, and Brazil, the Russian Federation, India and China (the BRIC countries) accounting for 39 percent. With the exception of Brazil, more than 75 percent of hidden costs are associated with dietary patterns. In the case of Brazil, almost half are associated with environmental sources, of which 31 percent are from GHG emissions and 67 percent from nitrogen emissions. However, when considering the share of quantified hidden costs to GDP, low-income countries face higher burdens. In the Democratic Republic of the Congo, for example, the ratio reaches an alarming 75 percent.

Figure 9 underscores the importance of adopting a nuanced TCA approach that considers country specificities when examining the hidden costs of agrifood systems, as these can vary considerably in their composition across and within income groups. By expressing the magnitude of hidden costs in monetary terms, TCA further enables the prioritization of targeted interventions. However, as highlighted in the two-phase process introduced in Chapter 1, identifying these potential priorities is just the very first step in a process that will lead to action. Identifying options further requires understanding abatement costs, which refer to the costs incurred in avoiding or reducing hidden costs and which are excluded from the analysis in this report, while hidden costs estimate the costs of inaction (see Glossary). It is important to consider the latter, as a specific subcategory may be causing significant costs to an economy, but abating these costs may be just as costly, or even costlier, making it difficult to reduce their negative impact. Take the case of Argentina and Colombia. Figure 9 suggests a focus on healthy diets in both countries, followed by climate change considerations in Argentina and nitrogen emissions in Colombia. However, redirecting consumer preferences and choices towards healthy and sustainable diets can be extremely challenging and potentially costly. It is necessary to understand how much such an intervention would cost and by how much it would reduce hidden costs (that is, the benefits of the action).

Another important element to consider is the entry point for action. The scope of the agrifood systems presented in Figure 5 highlights the numerous points along the food value chain involving multiple actors that can negatively impact society. For example, GHGs and nitrogen can be released into the environment during fertilizer production at farm level, but also downstream in the value chain, all the way to consumers via waste and sewerage. Narrowing down which hidden costs to focus on and mapping them to specific actors in agrifood systems is the next step in the process of identifying targeted actions. ■

INDICATORS TO INFORM POLICY ENTRY POINTS TO ADDRESS THE HIDDEN COSTS

The hidden costs described in the previous sections can be combined with other relevant metrics – such as GDP, agricultural value added and agricultural land use – to develop indicators that help identify entry points for the prioritization of interventions and investments. Different indicators may be created for different contexts, depending on the issues faced, the size of the economy and the relative importance of the agrifood sector. The first step should be to identify where in a given agrifood system hidden costs are more significant and due to what activities. Following this first step, and using estimated hidden costs and other national metrics, this report proposes three indicators relevant to the environmental, social and health dimensions, targeting specific entry points: primary producers, the poor and consumers.

Starting with the environmental dimension, estimates suggest that these costs occur mostly in primary production, with pre- and post-production costs comprising less than 2 percent of total quantified hidden costs. In other words, the primary sector should be seen as the main entry point for effecting change in environmental pathways. Consequently, it is fitting to propose an indicator that considers the intensity of hidden costs related directly to primary production, all of them being environmental, per unit of value added to GDP (in 2020 PPP dollars). This indicator, called the **agricultural externalities impact ratio (AEIR)**, expresses the relative importance and, thus, priority of the primary production sector in agrifood systems transformation. It is the ratio between a country's hidden costs from agricultural production – that is, the costs from GHG and nitrogen emissions, water and land use, and land-use change – and national gross valued added (GVA) of agriculture, forestry and fisheries in PPP terms. This indicator, therefore, excludes from the numerator all quantified hidden costs outside primary production – that is, agricultural inputs, manufacturing, retail consumption and waste (see Figure 5). Because forestry is outside the scope of the analysis, it is also not included in the numerator, despite being included in the denominator through GVA. Consequently, the AEIR is expected to be a conservative estimate. Globally, the AEIR is estimated to have a value of 0.31, meaning that each dollar of agricultural value added generates 31 cents of hidden costs. In other words, hidden costs from agriculture are equivalent to almost one-third of agricultural value added in 2020 PPP dollar terms.

Moving on to the social dimension, the second indicator proposed is called the **social distribution impact ratio (SDIR)**. This indicator focuses on the vulnerable actors and expresses the contribution of agrifood systems to moderate poverty – that is, the overall distributional failure of sufficient revenues and calories needed to ensure productive lives. Mathematically, it is defined as the ratio of the total income shortfall of agrifood workers below the moderate poverty line of 3.65 2017 PPP dollars per day over the annual total income of the moderately poor. This expresses the required magnitude of potential future transfers from governments to avoid these productivity losses and compensate for income shortfalls relative to the moderately poor's overall income. The moderately poor are mostly in low- and lower-middle-income countries, for which the indicator values are 0.57 and 0.27, respectively. This suggests that to avoid distributional failure costs in agrifood systems, the incomes of the moderately poor working in agrifood systems need to increase, on average, by 57 percent in low-income countries and 27 percent in lower-middle-income countries.

The third and final indicator focuses on the health dimension and is named the **dietary patterns impact ratio (DPIR)**. It relates to consumers and captures the intensity of hidden costs from dietary patterns leading to obesity and NCDs and, as a consequence, productivity losses. It is measured as a ratio of the average productivity losses per person from dietary intake in 2020 PPP dollars to GDP PPP per capita. As before, direct costs, such as health care costs, are excluded, as these are already incorporated into the economy. Globally, the value for this indicator is equivalent to 7 percent of GDP PPP in 2020; low-income countries report the lowest value (4 percent), while other income categories report 7 percent or higher.

Figure 10 is a global spatial representation of the three indicators: AEIR (top), SDIR (middle) and DPIR (bottom).

Table 2 compares the three indicators for a selected group of countries by income category, as there can be significant variations, and suggests a sense of urgency ranging from low (green) to very high (red). This gives an indication of priority areas where further investigation is needed to examine options and understand abatement costs. For example, in **low-income countries** such as Burkina Faso, the Democratic Republic of the Congo, Madagascar, Mozambique, the Niger and Uganda, priority should be given to distributional failures in agrifood systems, although the Democratic Republic of the Congo also shows significant costs at farm level related to GHG emissions from deforestation.

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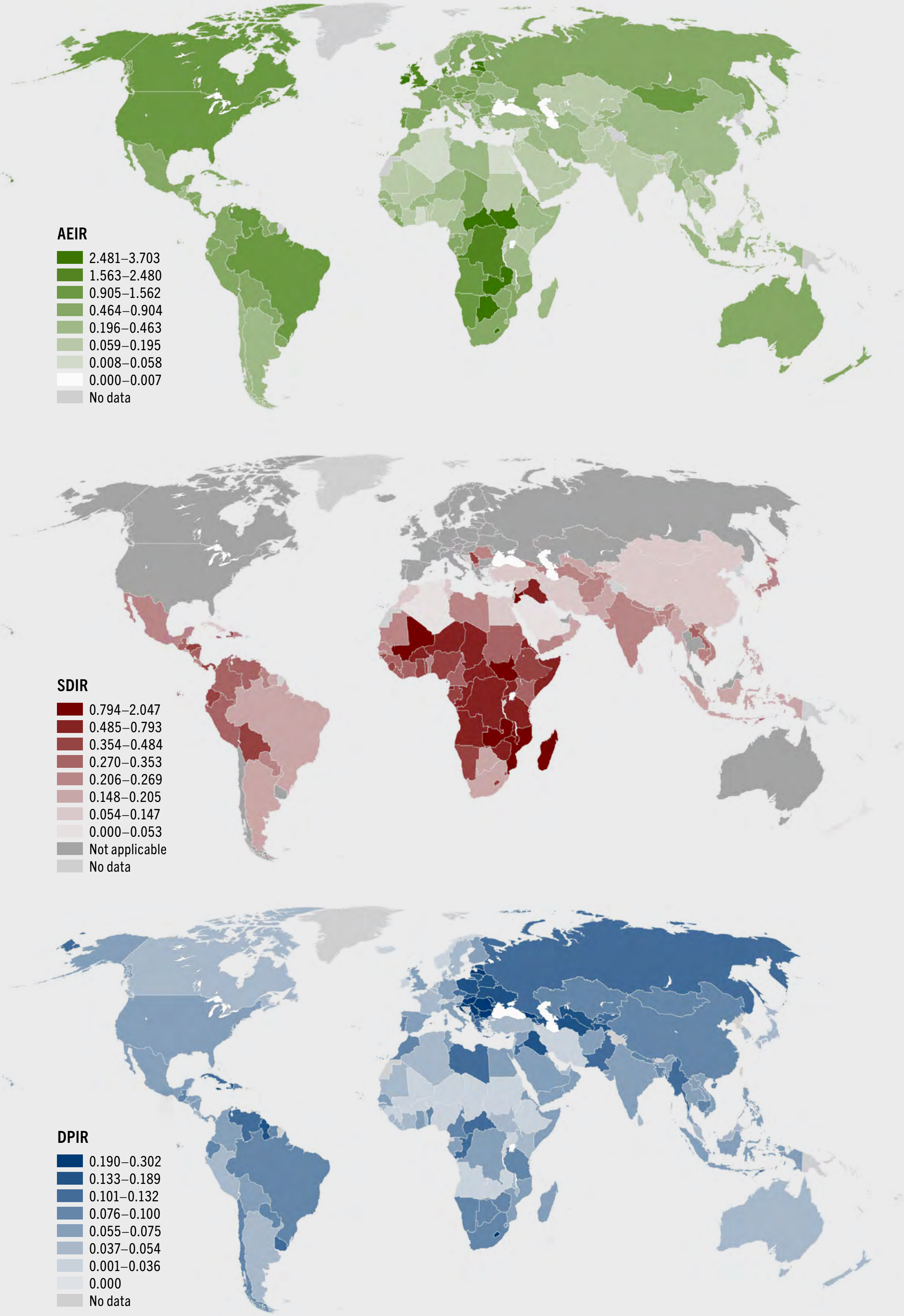
FIGURE 10 SPATIAL DISTRIBUTION OF INDICATORS OF HIDDEN COSTS IN GLOBAL AGRIFOOD SYSTEMS, 2020



NOTES: AEIR = agricultural externalities impact ratio; DPIR = dietary patterns impact ratio; SDIR = social distribution impact ratio. Values are averaged over 2016–2020, and the average is converted to 2020 PPP dollars for consistency with the numerator. In the case of the SDIR indicator, "not applicable" applies to cases in which less than 2 percent of the population is below the moderate poverty line. See **Annex 2** for the results of the full set of countries.
SOURCE: Lord, S. 2023. *Hidden costs of agrifood systems and recent trends from 2016 to 2023 – Background paper for The State of Food and Agriculture 2023.* FAO Agricultural Development Economics Technical Study, No. 31. Rome, FAO.

TABLE 2 A TRAFFIC-LIGHT REPRESENTATION OF THE THREE INTENSITY INDICATORS TO SIGNAL POTENTIAL PRIORITIES FOR A TARGETED ASSESSMENT

	Agricultural externalities impact ratio (AEIR)	Social distribution impact ratio (SDIR)	Dietary patterns impact ratio (DPIR)
Low income	0.36	0.57	0.04
Afghanistan	0.09	0.23	0.08
Burkina Faso	0.29	0.53	0.03
Democratic Republic of the Congo	2.04	0.64	0.06
Ethiopia	0.22	0.37	0.02
Madagascar	0.32	1.39	0.06
Mozambique	0.70	0.94	0.06
Nepal	0.14	0.25	0.09
Niger	0.29	0.66	0.04
Sudan	0.19	0.32	0.03
Uganda	0.17	0.64	0.02
Upper-middle income	0.35	0.15	0.09
Argentina	0.40	0.15	0.05
Brazil	1.30	0.17	0.08
China	0.21	0.07	0.09
Colombia	0.76	0.29	0.06
Iraq	0.25	0.54	0.14
Mexico	0.54	0.21	0.07
Russian Federation	0.55	0.03	0.10
South Africa	0.56	0.18	0.09
Thailand	0.18	NA	0.06
Türkiye	0.45	NA	0.04
Lower-middle income	0.17	0.27	0.07
Bangladesh	0.15	0.25	0.09
Egypt	0.04	0.10	0.07
India	0.13	0.24	0.07
Indonesia	0.26	0.20	0.06
Iran (Islamic Republic of)	0.27	0.14	0.04
Nigeria	0.06	0.43	0.03
Pakistan	0.11	0.20	0.11
Philippines	0.17	0.15	0.07
United Republic of Tanzania	0.27	0.65	0.09
Viet Nam	0.18	0.24	0.06
High income	0.76	NA	0.06
Canada	0.99	NA	0.05
Chile	0.23	NA	0.10
Germany	0.76	NA	0.07
Israel	0.30	NA	0.04
Italy	0.44	NA	0.07
Japan	0.33	NA	0.04
Republic of Korea	0.21	NA	0.04
Saudi Arabia	0.08	NA	0.07
United Arab Emirates	0.21	NA	0.05
United States of America	1.15	NA	0.06

Priority

Low 🟩 Medium 🟨 High 🟥 Very high 🟥

NOTES: Countries were selected based on population, geography and relevance of the agrifood sector, per Figure 9. Priority of action is measured as follows: for the AEIR and SDIR indicators, priority is low when values are less than 0.2, medium when values are between 0.2 and 0.4, high when values are between 0.4 and 0.8, and very high when they surpass 0.8. For the DPIR indicator, values are smaller, as they are relative to total GDP. Priority is low when values are less than 0.03, medium when values are between 0.03 and 0.06, high when values are between 0.06 and 0.09, and very high when they surpass 0.09. In the case of the SDIR indicator, NA stands for "not applicable" and applies to cases in which less than 2 percent of the population is below the moderate poverty line. See **Annex 2** for the results of the full set of countries.
SOURCE: Lord, S. 2023. *Hidden costs of agrifood systems and recent trends from 2016 to 2023 – Background paper for The State of Food and Agriculture 2023*. FAO Agricultural Development Economics Technical Study, No. 31. Rome, FAO.

» For **lower-middle-income** countries, such as Nigeria and the United Republic of Tanzania, income shortfalls among the moderately poor population are also a major concern. In the United Republic of Tanzania, the focus should also be on dietary-induced productivity losses, as in Bangladesh and Pakistan. The situation is quite different for **upper-middle-income countries**, where China, Iraq, the Russian Federation and South Africa, for example, face alarming productivity losses from dietary choices, along with environmental challenges from primary production externalities.

High-income countries, in contrast, are mostly challenged by both environmental externalities from primary production activities and unhealthy dietary patterns, although substantial variation exists. Canada and the United States, for example, are confronted with serious challenges from nitrogen emissions and the loss of ecosystem services due to land-use change, whereas in Chile, the focus should probably be on promoting healthier diets. It is interesting to note that, despite the high incidence of NDCs and obesity from unhealthy dietary patterns in high-income countries such as the United States, values for the DPIR indicator are relatively low. Indeed, some middle-income countries, which report lower hidden costs associated with dietary patterns (see Figure 9), indicate relatively higher DPIR values due to the lower value of GDP per capita, the denominator of the indicator.

In sum, these indicators express the intensity of hidden costs across the different dimensions and for different countries. They aim to provide a more nuanced understanding of agrifood systems challenges to guide policymakers in making effective interventions and investments to mitigate their hidden costs. Due to the multisectoral nature of the hidden costs, however, it is important to acknowledge that these cannot be reduced by action on agrifood systems alone. It will further require leveraging and coordinating policies that go beyond agrifood systems (for example, environmental, energy, health and other systems). ■

CONCLUSIONS

Sustainability in agrifood systems is not simple to achieve. Changing the course of agrifood systems first requires a background understanding of the current state of agrifood systems at global, regional and national levels. Although it provides only a partial picture, this stocktaking exercise is a crucial starting point for addressing some of the most important challenges in our systems. This chapter attempts to advance this first phase, presenting preliminary national-level quantification of the environmental, social and health hidden costs of agrifood systems for 154 countries. Because of the preliminary nature of these results, considerable uncertainty persists with regard to estimates, so some categories of hidden costs – such as pesticide exposure, land degradation, AMR and the overexploitation of biological resources – have not been included, amid a lack of global databases reporting these dimensions at country level. The 2024 edition of *The State of Food and Agriculture* will attempt to improve this initial preliminary quantification and analysis based on country-specific information and input from in-country stakeholders and experts.

Yet, despite some hidden costs not being included in the analysis, the preliminary estimates of the global quantified hidden costs amount to 12.7 trillion 2020 PPP dollars, equivalent to almost 10 percent of global GDP. Of these, 73 percent were associated with unhealthy dietary patterns that led to productivity losses; 20 percent with environmental costs, mostly due to nitrogen and GHG emissions; and 4 percent with social hidden costs, driven by undernourishment and poverty in agrifood systems. The quantified hidden costs associated with unhealthy diets become increasingly important as the level of income increases. In contrast, addressing poverty and undernourishment remains a priority in low-income countries.

The finding that unhealthy dietary patterns are the main contributor to global hidden costs should not, however, divert attention from the environmental and social hidden costs of agrifood systems. Rather, it emphasizes the importance of repurposing current public support and food environments towards the production and consumption of healthy diets, with positive impacts on the environment. Past evidence has shown that the adoption of healthier and more sustainable dietary patterns can reduce costs related to climate change by up to 76 percent.[19] Still, in low-income countries, the priority remains reducing poverty and undernourishment.

To decide on the most appropriate policies and investments, however, cost–benefit and scenario analyses are needed in addition to further knowledge on the abatement costs of the different strategies (see Chapter 3). For instance, diets often come down to personal choice and preference, and can be more difficult to regulate or shift; consequently, cost-effective climate change mitigation strategies may be more attractive.

This chapter further introduces three intensity indicators to measure the relative weight of quantified hidden costs across different dimensions and countries. These estimates and, in particular, the indicators can help identify entry points for prioritizing a more targeted assessment to guide policy actions and investments to reduce or eliminate hidden costs.

Overall, the results suggest that the quantified hidden costs associated with agrifood systems are substantial for all countries, even after accounting for uncertainty. They reveal the magnitude of transformation required and identify the potential economic risks associated with current practices, but do not consider the net gain or loss that countries might experience by transitioning to alternative agrifood systems. They also do not measure the cost of mitigating or preventing the different challenges, nor do they express whether it is feasible to do so. Rather, they indicate the relative contributions of various activities or pollutants and highlight areas needing further investigation in a targeted assessment and possible intervention by both public and private entities.

Consequently, these estimates can also be used to inform ongoing agrifood systems assessments and consultations that are outside the scope of TCA. Such initiatives consider interactions across sectors and capitals and can help spark national dialogue and determine relevant entry points for transformative action. However, they do not uncover the hidden costs and benefits that hinder the performance of systems. An example is FAO’s Food Systems Assessment project, in partnership with the European Union and the International Cooperation Centre of Agricultural Research for Development (CIRAD), which has advanced large-scale assessments and consultations on food systems in more than 50 countries as a first step towards transforming them.[24] The evidence and knowledge proposed by the first phase of this two-phase approach – and gathered for this report – can be a useful complementary tool for projects such as the Food Systems Assessment, to better identify the key challenges faced by agrifood systems and to define the policies and investments needed.

The next step in this two-phase approach is to compare the costs related to transforming our current systems (termed “abatement costs”) with the reduced hidden costs realized from such a transformation. This is the crux of decision-making processes: a transformation to alternative agrifood systems will only be feasible (and desirable) if the cost of making that change is perceived to be less than the value of the reduced hidden costs realized from the transformation. The decision processes to inform transformational options to address hidden costs are at the centre of the next chapter that will lead to the fourth and final chapter, which examines the levers that can be activated to effect change. ■

SERBIA
Preparing vegetables for a nutritious meal.
©Kristina Snowasp/Pexels.com

CHAPTER 3
MOVING TOWARDS TARGETED TRUE COST ASSESSMENTS FOR INFORMED DECISIONS

KEY MESSAGES

➔ Agrifood systems are complex, making it difficult to measure their impact comprehensively. As a result, targeted assessments that focus on key sectors and challenges are necessary.

➔ True cost accounting (TCA) is a fitting approach for conducting targeted agrifood systems assessments, for example, of dietary patterns, investments, organizations and products. The chosen unit of analysis will depend on the actor(s) for whom the results are most relevant.

➔ Any agrifood systems intervention or management option can involve trade-offs and synergies, including between environmental and economic impacts. Targeted TCA assessments can help identify and manage them, thus aiding governments, businesses and other stakeholders to make more responsible decisions to improve sustainability.

➔ Analysing key policies is essential in targeted TCA assessments to address trade-offs and maximize synergies. Scenario analysis plays a complementary role by exploring the possible outcomes of different future interventions and deciding which will be most effective.

➔ True cost accounting not only helps businesses better understand and manage their impacts and dependencies on agrifood systems, but also leads to improvements in performance, reputation and resilience.

How can we work to transform agrifood systems if their impacts are not well understood at a more granular level? An essential first step in the process is to use an analytical and methodological approach that takes into account all the relevant actors and impacts. To this end, Chapter 1 proposed a two-phase assessment approach to improve understanding of current and future agrifood systems and guide policymakers' and stakeholders' interventions towards sustainability.

Chapter 2 presented an initial effort to advance **phase one** of the assessment process, estimating the hidden costs of national agrifood systems for 154 countries and suggesting some indicators for further analysis. These results should hopefully encourage discussion and dialogue among various sectors and stakeholders. They provide a useful breakdown of the estimated hidden costs of agrifood systems in order to identify the most pressing challenges, which is key to understanding overall priorities. However, these estimates are incomplete and involve a large degree of uncertainty because of data limitations. What is more, they are based on an accounting exercise that captures only part of the hidden costs of agrifood systems and says nothing about the drivers of those costs or the cost of reducing them. This calls for a more granular analysis to capture local specificities, to understand the drivers of hidden costs and the role of current policies in generating them, and to estimate the cost of transformative actions to address them. Such granular analysis is essential in order to compare the effectiveness and cost of potential interventions to address identified priorities.

This chapter focuses on the **second phase** of the assessment process: conducting targeted assessments to support decision-making to improve the sustainability of agrifood systems. In particular, it provides insights into the fundamentals of conducting targeted agrifood systems assessments in countries using TCA. Through a flowchart, it guides policymakers and other interested stakeholders on how to conduct such targeted assessments – from gathering the available data on agrifood systems impacts to evaluating and applying measures needed to achieve the desired outcomes. Acknowledging the complexity of agrifood systems and the fact that policies and other interventions might have spillover effects, the chapter further discusses the importance of assessing policies, such as through scenario analysis, to compare future options and manage trade-offs and synergies.

Lastly, given the increasing pressure on agrifood businesses to adopt more sustainable practices and report on their performance across all capitals (natural, human, social and produced), the chapter investigates the role of TCA assessments in the private sector (that is, business and investment) for transforming agrifood systems. ■

DEFINING TRANSFORMATIVE ACTIONS THROUGH TARGETED ASSESSMENTS

Due to the complexity of agrifood systems, the focus of targeted assessments should be on the key concerns of agrifood systems sustainability and how systemic outcomes can be affected in the short and long term. To this end, the flowchart depicted in Figure 11 presents how to initiate and scale up phase two assessments. The process of targeted assessments is organized into four steps, of which the first three are discussed in this chapter and the fourth in Chapter 4.

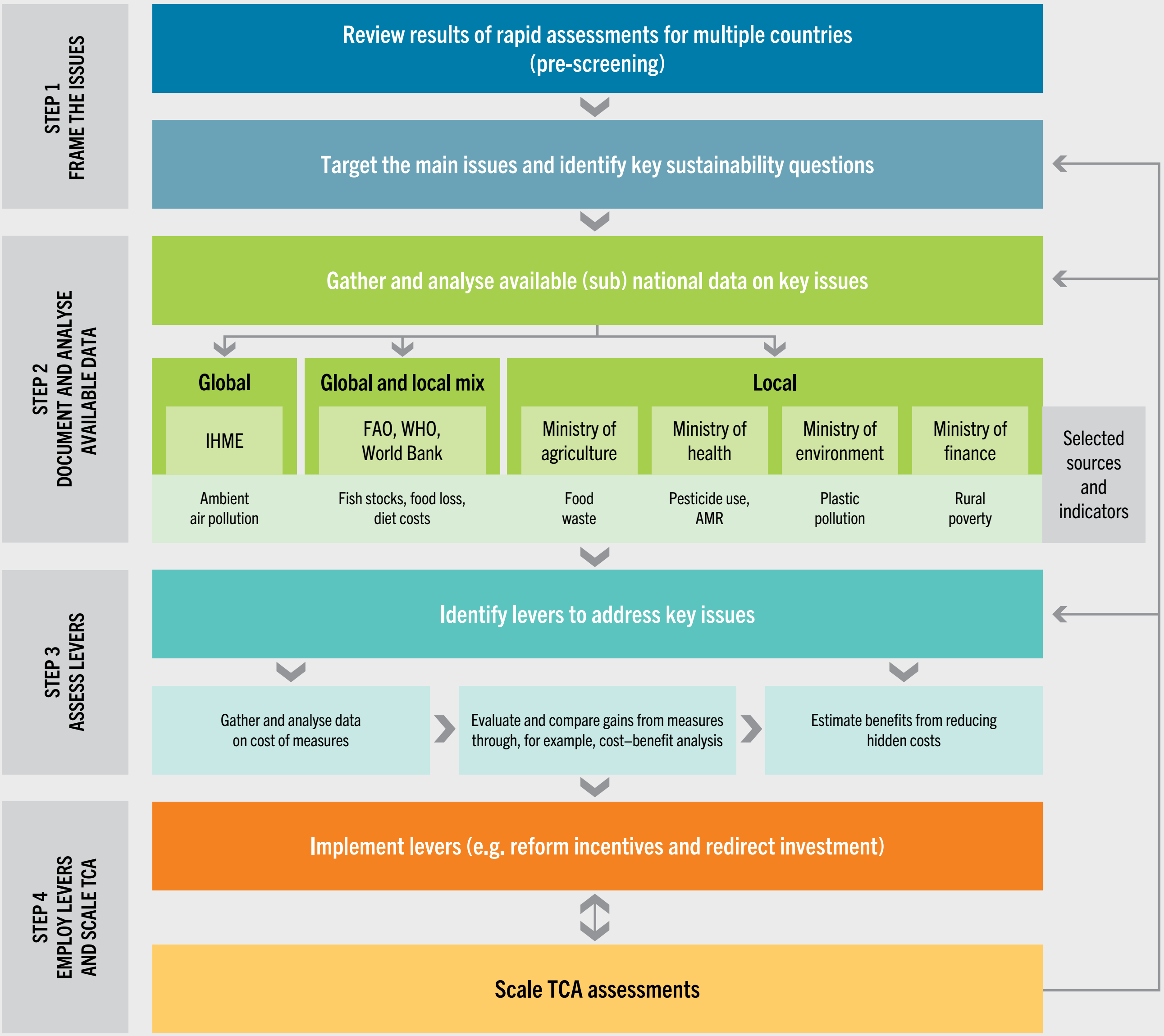
Step one frames the issues. It is based on the results obtained in phase one, which focuses on wider assessments aimed at raising awareness about the current state and performance of national agrifood systems and identifying key issues and policy questions. A good point of departure is the national-level estimates provided in Chapter 2 on the hidden costs of agrifood systems across environmental, social and health dimensions. These results can function as a springboard for dialogue with policymakers and other stakeholders on the magnitude of hidden costs and how they relate to their priorities.

Step two focuses on complementing the national (phase one) estimates with more accurate and disaggregated data, where possible, to reduce their inherent uncertainty. These can be sourced from international institutions, such as the Institute for Health Metrics and Evaluation (IHME), FAO, the World Health Organization (WHO) and the World Bank, or from local entities such as ministries of agriculture, environment and health.[1] Disaggregated data, for example, by gender and income level, are key to revealing differences and disparities not comprehensively reflected in aggregate figures.[2] Due to the diversity of agrifood systems and their contexts within countries, the national scale may be imperfect as an analytical unit for effective actions. Thus, depending on data and resource availability, national-level data should be complemented by spatial analyses, which will enable the heterogeneity of the main impacts and drivers of agrifood systems to be captured at subnational level.

Step three involves identifying potential entry points and levers to address the key issues relating to agrifood systems, evaluating the effectiveness of the measures and making a final choice about which to employ. For this to be effective, the process should be inclusive and allow for dialogue and collaboration among all agrifood systems stakeholders, including policymakers, private-sector entities and local authorities. This is critical to achieving a common understanding of current and future agrifood systems challenges. A combination of cost–benefit and cost-effectiveness analyses can inform the dialogue by comparing the costs and benefits of the various potential policy and investment options in order to reach a final consensus.

Step four, which is the focus of Chapter 4, involves two parallel, but linked, processes: (i) implementing and promoting levers to reform policies, investments and other interventions to address the concerns identified in the previous steps; and (ii) scaling up targeted TCA assessments to enable the monitoring of reforms

FIGURE 11 A FOUR-STEP PROCESS TO INITIATE AND SCALE UP TARGETED AGRIFOOD SYSTEMS ASSESSMENTS



NOTES: AMR = antimicrobial resistance; IHME = Institute for Health Metrics and Evaluation; TCA = true cost accounting; WHO = World Health Organization.
SOURCE: Adapted from Markandya, A. 2023. *Accounting for the hidden costs of agrifood systems in data-scarce contexts – Background paper for The State of Food and Agriculture 2023*. FAO Agricultural Development Economics Working Paper, No. 23-12. Rome, FAO.

and the expansion of TCA assessments to new areas of concern. The arrows going from the bottom box to previous steps in Figure 11 illustrate the cyclical nature of targeted assessment processes, whereby the scaling of TCA should not be viewed as the final objective, but the start of a new cycle of measurement and evaluation to ensure continuous positive results.

In choosing the most appropriate levers and measures, it is important to reveal and evaluate their potential positive or negative cascading effects both within the same dimension and across others. For instance, there are considerable trade-offs between environmental issues, such as GHG emissions and water quality or biodiversity conservation. Trade-offs likewise

BOX 9 THE COST OF IGNORING TRADE-OFFS: THE CASE OF INSECTICIDE USE IN THE HORN OF AFRICA

The growing frequency and intensity of disasters – from floods and droughts to pest invasions and wildfires – are jeopardizing entire agrifood systems.[3] Furthermore, the true costs of such disasters – including the costs of inaction or (mis)management – are often hidden, with far-reaching environmental and social impacts left unaccounted for. True cost accounting (TCA) allows stakeholders to compare and select interventions that are not only more effective but also more sustainable. Two distinct responses to the 2019–2021 desert locust upsurge in the Horn of Africa are a case in point, illustrating stark differences in their impacts on both production and the environment.

In Ethiopia and Kenya, while the control campaign was well intentioned, the methods used also had destructive environmental effects that went unacknowledged.[4] Specifically, while the large-scale spraying of chemical insecticides (broad-spectrum organophosphate and pyrethroid insecticides) designed to kill the locusts did suppress the upsurge, it also inflicted collateral damage on non-target animals, including honeybees. Between 2019 and 2021, honey production in Ethiopia decreased by a staggering 78 percent. Taking into account the impact on wild pollinators, birds and other animals, the true cost of control operations could be in the billions of dollars.

An example-setting response for locust management applying exclusively biopesticides, which use natural bacteria, fungi or viruses to attack insect pests, took place in Somalia during the locust emergency,[5] proving that persistent and pervasive use of organophosphate insecticides can no longer be justified. The Government of Somalia and FAO used the fungus *Metarhizium acridum* and insect growth regulators – a more innocuous and targeted chemical remedy with much lighter environmental impact than traditional pesticides – to effectively control the locusts. The biopesticide response safeguarded grazing lands, which chemical pesticides would have made unsuitable for livestock for some time, thereby enabling pastoralists to maintain their livelihoods.

These findings highlight the need to undertake TCA analysis prior to disasters such as pest outbreaks, which not only incur financial costs in terms of lost crop yield and pest control measures, but also cause potential harm to human health and the environment from the use of toxic pesticides. The TCA analysis should become an essential component of planning and preparing for disasters and emergencies and can complement and even inform investments in disaster risk reduction. *Ex ante* TCA analysis can draw on existing data on different ways of handling a disaster. The analysis would contrast the true costs (and benefits) of status quo methods with those of alternative strategies that protect the health of communities and ecosystems and prevent an upsurge. In the example of an expected pest outbreak, this means comparing the impacts of highly toxic chemical pesticides with the implementation of preventive measures that are environment and health friendly, such as use of biopesticides.

SOURCES: Lazutkaite, E. 2023. Unveiling the hidden costs of climate-related disasters in eastern Africa. In*: TMG*. [Cited 28 April 2023]. https://tmg-thinktank.com/unveiling-the-hidden-costs-of-climate-related-disasters-in-eastern-africa; FAO. 2022. How Somalia used biopesticides to win against desert locusts. In: *FAO.* [Cited 26 May 2023]. http://www.fao.org/fao-stories/article/en/c/1604415

exist between environmental and economic impacts. For example, subsidizing chemical inputs may increase productivity, but also cause environmental harm.[1] Such trade-offs are highlighted in Box 9, which describes the differing responses to the 2019–2021 desert locust upsurge in the Horn of Africa and their varying impacts on production and the environment. No TCA was undertaken in making these choices, so the potentially negative consequences were left unacknowledged. While this can be understood, given the time constraints of such an emergency situation, the example nevertheless points to the power of the TCA approach in planning for similar emergencies, so that – to the extent possible – trade-offs and synergies are identified in advance to steer towards the most effective interventions and avoid causing undue harm. ■

BOX 10 GUIDING PRINCIPLES OF THE TEEBAgriFood EVALUATION FRAMEWORK

The TEEBAgriFood Evaluation Framework has three guiding principles:[8] **universality** – the Framework is applicable to evaluate agrifood systems in any geographical, ecological or social context; **comprehensiveness** – covering all agrifood systems components; and **inclusiveness** – supportive of multiple analytical methods.

The universality principle ensures that the elements considered and evaluated in each assessment are defined and described in a uniform, methodical and consistent manner. This is essential to avoid the limitations of siloed assessment models, such as those only assessing agricultural systems on the basis of land productivity, or water- or energy-use efficiency. These models neglect other aspects of sustainability or equity that are related to, but not determined by, the issues studied in siloed assessments.

The principle of comprehensiveness ensures that all (relevant) hidden costs and benefits, including dependencies and impacts upstream and downstream affecting different stakeholders, are part of the assessment.

The principle of inclusiveness recognizes that several market and non-market valuation tools and methods, including in quantitative and qualitative terms,[8] can assess the hidden costs of agrifood systems. While many flows and stocks can be measured in monetary terms, this is not possible for all aspects of human well-being. Indeed, in different contexts, monetary valuation may not be possible or ethically appropriate, and measurement in qualitative, physical or non-monetary terms may provide important insights.[9]

Thus, the TEEBAgriFood Evaluation Framework allows for a plurality of value perspectives and assessment techniques. Consequently, it can accommodate national-level assessments (as presented in Chapter 2), but expand the analysis with more targeted assessments that recognize local contexts within countries.

NOTE: TEEB = The Economics of Ecosystems and Biodiversity.

GETTING STARTED WITH TARGETED ASSESSMENTS

Defining the scope of targeted assessments

Unlike the broad national-level estimates provided in Chapter 2, targeted assessments enable evaluation of the impacts of specific agrifood systems policies or agrifood business operations. They can also reveal the values of ecosystem services – often neglected by wider assessments due to data limitations (see Chapter 2) – so that these can be factored into decisions, as well as provide recommendations on how to change to practices that deliver more equitable and sustainable agrifood systems. Such an example can be found in Indonesia, where a TCA study convinced the government to include cacao agroforestry in its 2020 Five-Year Development Plan.[6, 7] The same TCA study relied on the TEEBAgriFood Evaluation Framework, which, as noted in Chapter 1, has the broadest support when it comes to targeted assessments and has been applied numerous times in both the public and the private sectors in various countries. Box 10 discusses the framework's three guiding principles – universality, comprehensiveness and inclusiveness – in which targeted TCA assessments should be rooted.

An important part of setting up a targeted assessment is to establish the boundary of analysis to keep the scope of the study feasible while allowing it to sufficiently meet its goal. This starts with choosing the functional unit of analysis, that is, what is being assessed and measured.[10] Figure 12 describes the scopes of the different functional units – agrifood systems, dietary patterns, investment, organization and product – and their relevance to the transformation of agrifood systems towards sustainability.

FIGURE 12 FIVE COMMONLY USED FUNCTIONAL UNITS, THEIR SCOPE AND RELEVANCE

UNIT	SCOPE	RELEVANCE
AGRIFOOD SYSTEMS	Covers the journey of food from farm to table – including when it is grown, fished, harvested, processed, packaged, transported, distributed, traded, bought, prepared, eaten and disposed of. It also refers to non-food products that constitute livelihoods and all of the people as well as the activities, investments and choices within agrifood systems that play a part in getting us these food and agricultural products.	Crucial to holistically assess policies, accounting for the multidimensional, complex, and interconnected nature of agrifood systems. Most complete and, thus, most desirable.
DIETARY PATTERNS	Captures different forms of diets (e.g. pescatarian or vegetarian) or examines policy interventions towards a healthier diet based on a population's current dietary patterns.	Important to understand and influence dietary patterns of the population, as these determine health outcomes and overall welfare.
INVESTMENT	Typically refers to investments made by organizations or private investors. For policymakers, it refers to public investments or expenditures of public financial means.	Simultaneously constitutes a policy goal and a functional unit. Relevant to answering the question of how spending can decrease hidden costs and thereby contribute to better agrifood systems.
ORGANIZATION	Describes the impacts of an entity, typically used for commercial organizations.	Only relevant for policymakers if commercial actors are part of the theory of change behind a policy intervention, for example, public–private collaborations. Private corporations often conduct their own true cost accounting assessments, which policymakers can tap into.
PRODUCT	Looks at the impacts of a product, ideally covers its full production process and end of life.	Often crucial to understanding the levers with which products and, thus, systems can be improved.

SOURCE: Adapted from de Adelhart Toorop, R., van Veen, B., Verdonk, L. & Schmiedler, B. 2023. *True cost accounting applications for agrifood systems policymakers – Background paper for The State of Food and Agriculture 2023*. FAO Agricultural Development Economics Working Paper, No. 23-11. Rome, FAO.

The scope of the analysis is further defined by geographical and temporal boundaries. Geographical boundaries set the study within a defined geographical area such as a country or subregion. Examples include a study that assesses different dietary patterns in the United States,[11] one that analyses meat produced in Germany,[12] and another that studies rice production in Thailand.[13] The temporal boundaries in a TCA study refer to the time span of the results, including the baseline of the data used and the policies assessed, as well as the timeline for scenario analysis.[14] In essence, any targeted assessment will inevitably be a partial and incomplete snapshot of reality, limited by a given set of boundaries over a given period of time.

The chosen functional unit will depend on the policy focus or research question. Generally, boundaries of analysis that incorporate the higher level of agrifood systems and include various actors are most suitable for

BOX 11 TEEBAgriFood EVALUATION OF RICE PRODUCTION IN NORTHEASTERN THAILAND

The TEEBAgriFood Evaluation Framework was used to identify and measure the diverse costs and benefits of expanding organic rice production in Thailand. The aim was to pinpoint options for promoting the long-term sustainability of production and management of rice landscapes. The analysis was concluded in June 2022 and considered hidden costs across all four capitals: natural (greenhouse gas [GHG] emissions and biodiversity), human (effects of air pollution and pesticides on health, happiness and well-being), social (cooperation, trust and pro-social or voluntary behaviour) and produced (revenues and expenditures of conventional versus organic rice).

Taking into account government policies and targets, as well as the views of local stakeholders – including local agricultural officers, farmers and banks – the analysis proposed four scenarios to demonstrate the potential synergies and trade-offs of different rice practices in Thailand over 2019–2035. One was the baseline business-as-usual (BAU) scenario (S1), while the other three scenarios (S2, S3 and S4) assumed the progressive adoption of organic rice production and other sustainable practices. Each scenario was measured over three time frames: short (2025), medium (2030) and long (2035).

Applying cost–benefit analysis to the results of the four scenarios, the study found that the expansion of organic rice area under S2, S3 and S4 (compared with S1) generated benefits for the environment (as a result of lower GHG emissions) and human health (thanks to reduced exposure to pesticides and air pollution). The human health net benefits ranged from USD 438 million in S2 to USD 4 146 million in S4. The net environmental benefits were between USD 2 million in S2 and USD 16 million in S4. However, this same expansion caused a net loss of revenue – from USD 29 million in S2 to USD 389 million in S4. Putting this in perspective, this loss is less than 1 percent of the total BAU scenario projection of net revenue of USD 57 billion.

However, it was estimated that the revenue lost as a result of the decline in yield would be offset if organic rice were priced 3.5 percent higher than conventional rice. Given these findings, the assessment recommended that subsidies be reoriented to induce farmers to adopt sustainable agricultural practices, including organic rice growing. This was particularly pertinent to the transitional period, when farmers would need more support, as organic rice yields could be expected to fall slightly in the short to medium term. Furthermore, to boost demand for the increased output of organic rice, export promotion might be needed, for example, policies and standards for certification, such as policies to promote the grouping of farmers into discreet areas certified as organic to share the cost.

NOTE: TEEB = The Economics of Ecosystems and Biodiversity.
SOURCE: Khon Kaen University. 2022. *Measuring What Matters in Rice Systems: TEEBAgriFood Assessment Thailand, focus on the Northeast region. Key messages, August 2022*. TEEB. https://teebweb.org/wp-content/uploads/2022/09/5-TEEBAgriFood-IKI-Key-messages.pdf

policymaking, as they are more holistic and consider the potential to steer systemic impact.[14] Chapter 2 relied on the highest functional unit (national agrifood systems) to estimate the hidden costs of entire systems for 154 countries. Despite their importance in catalysing change, analyses at a systemic level remain aggregated and do not allow great detail.

Activating levers for change usually requires analysis on a more granular level. This often requires *product* or *investment* to be the functional units necessary to inform concrete decisions. For instance, Box 11 assesses the impact of changes in rice production, and thus *product* is chosen as the functional unit. However, the assessment could also have been conducted at a territorial level to complement farm-level results, to capture the full range of impacts, externalities and dependencies taking place beyond the farm gate, such as the impact on food security.[13]

Furthermore, if the policy concern is to promote healthy diets, then choosing *dietary patterns* as the functional unit would be more appropriate. Choosing *organization* as the functional unit might also be suitable in certain cases. While it is mostly used for the private sector, *organization* as the functional unit can produce valuable insights if the policy goal is to identify areas in which businesses need support either to conduct TCA themselves or to reduce their negative impacts.[14]

Policy and scenario analyses: their fundamental and complementary roles in targeted TCA assessments

Scenario analysis is a critical feature of any TCA exercise, regardless of the boundaries of the analysis. In this report, scenarios are defined as representations of possible futures for one or more components of the studied system, based on alternative policy or management options. Whether the domain of a TCA application is national agrifood systems, local dietary patterns, a public investment or a value chain, the analysis of these scenarios involves the comparison of potential future paths and assesses the impact and effectiveness of different policies and management options.[15] Scenario analysis aims to answer the following questions: What will happen if no action is taken? Will the problem worsen and how quickly? What will the cost of inaction be? In answering these questions, scenario analysis identifies emerging issues from inaction and explores alternative options for action that can potentially lead to improved outcomes, as well as synergies and trade-offs. Such trade-offs can then be carefully weighed to formulate stronger strategies and assess the effectiveness of different potential actions.

Policy analysis builds on and complements scenario analysis – to evaluate and compare the different proposed policy options, as well as their relative potential in achieving specific policy goals. In other words, policy analysis uses scenarios to identify, from the pre-screened policies, those options most likely to be economically viable and effective in achieving the desired policy outcome, given the estimated resources required for implementation against available resources. In a policymaking context, scenario analysis is applied in relation to the decision-making process depicted in Figure 13.[15]

Problem identification (scenario of inaction), policy formulation and policy assessment (scenarios of action for policy analysis) are stages of the decision-making process that take place before implementation, which is followed by monitoring and evaluation.

To use scenarios in policymaking, the first stage is problem identification. Here, **exploratory scenarios** can examine a range of plausible futures based on potential trends in drivers such as climatic, socioeconomic, biophysical and technological factors. These scenarios enable policymakers to be aware of the baseline (that is, the current situation) and the main drivers of change in a scenario of inaction (the business-as-usual [BAU] scenario). These scenarios rely on input from a multistakeholder approach that involves the various actors in question and, thus, incorporates different perspectives and expertise, promoting a more comprehensive understanding of agrifood systems. The objective of this stage is to map the relationships between agrifood systems and the four capitals, represented by the most important flows in the specific content, such as the impacts of agrifood systems on GHG emissions, human health and income distribution.[8]

Box 12 describes a scenario analysis used to compare current and future food consumption – following the BAU scenario – and alternative consumption scenarios that have been devised as being healthier and more sustainable.

These exploratory scenarios can help to reframe the problem in order to set a policy agenda more effectively. They typically have both qualitative and quantitative components and are often combined with participatory approaches involving local and regional stakeholders. For example, population growth projections can be used to estimate expected land-cover changes when investigating trends in agricultural expansion or urbanization.

The next stage of the decision-making process is policy formulation, which is critical if a targeted assessment is to be impactful. Based on input from the BAU scenario in the problem identification stage, targets can be set to drive change towards more desirable outcomes, again

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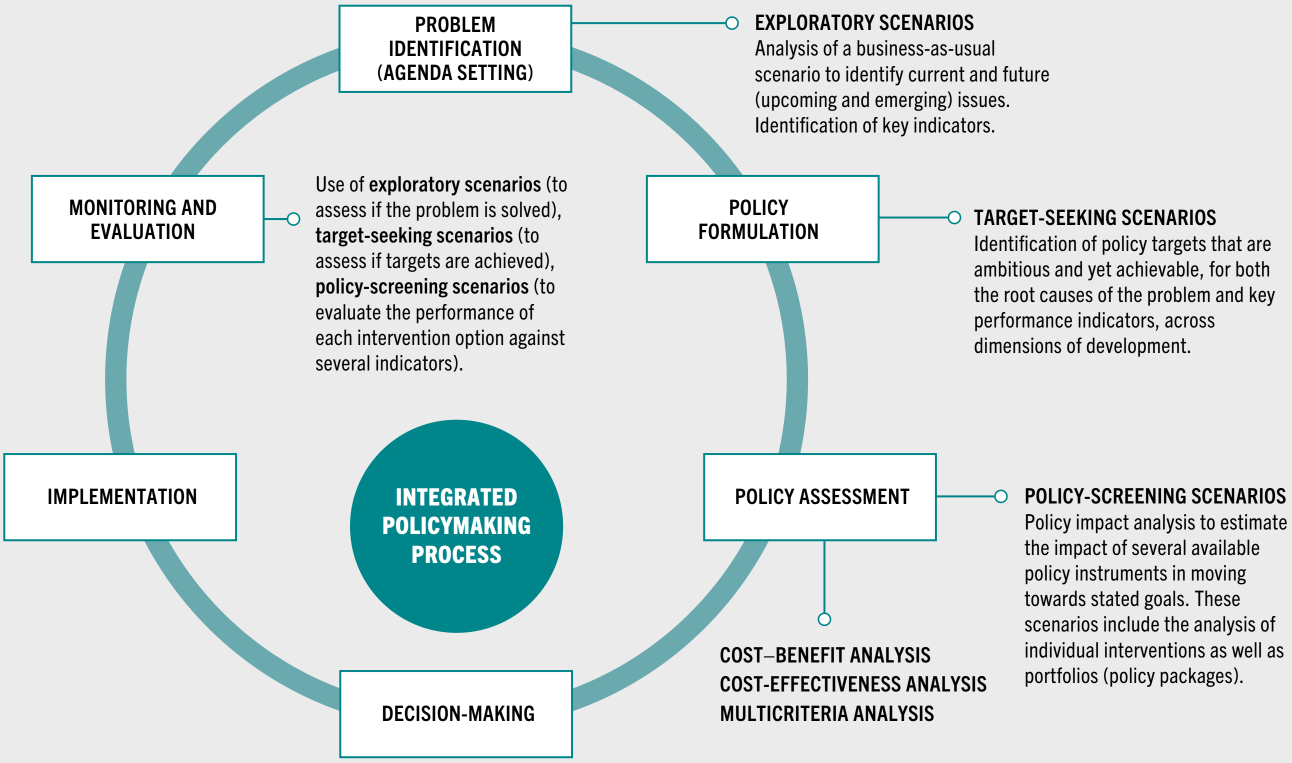
FIGURE 13 THE ROLE OF SCENARIOS IN INFORMING POLICYMAKING



SOURCE: Authors' own elaboration based on Bassi, A. 2023. *A guide to applying TEEBAgriFood for policy assessment*. Geneva, Switzerland, the Economics of Nature Unit, UNEP.

BOX 12 SCENARIO ANALYSIS TO UNCOVER THE HEALTH AND ENVIRONMENTAL HIDDEN COSTS OF DIFFERENT DIETS

An analysis by Springmann (2020)[16] as a background paper for FAO *et al.* (2020)[17] estimated health- and climate-related hidden costs of dietary patterns by the year 2030. It compared the continuation of current dietary patterns (see Figure 12) with four alternative consumption scenarios that had been devised as healthier and more sustainable (flexitarian, pescatarian, vegetarian and vegan). The objective was to measure by how much these costs could be reduced and, thus, inform food policy to incentivize dietary changes towards healthy diets that were more environmentally sustainable.

The results showed that if current food consumption patterns continued, diet-related health costs linked to non-communicable diseases and their mortality would likely exceed USD 1.3 trillion per year by 2030. In contrast, shifting to healthy diets would lead to an estimated reduction of up to 97 percent in direct and indirect health costs, generating significant savings that could be invested to lower the cost of nutritious foods. As for climate-related costs, greenhouse gas emissions associated with current dietary patterns were projected to exceed USD 1.7 trillion per year by 2030. The adoption of alternative diets, however, would reduce this cost by an estimated 41–74 percent in 2030, depending on the scenario.

» based on national objectives. **Target-seeking scenarios** can then be used to examine and formulate policy targets, depending on their viability and effectiveness.

These identified policies are then pre-screened in the policy assessment stage, using **policy-screening scenarios** that assess how a policy instrument (or set of instruments, such as incentives, mandates, direct investments or awareness raising) can modify the future.[18] This enables better understanding and forecasting of the outcomes of implementing a specific policy, by exploring the interlinkages and interdependencies within and between the systems targeted by the policy. Criteria that might be considered for the selection of specific policy instruments include: (i) the extent to which reaching the stated target is economically viable and whether new valuation evidence might support the adoption of a new policy; (ii) political economy – who favours the change, who is against it and what the influence of each group is; and (iii) who might gain and who might lose from the change, and whether the new policy would provide livelihood options to communities or sectors of society that have few alternatives. Considerations can be informed by the use of qualitative and quantitative methods, including simulation models, as well as stakeholder and expert consultation workshops. Box 13 provides an example from Indonesia on how policy-screening scenarios can be used in a real policy context (see Box 11 for another example in Thailand).

Lastly, the policy-screening scenarios need to be ranked so that they can inform decisions. Ranking can be informed by a cost–benefit analysis or a cost-effectiveness analysis, coupled with a multicriteria analysis. While a cost–benefit analysis compares the benefits and costs of different interventions and determines their economic and financial viability, a cost-effectiveness approach compares the costs of meeting a given objective when using different intervention options, such as the cost per tonne of avoided emissions through energy efficiency, renewable energy and reduced deforestation. These ways of ranking results are particularly relevant when examining different options for reducing the hidden costs of agrifood systems, because the cost of transformation (that is, the abatement cost), despite being necessary for effective decision-making, is not always visible.

In some cases, certain hidden costs cannot be valued in monetary terms, but are material to a policy decision – in other words, meaningful in a given decision-making context (see Glossary for a definition of “materiality”). For these, both a cost-effectiveness analysis and a multicriteria analysis (which couples qualitative and quantitative indicators) can be used to determine the extent to which an intervention option generates societal value and is worth implementing. Ultimately, TCA analyses should consider all material indicators, including monetizable and non-monetizable impacts. The aim is to account for all costs and benefits of any proposed investment or policy change over the foreseeable future, so an assessment can be made as to where the benefits exceed the costs.

Based on the outcomes of the scenario analysis, policy decisions are made and implemented, as illustrated in Figure 13. This should be followed by monitoring and evaluation to assess past efforts to achieve policy goals in all stages of the policy cycle and decision-making context. These assessments also rely on exploratory, target-seeking and policy-screening scenarios to assess: (i) whether the identified problem has been solved; (ii) whether the set targets have been achieved; and (iii) how each intervention performed against specific indicators. ■

TARGETED ASSESSMENTS FOR SUSTAINABLE AGRIFOOD BUSINESSES AND INVESTMENTS

So far, this chapter has provided guidance on how to initiate a targeted TCA assessment and discussed its relevance in defining policies that transform agrifood systems towards sustainability. Indeed, policy interventions may partly correct existing market failures, but policy alone is unlikely to address all issues. Agrifood systems are largely shaped by the endeavours

BOX 13 USING SCENARIO ANALYSIS IN A REAL POLICY CONTEXT: AN EXAMPLE FROM INDONESIA

In scenario analysis for agrifood systems transformation, a key policy question is: how can sectoral sustainability be enhanced? Such was the question in Indonesia, where cacao is an important crop, contributing to export earnings and job creation, but where current monoculture practices threaten its sustainability.[19, 20] The use of scenario analysis in a TEEBAgriFood study of North Luwu Regency, South Sulawesi focused on the impacts and dependencies of cacao production, including processing, distribution and consumption activities and their relationships with ecosystems.[7] It compared the social and environmental impacts of monoculture cacao production and agroforestry cacao production systems to develop agriculture and land-use policies that will build its resilience and economic viability.

Specifically, the study determined the total economic value (TEV) of cacao production under monoculture and agroforestry practices. It further evaluated the consequences of scenarios of cacao agroforestry expansion. To achieve this goal, a set of dynamic simulation models was applied to evaluate the TEV of particular areas between 2021 and 2050.

The assessment compares the potential costs and benefits of a business-as-usual scenario (monoculture) with a simple agroforestry and a complex agroforestry (CAF) scenario. For the implementation of the CAF scenario, two policy interventions are considered and tested in policy-screening scenarios: (i) providing seedlings for the agroforestry system along with targeted extension services and training on good agricultural practices; and (ii) promoting certification and eco-labelling. These cacao production scenarios were generated using a comprehensive suite of environmental, biophysical, statistical and socioeconomic models.

The results of this exercise show that cacao agroforestry provides higher total economic value than both cacao monoculture and cacao intercropping. The benefits derive from a variety of sources, including lower rates of erosion and nutrient leaching, and higher rates of carbon storage in the hypothetical agroforestry systems, leading to both social and private benefits (fewer greenhouse gas emissions and higher crop productivity). In addition, farmers would improve their private income when measuring all possible agroforestry products and could enhance their resilience through income diversification.

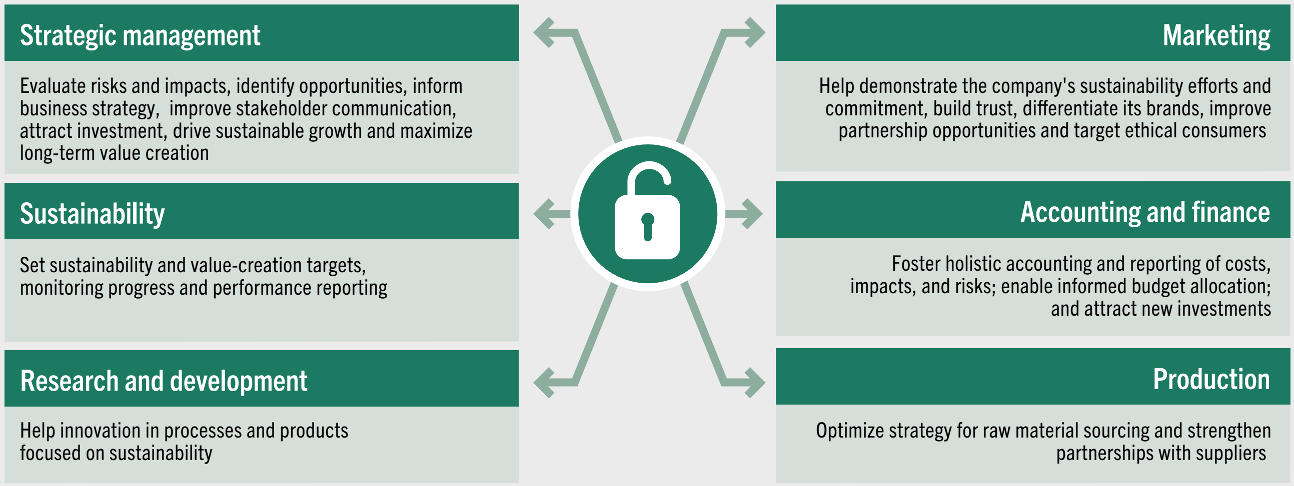
Despite these benefits, the adoption of cacao agroforestry is still very limited. While the study identifies the need for capacity building on good agricultural practices as a major priority, it also points to the need to create incentives for producing premium-quality agroforestry systems.

of the private sector, which could take on some of the responsibility for minimizing market failure. This section, therefore, complements the previous ones by presenting and discussing the relevance of the TCA approach and various related initiatives to agrifood businesses and investments.

With pressure from both consumers and governments mounting, agrifood business are increasingly adopting sustainable practices and reporting on their environmental, social and governance performance. Still, many private businesses might have a vested interest in maintaining the status quo, therefore governments may impose laws and regulations affecting the private sector. Such regulations might constrain the way private businesses produce, process and promote their products. Targeted TCA assessments can therefore help businesses monitor the hidden costs they impose on society.

However, agrifood businesses could see value in targeted TCA assessments for their own business interests. Specifically, BAU scenarios identify current and future risks to business viability by revealing the hidden costs that may be imposed on them. This allows businesses to rethink operational and strategic business models and change planning horizons from short-term profit maximization to long-term sustainability strategies as the foundation of businesses fit for the future.

FIGURE 14 EXAMPLES OF HOW TRUE COST ACCOUNTING CAN INFORM DECISION-MAKING IN DIFFERENT DEPARTMENTS OF AN AGRIFOOD COMPANY



Strategic management

Evaluate risks and impacts, identify opportunities, inform business strategy, improve stakeholder communication, attract investment, drive sustainable growth and maximize long-term value creation

Sustainability

Set sustainability and value-creation targets, monitoring progress and performance reporting

Research and development

Help innovation in processes and products focused on sustainability

Marketing

Help demonstrate the company's sustainability efforts and commitment, build trust, differentiate its brands, improve partnership opportunities and target ethical consumers

Accounting and finance

Foster holistic accounting and reporting of costs, impacts, and risks; enable informed budget allocation; and attract new investments

Production

Optimize strategy for raw material sourcing and strengthen partnerships with suppliers

SOURCE: Riemer, O., Mairaj Shah, T.M. & Müller, A. 2023. *The role of true cost accounting in guiding agrifood businesses and investments towards sustainability – Background paper for The State of Food and Agriculture 2023*. FAO Agricultural Development Economics Working Paper, No. 23-13. Rome, FAO.

How TCA can support sustainable business models and investments in the agrifood sector

Targeted assessments play a crucial role in providing a framework for businesses to assess and manage their impacts and dependencies more comprehensively and accurately. Whether the functional unit of the assessment is product, organization or investment, targeted TCA assessments can inform decision-making in different departments of an agrifood company (see Figure 14). For example, some environmentally conscious food-processing companies use TCA to assess supplier performance on various sustainability criteria, such as farming techniques, pesticide management and social justice. As such, TCA can lead to a slew of measures that enable agrifood business actors to make informed decisions that support the transformation of agrifood systems, bringing benefits to both the businesses and their investments, as well as the public.

True cost accounting can be integrated into everyday decision-making and management strategies. It can help agrifood businesses monitor and unlock opportunities at different stages of the supply chain, achieve sustainable production, attract private investment and avail of government incentives. When adopted by policy and backed by laws and regulations (see Chapter 4), TCA redefines key performance indicators and changes the bottom line of business success by including human, social and natural capitals. In brief, it redefines the concept of "successful business". When adopted by businesses and investments, TCA can enable disclosures that improve their reputational standing, supporting their marketing strategies.

The concept of "materiality" was introduced in Chapter 1 in the context of incorporating into TCA assessments only those indicators that were meaningful to decision-making. A related concept is that of "double materiality", which refers to (i) how a business is affected by sustainability issues, such as the risks of conducting business as usual, and (ii) how its activities impact society and the environment.[21] In the case of agrifood businesses, double materiality helps identify material risks, as well as opportunities other than explicitly financial ones, so they can develop resilient strategies that attract investment.[21] In this regard, TCA can help to change mindsets and make the private sector understand the importance of considering the impacts and interdependencies

BOX 14 INCENTIVIZING CLIMATE-SMART COFFEE PRODUCTION IN COLOMBIA

Solidaridad is an international civil society organization, based in the Kingdom of the Netherlands, which promotes climate-smart agriculture (CSA) as a valuable model for coffee production. Focusing on Colombia, Solidaridad commissioned a true cost accounting (TCA) analysis using the True Price framework* to better understand the implications of investing in and adopting CSA practices in coffee production. The study is based on primary data from a group of 60 smallholder farmers in the state of Cauca, who use a set of 16 CSA techniques.

The TCA study assessed the environmental and social value of CSA in coffee production relative to conventional practices. The results showed that adopting CSA practices in coffee production is financially sustainable – as evidenced by a positive return on investment, increased profitability and greater cost-effectiveness. There are also substantial social and environmental benefits, largely due to the fact that climate-smart coffee uses far less fertilizer. It further reduces climate change risk, increases resilience to coffee rust and improves coffee quality. By making these insights transparent, businesses can mobilize investment with higher impact and lower risk. For investors seeking to have an impact on environmental issues, these results also suggest that switching to CSA farming is particularly relevant. However, as switching to CSA requires significant investment, both up front and in the early years, farmers must be given support, for example, in the form of loans or payments for environmental services.

NOTE: * The True Price framework aims to incorporate the environmental and social hidden costs of agrifood products into the prices at which they are sold.
SOURCE: Brounen, J., de Groot Ruiz, A., Isaza, C., van Keeken, R., Varoucha, E. & García, R. 2019. *The true price of climate smart coffee. Quantifying the potential impact of Climate-Smart Agriculture for Colombian coffee.* https://www.solidaridadnetwork.org/wp-content/uploads/migrated-files/publications/TP%20CSA%20Coffee%20COL.pdf

of all four capitals that are critical to business and investment success.

Financial institutions such as banks and insurance companies can also use TCA to determine credit and insurance conditions based on better risk assessments, thus improving credit and insurance conditions for sustainable businesses. A comprehensive assessment of costs and benefits with TCA can also help businesses mobilize financial resources for the transition to sustainability, opening up opportunities for new investment and upscaling. Box 14 describes a TCA study on climate-smart coffee production in Colombia as part of an effort to nudge coffee producers into adopting sustainable practices, attracting investment and controlling risks.

In addition, TCA can also help businesses respond to the growing demand for supply-chain transparency from consumers, who are increasingly becoming conscious of the different aspects of production, including working conditions and environmental impacts. According to a survey conducted by The Food Industry Association (FMI) in 2022, 65 percent of respondents were willing to switch from their preferred brands to ones that were more transparent on supply-chain conditions, and to embrace values such as fair trade and animal welfare.[22] In this regard, TCA can also help businesses qualify for voluntary certifications (such as Fairtrade) and government incentives.

Insights from applications of targeted assessments in the private sector

Faced with the growing urgency of quantifying the hidden costs incurred by businesses, particularly those of agrifood products, several initiatives have taken the first steps. These target TCA within the private sector of agrifood businesses and financial institutions and can help fill data gaps and contribute to capacity building, both of which are fundamental barriers to scaling up TCA, especially in middle- and low-income countries. In addition to the *TEEBAgriFood Operational Guidelines for Business* discussed in Chapter 1, which adapt the TEEBAgriFood Evaluation Framework to the needs of transforming agrifood businesses, there are other efforts guiding companies on evaluating their impacts, as described in Box 15. Overall, the existing resources cover a significant amount of ground when it comes

BOX 15 TRUE COST ACCOUNTING INITIATIVES IN THE PRIVATE SECTOR

The private sector is taking significant steps towards implementing true cost accounting (TCA) in the agrifood sector. Several initiatives – in addition to the release of the *TEEBAgriFood Operational Guidelines for Business*[23] – have been launched to provide concrete and practical TCA methodologies, standardize natural capital accounting and create impact statements for businesses. For example, the True Cost Initiative produced the *True Cost Accounting AgriFood Handbook*, which outlines a TCA methodology that was tested on 20 supply chains in 14 countries on 5 continents.[24] The Transparent project issued a report to inform the standardization process of natural capital accounting in corporate environmental assessments,[25] while the Impact Institute developed its Integrated Profit and Loss Assessment Methodology aimed at creating impact statements for businesses.[26]

At the primary production level, the Global Farm Metric launched the first edition of a framework that defines on-farm sustainability and measures whole-farm impacts.[27] Other initiatives are advancing TCA in the field of true pricing, such as the True Price Foundation, which aims to incorporate the environmental and social costs of agrifood products into selling prices, and which published draft principles for true pricing in 2020.[28]

Several networks with a focus on joint communication have also been formed to increase visibility and outreach for TCA. Examples include Business for Nature and We Value Nature – both of which have emerged from the Capitals Coalition – in addition to the TCA Accelerator and the True Value of Food Initiative. These networks play critical roles in raising awareness of the hidden costs of agrifood systems, informing private- and public-sector policy, calling on governments to take action, sharing information and data, providing training, organizing events and forming partnerships to accelerate TCA upscaling.

to the business applications of TCA. However, there are still areas where further development is needed to fully realize the potential of TCA in the private sector. These include frameworks and standards, methods, corporate governance and strategy, and reporting guidelines.[21]

Consequently, only a small number of agrifood businesses analyse the outcomes and effects of their actions, and even fewer assign a value (see Box 16 for examples). Notably, businesses often start their impact and valuation journey by assessing their impacts on and risks to natural capital, especially GHG emissions. This is probably due to the fact that resources, especially services and tools, are widely available and there is widespread knowledge of the urgency of the climate crisis, also among consumers. In this regard, the main comparisons made by agrifood businesses in their TCA assessments have been between organic or biodynamic agriculture and conventional agriculture.

Though these initiatives demonstrate a growing commitment from the private sector towards implementing TCA in the agrifood sector, there is still much work to be done to fully realize its potential. For instance, in the absence of a standardized methodology for TCA, there is a risk of genuine efforts not being appropriately recognized, while half-attempts that misuse numbers gain more recognition. Half-attempts refer to businesses that only dedicate a small portion of their budgets and resources to sustainable activities, but present them as an indicator of their sustainable nature. This reinforces the need to further formalize and mainstream TCA in the private sector. ■

CONCLUSIONS

This chapter goes beyond the wider, national-level estimates presented in Chapter 2 and focuses on conducting targeted assessments to support decision-making to improve agrifood systems sustainability in the short and long term. It presents conceptual guidance on how to conduct TCA through the TEEBAgriFood Evaluation Framework to assess the impacts of agrifood policies and businesses. Thus, it helps to formulate recommendations to change agrifood systems activities, be they in business or government, so that agrifood systems transform towards sustainability.

BOX 16 HOW BUSINESSES MAKE USE OF TRUE COST ACCOUNTING – EVIDENCE FROM THREE BUSINESSES

The following examples describe diverse ways in which businesses make use of true cost accounting. What connects the different efforts is their motivation and the goals of increasing transparency and reducing negative impacts on society and the environment.

Eosta is an agrifood business focused on the distribution of fresh organic fruits and vegetables based on fair trade. It keeps track of the different benefits and costs the business entails for the four capitals through its own accounting system, called Nature & More. Customers can visit the website and learn about the quality of certain products, and access background information on the growers and their ecological and social commitment, including metrics such as water and soil conservation and reduction in CO_2 emissions. In 2017, Eosta performed an assessment of nine fruits and vegetables and concluded that, based on true costs, conventional, non-organic products are more expensive than organic produce. Based on its accounting system, Eosta has saved more than 100 000 tonnes of soil and 2 billion litres of water and reduced CO_2 emissions by more than 10 000 tonnes.

Olam International is a food and agriculture business supplying food ingredients, feed and fibre to more than 20 000 customers worldwide, with operations in over 60 countries, including farming, processing and distribution, as well as a sourcing network of 5 million farmers. The business has developed a tool for multicapital accounting – the Olam Integrated Impact Statement – which allows Olam to disclose its impact on multiple capitals and to measure and value its annual multicapital flows and accumulated multicapital stocks. By monetizing, consolidating and reporting hidden costs alongside conventional financial figures, Olam can account for these costs, better understand future risks and manage them promptly.

PENNY, a popular German discount supermarket chain, started calculating the "true prices" of a set of products – including fruits, vegetables and animal-based foods – and posting these alongside their market prices in 2020. It found, on average, a gap of 62 percent between the true costs of conventionally produced foods and their retail prices. In the case of organic foods, the gap is 35 percent. Uncovering the true costs need not imply higher food prices, however. For example, if the root causes of hidden costs are addressed upstream in the value chain in a cost-effective manner, families' expenditures on food need not increase.

SOURCE: Riemer, O., Mairaj Shah, T.M. & Müller, A. 2023. *The role of true cost accounting in guiding agrifood businesses and investments towards sustainability – Background paper for The State of Food and Agriculture 2023.* FAO Agricultural Development Economics Working Paper, No. 23-13. Rome, FAO.

In particular, the chapter emphasizes how targeted assessments need to be selected based on the priorities of policymakers in specific contexts. It shows the power and flexibility of TCA in its application to different scopes, from an entire agrifood system down to a single product. Regardless of analysis scope, TCA can be used to compare different policy and management choices. Scenario and policy analyses feed into TCA, examining a range of plausible futures, including the outcomes and effectiveness of various policy or management options. Depending on the data used in the scenario analysis, methods such as cost–benefit analysis, cost-effectiveness analysis and multicriteria analysis can be used to group results and propose reforms that can affect incentives, regulations, standards and investments.

To complement the role of TCA in better informing policymakers, the chapter also reviews its role in guiding sustainable agrifood businesses and investments. Specifically, it shows how TCA can help businesses and private investments to become sustainable and more resilient by improving strategic and operational management, leading to better supply-chain transparency. The chapter cites TCA initiatives and applications in the sector to illustrate how TCA can support businesses in monitoring and unlocking opportunities that can help improve their sustainability.

In conclusion, the chapter provides conceptual guidance for policymakers and agrifood businesses on undertaking targeted assessments. Based on the significant progress already made by existing resources, Chapter 4 presents how policymakers, academia and standard-setters play complementary roles in scaling up the adoption of TCA for agrifood policy and business analyses. The objective is to better inform decisions, so that action can be taken to address the key systemic hidden costs. ■

CHINA
Bai woman shopping for food.
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CHAPTER 4

MAINSTREAMING TRUE COST ACCOUNTING TO SUPPORT THE TRANSFORMATION OF AGRIFOOD SYSTEMS

KEY MESSAGES

➔ Governments have a wide array of levers at their disposal to effect the transformation of agrifood systems. When based on targeted true cost accounting (TCA) assessments, these levers can be used to improve the economic, social and environmental sustainability of agrifood systems.

➔ Subsidies are one of the most important ways in which governments support food and agriculture. Repurposing these subsidies has the potential to improve environmental sustainability and human health without reducing economic welfare.

➔ Private capital invested in the food and agriculture sector of as much as USD 9 trillion a year, or 14 times global public support, plays an important role in shaping sectoral sustainability by affecting the way food is produced, processed and distributed. It also influences consumer choice.

➔ Scaling up the adoption of TCA can facilitate the correct implementation of the levers. For this to happen on a large scale, especially in low- and middle-income countries, the barriers of data scarcity, poor-quality data and lack of capacity need to be overcome.

➔ Governments are the linchpins in creating a conducive environment for the scaling up of TCA, alongside research organizations and standard setters. Accounting firms, business consultancies and financial institutions can further advise and support businesses in their sustainability transition.

The first chapter of this report proposed a two-phase approach to capturing the complexity and interdependency of agrifood systems actors, starting with wider, national-level assessments involving high levels of uncertainty, followed by targeted, subnational evaluations to prioritize solutions. Chapter 2 provided input to the first phase of this process by valuing the national-level hidden costs of agrifood systems for 154 countries as a starting point for dialogue with policymakers and other stakeholders. Chapter 3 focused on how to initiate the second phase by conducting targeted assessments to better inform and support decision-making with a view to implementing the changes needed to improve the sustainability of agrifood systems in the short and long term. In addition to providing guidance to policymakers, Chapter 3 also discussed the relevance of TCA to the private sector (businesses and investors) in terms of the opportunities it can present for the benefit of both private companies and the public more broadly.

Recalling Figure 11 in Chapter 3, which introduced a four-step framework to guide decision-makers in undertaking targeted assessments and choosing the most appropriate interventions, this fourth and final chapter focuses on the last step of that framework – to present in more detail the role of different levers and how they can be strategically employed to propel agrifood systems towards sustainability. This chapter also discusses the requirements for an enabling environment to scale up TCA. It ends with important considerations for choosing policies, including how to handle multiple policy objectives and the resulting implications for food prices of addressing the hidden costs of agrifood systems. ■

TRUE COST ACCOUNTING CAN INFORM THE USE OF LEVERS TO TRANSFORM AGRIFOOD SYSTEMS FOR THE BETTER

After conducting phase-two targeted assessments, policymakers and stakeholders will have a better understanding of current and future agrifood systems challenges and opportunities. Integral to these TCA assessments are scenario and policy analyses, which assess the impact and effectiveness of different policies and management options. This is essential to identifying synergies and trade-offs and, thus, identifying the most appropriate entry points to improve the sustainability of agrifood systems, including the socioeconomic viability, cost-effectiveness and potential environmental performance of different levers. The overall objective is to help guide decision-makers in activating the right set of levers that will help to make agrifood systems more economically, socially and environmentally sustainable.

Existing levers in agrifood systems, such as agrifood subsidies, could be redirected or reformed, while promising and emerging strategies for sustainable business and investment should be scaled up. The choice of lever will depend on the results of TCA – and, in particular, the scenario and policy analyses described in Chapter 3 that feed into it – and on context-specific needs, priorities and available resources. Against this backdrop, this section provides general guidance on the potential use of levers for transforming agrifood systems for the better, contingent upon the context and the findings of TCA analyses.

Expanding on Figure 1, which showcased important areas of leverage for influencing the actions of decision-makers, Figure 15 illustrates the specific levers that can be deployed to stimulate a change in agrifood systems. As the figure shows, levers can affect the supply side (production and intermediaries), the demand side (food consumption) and public goods supporting agrifood systems (general services).[m] No single lever is new; the innovation lies in how they are used. Targeted TCA assessments, which were described in Chapter 3 and will be the focus of the 2024 edition of this report, allow a more comprehensive understanding of their direct and cascading effects, enabling decision-makers to use them more effectively to transform agrifood systems towards sustainability.

While governments have the broadest and most influential toolkit (denoted by the yellow dots), other actors – research institutions, civil society organizations, businesses and financial institutions – also play significant roles in shaping the performance of agrifood systems. Research and civil society organizations are grouped together (green dots) due to their similar and complementary roles in affecting certain levers, as are businesses and financial institutions (red dots).

It is important to note that some levers can be influenced by more than one player. For example, government policies can affect them all directly or indirectly through incentive schemes, laws and regulations. However, more than one stakeholder may have a role, as illustrated by the coloured dots in Figure 15. Other actors, such as donors and international organizations, can play an important part in influencing how the levers are activated, albeit indirectly and most likely through national bodies. For example, non-governmental and civil society organizations have actively supported the progressive realization of the right to food for national food security and have been involved in promoting national legislation and food programmes in many countries.[1]

These levers can affect agrifood systems in myriad ways, some of which are summarized in the right column ("potential transformation pathways"). The following sections discuss each of the levers and provide examples or case studies of their application to illustrate their potential role in transforming agrifood systems. For simplicity, the discussion is organized based

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[m] Levers impacting a specific food supply chain may also impact stakeholders in other supply-chain stages. The figure is only an attempt to identify the stage that is most likely to be impacted, but recognizes the complexity and interdependencies of agrifood systems.

FIGURE 15 LEVERS FOR AGRIFOOD SYSTEMS TRANSFORMATION

IMPACT AREA	LEVER	POTENTIAL TRANSFORMATION PATHWAYS
AGRIFOOD SUPPLY CHAINS	🟡 Trade and market interventions	Generate price incentives or disincentives to stimulate production of sustainable and nutritious foods
	🟡 Fiscal subsidies to producers	Stimulate production of specific sustainable and nutritious foods and influence input use
	🟢🟡 Laws and regulations	Restrict environmental impact, safeguard labour well-being, manage food safety, food labelling and food fortification
	🔴🟡 Public and private capital	Facilitate investment in sustainable and transparent production processes and businesses
FOOD CONSUMPTION	🟡 Fiscal subsidies to consumers	Incentivize the consumption of sustainable and healthy diets
	🟡 Taxes on foods that constitute unhealthy and unsustainable diets	Disincentivize the consumption of foods that constitute unhealthy and unsustainable diets
	🟢🟡 Consumer purchasing power	Prioritize products with clear information, reflecting values
	🔴🟢🟡 Marketing and promotion	Promote the consumption of nutritious foods
	🔴🟢🟡 Labelling and certification	Enable consumers to choose nutritious and sustainable foods
GENERAL SERVICES	🔴🟡 Infrastructure expenditure	Target bottlenecks contributing to inefficiencies, expensive foods and food loss and waste (e.g. invest in cold storage)
	🔴🟢🟡 Research and development	Advance science, innovations and technologies that improve the sustainability of agrifood systems
	🔴🟢🟡 Knowledge transfer services	Disseminate knowledge on sustainable agrifood systems practices and technologies
	🟢🟡 Inspection services	Manage food safety

DECISION-MAKER OR STAKEHOLDER INFLUENCING CONTROL OF LEVER

🟡 Government 🟢 Research and civil society organizations 🔴 Businesses and financial institutions

SOURCE: Authors' own elaboration.

on which agrifood systems component (supply chains, food consumption or general services) is directly targeted by the lever, recognizing that the latter may have ripple effects that indirectly affect other components, with cascading impacts on entire agrifood systems.

Levers that affect agrifood supply chains

Governments use differing levers to support agriculture and food supply, as illustrated in Figure 15. Many of these policies induce behavioural change among agrifood systems actors and the population with a view to changing agrifood systems outcomes.[2]

Trade and market interventions, such as import taxes and export bans, are ways for governments to help farmers receive better prices or make food more affordable for people. These policies affect how much food is traded, produced and consumed. Low- and middle-income countries often use some of these measures to protect the farming sector against import competition, or to influence domestic prices to ensure adequate supplies and access to food for consumers. However, these policy measures are often distortive and can lead to the suboptimal allocation of domestic resources among different food commodities. For example, tariffs targeting specific products or commodities can raise their domestic prices, with a negative effect on consumers. They can also discourage the production of other foods that would have been more profitable had the tariffs not been in place.[2]

Fiscal subsidies to producers are another important tool for influencing agricultural output. They are budgetary transfers from the government (or, more specifically, the taxpayer) to individual agricultural producers to achieve specific objectives, such as boosting agricultural production and productivity or supporting farm income by reducing production costs. They can also aim to safeguard the environment through payments for ecosystem services, as in the case of reforestation programmes in Costa Rica[3] and Guatemala.[4]

Both fiscal subsidies and trade and market interventions are types of direct support for producers that can have important implications for food security and nutrition. According to *The State of Food Security and Nutrition in the World 2022*, these two types of support make up the lion's share of the average USD 630 billion of public support allocated to food and agriculture globally each year. Not only does much of this support distort markets, it does not reach many farmers, hurts the environment and does not promote the production of nutritious foods. Support programmes currently target staple foods, the availability and affordability of which have increased, as they are key for combating food insecurity. However, this has diverted production away from nutritious foods, such as fruits, vegetables and pulses, which remain more expensive.[2] Furthermore, as many input subsidies are unconstrained, they lead to the overuse of agrochemicals and natural resources, and promote monoculture, with negative consequences for the environment and the sustainability of agrifood systems.[5, 6] An example of ending such practices is the 2022 World Trade Organization Agreement on Fisheries Subsidies, which prohibits harmful subsidies – a key factor in the widespread depletion of the world's fish stocks.[7]

Laws and regulations can be used by governments to influence agricultural production and food supply chains, setting standards and targets that affect both producers and intermediaries. Laws and regulations are mostly designed to safeguard natural resources and human health from damage that could result from externalities associated with, for example, production and processing. Commonly cited examples in this regard are regulations on natural resource use, input and fertilizer applications, safe food handling, and food labelling and marketing. An example is the European Union regulation on deforestation-free products, which bars companies from putting products on the EU market unless they are deforestation-free and legally produced and makes it illegal to export such products from the bloc.[8] Another example is the ten-year fishing ban on the waters of the Yangtze River, recently introduced by the Chinese Ministry of Agriculture and Rural Affairs with a view to conserving living aquatic resources.[9] In Latin America and the Caribbean, various countries have enacted laws or regulations on front-of-pack nutrition labelling.[10] For instance, Ecuador has a traffic light system, while the Plurinational State of Bolivia has approved the same system, but has yet to implement it. Such systems can effectively reduce the intention to buy products with excessive calories, sugars, sodium and saturated fats, help consumers make healthier choices, and contribute to the reformulation of food products. In Chile, for example, nutritional warnings with black octagons reduced purchases of sugar-sweetened cereal and beverages by 25 percent and 9 percent, respectively.[10]

However, laws and regulations can have unintended knock-on effects in other areas. It is, therefore, important for governments to be aware of the ripple effects of their laws, regulations and policies, especially when implementing a transformational agenda, and compensate for these through complementary measures. For example, the aforementioned fishing ban in China could lead to a reduced supply of fish products and risk an increase in prices. However, the Government of China believes that an improvement in and expansion of inland aquaculture and culture-based fisheries – supported by other incentives – could meet the rise in demand for aquatic foods resulting from the reduction in catch from inland capture fisheries.[9]

This raises the question of the need for synergy between government policies, incentives, laws and regulations to achieve national objectives. When addressing hidden costs, policymakers will have to weigh trade-offs with other objectives, such as improving livelihoods, reducing poverty and improving food security and nutrition. Laws and regulations can play an important role in limiting hidden costs by setting targets and limits, for example, on the use of chemical inputs. However, this may not be effective if there are no conditions or constraints placed on the public support system for agricultural inputs. Therefore, the support system needs to be aligned with the limits set by regulations. In some situations, for example, in low-income countries and countries affected by protracted crises, governments may not have the capacity to assess these trade-offs or the determination to take into account environmental externalities if they are facing high rates of hunger and extreme poverty. While capacity-building efforts are certainly required in these contexts to factor the trade-offs into the decision-making process, investing in long-term development to raise incomes, lift people out of poverty and improve food security and nutrition would remain a very high priority. Enhancing dialogue on the humanitarian, development and peace nexus can be an effective entry point in countries affected by protracted crises.

The results presented in Chapter 2 indicate how agrifood systems in different countries have varying hidden costs that may reflect their failure to ensure environmental sustainability and healthy diets for all, or to distribute the benefits. They change in their magnitude and composition, but in general, the current support system is thought to be distortive and responsible for many environmental externalities and other hidden costs. There is, therefore, an urgent need to reform the system in a way that maximizes synergies and minimizes trade-offs between major national objectives. Depending on the relative importance of hidden costs in a given context, reforms may place more emphasis on one specific dimension. For example, based on the results for low-income countries presented in Chapter 2, reducing poverty and hunger will remain the highest priorities. In other contexts, such as in high-income countries, environmental externalities such as GHG emissions can be of greater concern, so attention may be given to carbon sequestration.[11] However, this emphasis should not cause other hidden costs and the interlinkages between them to be ignored.

A comprehensive or even partial repurposing of the public support given to food and agriculture, if carefully designed and targeted, has the potential both to reduce hidden costs and to increase access to foods that form a healthy diet – that is, to achieve two objectives rather than trading one off against the other.[2] A recent global-level study found that several repurposing scenarios could lead to a reduction in GHGs and improvements in population health without an accompanying decline in economic welfare. These include repurposing up to half of fiscal subsidies to producers to support the production of foods with beneficial health and environmental characteristics, including fruits, vegetables and legumes, and combining this with the more equal distribution of subsidy payments globally.[12] The lesson of this study is that repurposing scenarios have the potential to unveil trade-offs and identify options to overcome them. To guide concrete policy reforms, such repurposing scenarios should be an integral part of targeted TCA assessments (see Chapter 3) to identify policy reform pathways that maximize overall benefits with the minimum abatement costs.

In Latin America and the Caribbean, for example, a scenario analysis has shown that redirecting fiscal subsidies to producers to support healthy diets and shifting tax subsidies from producers to consumers could increase the affordability of healthy diets.[2] However, the analysis recognizes that more research is needed on the potential trade-offs that may exist in terms of economic, environmental and consumption-related behavioural impacts.[10] Looking at national examples of agricultural support reform and repurposing can further illustrate its potential benefits. Viet Nam, for instance, has taken important steps to shift agricultural support to less distorting forms of assistance and to promote credit schemes that pay more attention to sustainability and resilience.[13, 14] Over the last decade, the country has lowered border protection and price supports and promoted subsidies that are not tied to the production of a specific crop and include greater sensitivity to agrifood systems sustainability. Similarly, in the Republic of Korea, price support policies have been de-emphasized in favour of income support and subsidies with a green farm focus.[13] At the same time, in low-income countries, which are mostly found in sub-Saharan Africa and where the affordability of food is a key concern, governments adopt policies that tend to suppress producer prices. Public resources to provide fiscal subsidies are also limited, so cannot compensate for the price disincentives generated by trade and market policies. Despite these challenges, recent evidence indicates that, following recent reforms, some input subsidy programmes have been downsized, increasing the fiscal space to allocate more funds to general services and public goods, which generate more sustainable and broad-based impacts (see Box 1).[15]

Public and private capital is another key lever in agrifood systems. Globally, private capital invested in agrifood systems amounts to as much as USD 9 trillion a year.[16] This is about 14 times public support to the food and agriculture sector, and it affects the way food is produced, processed and distributed, in addition to influencing consumer choice. Agrifood businesses and investors are also important funders of research on sustainability, such as improving farming techniques and technologies, as they are at the forefront of supply-chain threats and have a strong interest in developing creative initiatives to improve risk management and overall resilience (see Box 17 for an example of business efforts to address cocoa supply shortfalls and risks to production in Ghana).

Government policies, laws and regulations can influence how and where private capital is invested, and the way they interact is critical to the design of long-term development strategies. When policy is designed to support sustainable production pathways, it can incentivize co-benefits of sustainable agribusiness.

Public capital also holds significant potential to improve the sustainability of agrifood systems. Insurance, for example, can help actors in agrifood systems to produce and invest more towards sustainability. This is particularly important to small-scale producers, who may find themselves trapped in vicious cycles of shocks, debt and poverty. Decreasing the frictions in other components of financial systems, such as credit and savings institutions, is also essential to facilitate investments towards sustainable agrifood systems. Public–private partnerships can act as implementation mechanisms on this pathway.

By coordinating public and private investment, governments also have a role to play in facilitating access to credit, which can prioritize sustainable food supply chains (see Box 18 for an example from Chiapas, Mexico). Indeed, many investors are already moving to emphasize sustainability, even without direct promotion by governments. Investors are increasingly recognizing that these externalities can have a significant impact on the financial performance and long-term sustainability of businesses.[17] For example, a business that pollutes the environment may face regulatory fines, reputational damage and increased costs of compliance, all of which can impact its financial performance. Conversely, a business that invests in sustainable practices may benefit from increased customer loyalty, reduced regulatory risks and cost savings in the long run.

Levers that affect food consumption

Several levers can directly affect consumers' choices and shape food demand. They range from those directly mandated by governments, such as taxes and fiscal subsidies, to those influenced by other actors, such as businesses and civil society organizations (see Figure 15).

Fiscal subsidies to consumers are similar to those that target producers in that they are budgetary transfers borne by the taxpayer. They are meant to facilitate the right to adequate food by lowering the cost of food (for example, food »

BOX 17 MOBILIZING PRIVATE CAPITAL TO ADDRESS THREATS TO COCOA PRODUCTION IN GHANA

Ghana is the second largest cocoa-producing country in the world. Yet, concerns about shortfalls in cocoa supply and threats to production have prompted Mondelēz International – an American multinational food confectionery firm – to fund the Cocoa Life Program. The programme aims to secure a supply of more sustainable cocoa by: (i) improving the livelihoods of cocoa farmers; (ii) ensuring protection against child labour; and (iii) ending the deforestation associated with Cocoa Life farms globally. Mondelēz leverages its investment to attract co-financing and implementing partners. Each partner provides institutional in-kind support by linking its related programmes to Cocoa Life and leveraging Mondelēz's funding.

Mondelēz has identified a set of incentives to increase cocoa supply while improving its environmental, social and economic sustainability. Incentives include: training on sustainable cocoa practices, natural resources management, financial literacy and drying techniques; provision of improved cacao varieties and shade seedlings; promotion of community and farmer organizations; creation of women and youth empowerment programmes; income diversification; certification compliance; and access to finance.

By the end of 2021, 75 percent of cocoa volumes for Mondelēz International's chocolate brands were sourced through Cocoa Life. In the same year, the programme reached more than 200 000 cocoa farmers in over 2 500 communities and provided training and coaching on good agricultural practices. Almost 34 000 young farmers were further trained on cocoa-related enterprises. In terms of environmental impact, Cocoa Life also helped to protect forests by mapping most of its farms (78 percent) to monitor deforestation, with findings showing near to no deforestation on or close to Cocoa Life farms.

SOURCES: Cocoa Life. n.d. Cocoa Life – Why Cocoa Life? In: *Cocoa Life*. [Cited 3 May 2023]. https://www.cocoalife.org; Cocoa Life. n.d. Cocoa Life – Building a promising future for cocoa farming communities. In: *Cocoa Life*. [Cited 3 May 2023]. https://www.cocoalife.org/the-program/approach; Mondelēz International. 2021. *Snacking Made Right – 2021 ESG Report*. Deerfield, USA. https://www.mondelezinternational.com/Snacking-Made-Right/Reporting-and-Disclosure/Reporting-Archive

BOX 18 LEVERAGING FINANCE FOR SUSTAINABLE PRODUCTION AND BIODIVERSITY CONSERVATION IN CHIAPAS, MEXICO

The Proyecto Corredor Biológico Mesoamericano – México [Mesoamerican Biological Corridor Project – Mexico] is a 2002–2018 project coordinated by the National Commission for the Knowledge and Use of Biodiversity (CONABIO) and aimed at promoting sustainable agricultural production and biodiversity conservation in Chiapas, Mexico. The project leverages public and private investment to help strengthen the capacity of farmers to adopt sustainable production and agroforestry practices and, consequently, to restore degraded ecosystems, stop deforestation and conserve biodiversity.

Through the project, CONABIO has assisted farmers in overcoming barriers to complying with forest conservation laws, for example, by providing access to public programmes for more sustainable and integrated practices (such as milpa, agroforestry and silvopasture). By adopting sustainable practices and reducing deforestation, farmers have become eligible to apply for access to credit and to obtain improved seed varieties and organic fertilizers.

SOURCE: Biodiversidad Mexicana. 2023. *Proyecto Corredor Biológico Mesoamericano – México [Mesoamerican Biological Corridor Project – Mexico]*. [Cited 5 November 2023]. https://www.biodiversidad.gob.mx/region/cbmm

» subsidies), increasing consumer income (for example, cash transfers) or providing direct access to food (for example, in-kind food transfers and school feeding programmes). However, consumer subsidies currently make up a very small share of public support for food and agriculture, despite their potential to promote healthy diets. Targeted TCA assessments can inform the proper design of such support so that these subsidies improve accessibility to nutritious and environmentally friendly foods.[2]

Taxes on foods that constitute unhealthy and unsustainable diets complement subsidies that incentivize the consumption of healthier and more sustainable options. Dietary patterns are shaped by a combination of supply and demand factors. They are principally influenced by consumer preferences, such as taste, nutritional value and convenience. However, the relative cost of different food items can play a decisive role, given the income constraints shaping consumer sensitivity to prices. For example, fats and sugars currently provide dietary energy at very low cost, fuelling the burgeoning obesity epidemic. This means that food pricing is a fundamental driver of current unhealthy dietary patterns. Targeted TCA assessments can inform the design of taxation schemes to change the relative prices of foods in favour of more nutritious and sustainable options.[18]

Consumer purchasing power plays a key role. In some contexts – mostly in high-income countries, where people spend a relatively low share of their income on food – consumers are increasingly using their purchasing power to support businesses that embody their values. For this to become more effective and broader in scale, more transparent reporting of the business impacts on the natural, human and social capitals is needed. Here, support from governments in terms of mandatory sustainability and impact reporting can play a role in further empowering consumers to make informed decisions. For example, a survey by The European Consumer Organisation (BEUC) found that over half of EU consumers are influenced by environmental concerns and two-thirds are willing to change their eating habits accordingly. However, the survey also revealed that a lack of information and the challenge of identifying sustainable food options, as well as their limited availability and high prices, were perceived as barriers to consumers making the right decisions.[19]

Marketing and promotion of foods and agricultural products can also play a role in promoting healthy and sustainable foods. They can alter people's behaviour in a significant way without prohibiting any options or changing economic incentives. Marketing and promotion are widely used by agrifood businesses to influence consumer choices and steer buyers towards their products.

Labelling and certification have a vital role in this regard. Front-of-pack labels and/or certifications that refer to standards, for example highlighting sustainability characteristics, can influence consumers' purchasing behaviour.[20] However, the effectiveness of voluntary standard certifications is mixed and depends on their application and the capacity to enforce compliance with sustainability requirements (see Box 19 for the case of voluntary sustainability standards in the palm oil sector). Other examples are agricultural cooperatives and producer organizations, which can increase producers' incomes by meeting demand for speciality products, such as coffee grown under conservation agreements (Box 20).

Policy, research and civil society organizations can play an important role in activating the levers of marketing and promotion, as well as those of labelling and certification, for the benefit of consumers. This can happen if the regulations underpinning these levers are backed by behavioural public policies,[21] which are interventions designed on the principles of behavioural research, aimed at influencing people's behaviour by using nudges and correcting cognitive bias.[22] An example of how such policies can induce transformation in the right direction is to mandate the private sector, which makes ample use of these levers, to provide accurate and reliable information for consumers to make healthy and sustainable food choices.

Levers that affect general services

The bottom of Figure 15 illustrates the role of general services in shaping agrifood systems transformation. The provision of these services impacts the functioning of agrifood »

BOX 19 PALM OIL PRODUCTION IN INDONESIA AND MALAYSIA – THE ROLE OF VOLUNTARY SUSTAINABILITY STANDARDS

Oil palm fruit is a key crop used for diverse purposes, including for direct human consumption, as a biofuel and as an ingredient in processed foods, cosmetics, pharmaceuticals and other industrial products.[23] At the same time, the production of palm oil is associated with many environmental hidden costs, including deforestation, climate change, biodiversity loss, air and water pollution, and soil erosion.[24–27] It has also been associated with various socioeconomic hidden costs, such as conflicts related to land tenure, and human and labour rights violations.[25, 28, 29]

Indonesia and Malaysia are the two biggest palm oil-producing countries, making about 45 and 19 million tonnes of palm oil in 2020, respectively.[30] Consequently, they also incur the highest hidden costs, with related environmental costs amounting to about USD 25 billion and USD 10 billion, respectively, according to a 2016 study.[26] Most costs come from land-use change through greenhouse gas emissions and change in carbon stock, followed by air, land and water pollution from fertilizer application and mill effluent.[31] Also, in Indonesia, conflicts often arise, for example, because of how palm oil companies obtain control of land without community consent and violate licences.[32]

One of the main levers used to address these challenges is the adoption of **voluntary sustainability standards**[33] – including the Roundtable on Sustainable Palm Oil, the Rainforest Alliance, Organic, Indonesia Sustainable Palm Oil and Malaysian Sustainable Palm Oil. However, the effectiveness of standards is mixed and depends on their application and the capacity to enforce compliance with sustainability requirements.[33] Moreover, smallholder farmers are often excluded from certification schemes, given the high cost relative to the premium received by downstream firms for certified sustainable palm oil.[34–36] It is, therefore, vital to improve the design and implementation of these standards. Options include considering the landscape (as opposed to the farm) as the certified unit and assisting smallholder farmers in applying to certification schemes, for example, through access to credit, technical support and securing their land.[37] Alternatives include using tax revenues from palm oil-related land to support the adoption of more sustainable practices in the main producing regions.[38] Here, FAO's Ex-Ante Carbon-balance Tool (EX-ACT) is often used to identify interventions, enhance the carbon mitigation potential of oil palm cultivation interventions and, thus, increase their sustainability.[39]

BOX 20 HOW CONSERVATION AGREEMENTS ARE CURBING DEFORESTATION IN THE PERUVIAN AMAZON WHILE IMPROVING FARMERS' LIVELIHOODS

The Alto Mayo forest reserve in the Peruvian Amazon is home to unique biodiversity and provides water to the city of Moyobamba. However, coffee production in the area has led to deforestation and precarious working conditions. To address this problem, Conservation International started the REDD+ project (Reducing Emissions from Deforestation and Forest Degradation, plus the sustainable management of forests, and the conservation and enhancement of forest carbon stocks) in 2007. The project involved making conservation agreements with local communities based on their needs and providing the necessary incentives to transition to more sustainable practices. Coffee growers in the area committed to not cutting trees in exchange for support to improve their agricultural production and incomes. As a result, the communities adopted more sustainable practices, such as using native fruit trees, orchid cultivation and other forest-friendly activities. The project also provided access to speciality-grade markets, thereby increasing incomes and reducing deforestation. The project also generated carbon credits from reforestation and avoided deforestation. Today, the programme extends beyond the original project area and includes migrant farmers and Indigenous Peoples. The farmers, who are considered "conservation partners", have opened their own coffee cooperative and continue to improve their livelihoods and further opportunities for their families.

SOURCES: Conservation International. n.d. *Protecting forests and climate in Alto Mayo*. In: *Conservation International*. [Cited 3 May 2023]. https://www.conservation.org/stories/protecting-forests-and-climate-in-alto-mayo; Specialty Coffee Association. 2021. Meet The Alto Mayo Landscape Peru REDD+ Project, 2021 Sustainability Award Winner for Best Project. In: *Specialty Coffee Association*. [Cited 19 July 2023]. https://sca.coffee/sca-news/community/meet-the-alto-mayo-landscape-peru-redd-project-2021-sustainability-award-winner-for-best-project

BOX 21 IMPACT OF BRUCELLOSIS ON LIVESTOCK, HEALTH AND THE ENVIRONMENT – SCENARIO ANALYSIS IN THE INTERGOVERNMENTAL AUTHORITY ON DEVELOPMENT REGION

FAO's Global Livestock Environmental Assessment Model (GLEAM) simulated the prevalence of brucellosis, a contagious zoonotic disease of ruminants, and its impact on livestock production, greenhouse gas (GHG) emissions and public health.[59]

Looking at the Intergovernmental Authority on Development (IGAD) region of Africa,* where brucellosis is endemic, GLEAM found that, on average, about 11 percent of cattle, 7 percent of goats and 14 percent of humans were affected by the disease. The model also found that, in the absence of brucellosis, the production of meat and milk would increase by 7.9 percent and 3.3 percent, respectively. Despite the rise in production, GHG emissions only seemed to increase by a negligible 0.2 percent. Public health costs associated with the disease – amounting to almost 1.8 million disability-adjusted life years (DALYs) – would be fully eliminated.**

Monetizing the quantities of the GHG emissions would help assess the true cost of brucellosis to livestock systems, the environment and human health, as well as the return on investment of disease-mitigation interventions, such as a brucellosis vaccination campaign. Nonetheless, these estimates already suggest that such a campaign should generate positive returns for society and the environment.

NOTES: * The IGAD region comprises eight countries in Eastern Africa: Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan and Uganda.
** Public health costs are expressed in DALYs and assume 0.3 DALYs per brucellosis case.[60]

» systems more broadly and, when provided by governments, they fall under the category of *general services support* and mostly address market failures such as those driven by public goods, imperfect information or missing markets. With this type of support, governments aim to correct market failures and reduce transaction costs. They can boost productivity, contribute to food safety and food availability, and lower food prices, including of nutritious foods.[2]

Infrastructure expenditure, for example, keeps business operations efficient and can reduce transport costs and food losses along food supply chains, contributing to greater food availability.

Research and development (R&D) has further been recognized as an important lever for agrifood systems transformation.[40] Although public agricultural R&D is associated with high economic returns, it is also characterized by long time horizons and temporal lags.[41] However, a strong return on investment makes a solid case for investing in agricultural R&D to develop the innovations and technologies that can promote food security and nutrition and mitigate threats to global food supplies and farmer livelihoods.[42]

Knowledge transfer services – for example, training, technical assistance and other extension services – are another related and often publicly supported lever. The effective dissemination of knowledge is key to enabling the adoption of sustainability practices among producers. Similarly, policies that advance digital platforms and open data can further disseminate knowledge resources.

Inspection services as regards agricultural product safety, pests and diseases ensure that food products conform to regulations and product safety norms. The public provision of such inspection services helps consumers and businesses along the food supply chain (see Box 21 on brucellosis disease).

As shown in Figure 15, general services need not be provided solely by governments. Businesses, research institutions and civil society organizations can all play an important role. Many of the infrastructural services that support food and agriculture are run by the private sector, but their presence and expansion can be essential to the proper functioning of food supply chains, as in the case of cold storage infrastructure.

Civil society organizations can also complement government actions in various areas, including consumer protection and knowledge and information sharing. Although they may not be directly involved in inspection services to guarantee food safety and the conformity of products to regulations, they can participate more generally in surveillance against potential food fraud to protect consumers. They have been playing an increasing role of late in raising consumer awareness of issues related to environmental sustainability and economic exploitation (such as child labour).

In conclusion to this section, the question of creating synergies between the different levers and the way they are implemented remains a priority for achieving the desired outcomes. As stated in *The State of Food Security and Nutrition in the World 2022*, repurposing public support to the food and agriculture sector will not be enough. Policymakers need to avoid potential trade-offs that may emerge. For example, farmers may not be in a position to scale up the production of nutritious and sustainable foods due to resource constraints that prevent them from accessing technologies that enhance environmental sustainability. Moreover, repurposing, if not well-designed, can lead to unintended consequences on the most vulnerable, particularly small-scale producers, women and children.[2] A TCA approach provides a comprehensive framework for thinking through these and other trade-offs and linking agrifood systems to other – environmental, health, transportation and energy – systems. Then, targeted TCA assessments can generate insights into how to overcome them by unveiling the outcomes of policies, not only in terms of efficiency, but also equity, nutrition, health and environmental quality. ■

CREATING AN ENABLING ENVIRONMENT TO SCALE TRUE COST ACCOUNTING FOR AGRIFOOD SYSTEMS TRANSFORMATION

To facilitate the correct implementation of the right levers, TCA should be incentivized for policymaking, production processes and business management. As explained earlier in the report, TCA can facilitate a comprehensive understanding of impacts and dependencies and enable better decision-making to transition towards sustainable and resilient agrifood systems. This is currently not the case, despite perceptible progress. A number of players, including governments, academia, businesses, financial institutions, and intergovernmental and international agencies, are experimenting with innovative methods and frameworks to uncover the hidden costs of agrifood systems to guide actions towards sustainability. These efforts have spurred a positive change in agrifood systems, including businesses, but further development is still needed in many areas to fully realize TCA's potential. So, what steps must be taken to mainstream TCA into decision-making? And what is the potential role of the different actors in supporting the creation of an enabling environment for TCA use?

Most importantly, scaling up the adoption of TCA cannot be achieved by a single set of actors; it requires complementary contributions from different stakeholders that influence the functioning of agrifood businesses. Governments, with their policies, funds, investments, laws and regulations, play the central role in creating a conducive environment for the scaling up of TCA to transform agrifood systems. Research institutions and academia are also central, as the different tools and indicators used in these studies need to be properly backed by rigorous methodologies and accurate databases informed by research. To this end, research organizations can be fundamental to mainstreaming TCA through various channels, including the development of: (i) (interdisciplinary) indicators, especially social and human ones, and their respective valuation factors; (ii) accounting mechanisms and reporting formats reflecting the principles of TCA; and (iii) case studies that inform businesses about sustainable practices (see Box 14, in which a TCA study reveals the value of climate-smart coffee production in Colombia).[17]

Research organizations and standard setters are also key to advancing methodologies and setting standards for data to be collected and used in TCA assessments. This is essential to guarantee the transparency of the true costs and benefits of agrifood systems. The applications of TCA studies will largely be facilitated by accounting firms and business consultancies, which advise and support agrifood producers, businesses and other relevant stakeholders in their sustainability transition. Financial institutions and credit rating agencies could be instrumental if they favour sustainable production, business and investment. Ultimately, it is the producers and businesses – and the alliances they create – that will make the change and implement new standards, in particular, voluntary standards.

The need to advance TCA methodology and data

Any TCA study typically requires a substantial amount of data to assess the costs and benefits in scope. The obvious goal is that data be fit for purpose, in terms of both quality and detail needed to appropriately inform decision-makers. So far, data collection related to food and agriculture concerns the visible flows and impacts, which are mostly related to produced capital and some elements of human capital (see Figure 1). Data on other aspects of human capital, such as working conditions, are generally lacking. What is more challenging is to find data on social capital, such as social networks and cultural knowledge. The challenges of finding data for use in TCA studies also include how to easily quantify some variables, as explained in Figure 2.

The lack of such data at low cost is potentially the main barrier to scaling up TCA.[43] This is particularly pressing in middle- and low-income countries, where secondary data are scarce and primary data collection is costly due to limited resources. In view of the data-scarcity bottleneck, the scaling up of TCA will be informed by the following questions: How can the resource intensity of data collection be reduced? How can estimates of missing data be used in TCA? Can data of "insufficient" quality be included in TCA and ultimately inform policy decision-making?

Data can be obtained from three sources:[44, 45] (i) primary data collected specifically for the TCA study, such as surveys, physical measurements and field experiments; (ii) secondary data originally collected and published for another purpose or a different study, but approximating the information required;[46] and (iii) estimated data using models based on primary and secondary data from different contexts.

Needless to say, public sector-funded data collection, research and analysis are required to fill the data gaps. Unarguably, limitations relating to data scarcity and poor data quality pose an immensely pressing problem, particularly in low- and middle-income countries. Data gaps or poor-quality data are likely to cause high uncertainty in the assumptions required to perform a TCA study. This trade-off should be addressed in two broad ways.

Strategically, in the long term, data needed for TCA studies should be included in the systematic censuses and surveys conducted by public statistical agencies. For this to happen, an easy-to-use tool needs to be developed and tested, which can then be used to establish a standard procedure for accounting that can generate data on the hidden costs and benefits of agrifood systems, that is, on their impacts on social, human and environmental capitals (see Chapter 1). While acknowledging that this is a challenging task, requiring time and resources, it can pay off substantially in the long term by reducing the financial and human resources needed to collect data and perform true cost calculations at a later stage.

Governments can facilitate the process by developing reporting mechanisms and making them mandatory. Examples include the EU Taxonomy, which creates a common classification system for sustainable economic activities,[47] and the EU Corporate Sustainability Reporting Directive, which requires large and listed companies to publish regular reports on the social and environmental risks they face and on how their activities impact people, including human rights, and the environment.[48]

However, due to the pressing need to address the issue of hidden costs, decision-makers should not wait, but rather use what is available, provided its limitations are well understood. In the short-to-medium term, they should take advantage of all available secondary and estimated data. Modelling techniques and sensitivity analysis can then be used to identify data points that produced results that deviated substantially from the average and should be targeted for primary data collection. The prioritization of evidence can also be aided by a variety of different tools, such as Evidence Gap Maps, which visually represent the quantity and quality of available evidence on, for example, possible policy interventions and their outcomes. These maps make it possible to see at a glance the interventions for which there is strong evidence and those that have not been studied at all or only partially.[49]

Here, shared data directories for secondary data and standardized collection tools for primary data can greatly reduce the resources required to perform a TCA study.[46] In France, for example, public-sector efforts led to the creation of Agribalyse – a harmonized database of life cycle assessments for 2 500 food products – which, in turn, has been used to develop environmental impact labelling schemes.[49] These initiatives should be a collective effort of the TCA community, as they enable data gaps to be filled at a reduced cost, which is essential for scaling up TCA studies.

It is important to emphasize that the different tools and indicators used in TCA studies need to be backed by rigorously conducted research and accurate databases.[8] There is a lot of research to be done on TCA to narrow the currently wide gaps in data availability. Recent tools and models developed by FAO exemplify the role of research in facilitating the mainstreaming of TCA in agrifood systems. For example, FAO's Ex-Ante Carbon-balance Tool (EX-ACT) and its complementary tools – the Biodiversity Integrated Assessment and Computation Tool (B-INTACT) and the Ex-Ante Carbon-balance Tool for Value Chains (EX-ACT VC) – allow the consistent estimation and tracking of outcomes of agricultural interventions on GHG emissions and biodiversity.[50] The tools can be used individually or together to focus on specific elements of projects and policies, or to develop a holistic overview of their environmental impacts. Another example is the Global Livestock Environmental Assessment Model (GLEAM), which is based on life cycle assessment (LCA) and can be used to assess alternative scenarios towards more sustainable livestock production. GLEAM can be used to generate scenarios on the potential impacts of biological shocks (driven by disease) on livestock production and related GHG emissions (Box 21), or to conduct comparative analysis of different production systems in terms of productivity and sustainability indicators (Box 22).

These tools are valuable in accounting for the different impacts and in assessing scenarios that can feed into policy analysis in the context of TCA (see Chapter 3). They also help to fill the data gaps currently hindering TCA mainstreaming and to make scientific findings and data available, accessible and comprehensible to policymakers and other stakeholders.

Life cycle assessment, which sheds light on the environmental impact of certain value chains or single products, can be a valuable input to TCA and should be used to scale up TCA studies.[51] For example, LCAs have been used to compare the environmental costs of animal-source food production for livestock, aquaculture and capture fisheries, finding that the lowest-impact production methods were small pelagic fisheries and mollusc aquaculture, whereas the highest-impact production methods were beef production and catfish aquaculture.[52] Caution should be exercised, however, with current LCA methodology and studies that tend to favour high-input intensive agricultural systems and misrepresent less intensive agroecological systems, such as organic agriculture.[53] Furthermore, any evidence gaps that affect LCA in agrifood systems can carry over to TCA estimates.[54] Nevertheless, LCA can be used as a starting point for TCA analysis, with impacts that are typically reported in physical units being converted into monetary terms (as in the case of GHG emissions). Box 22 describes two

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BOX 22 GREENHOUSE GAS EMISSIONS FROM EGG AND MILK PRODUCTION – EVIDENCE FROM TWO LIFE CYCLE ASSESSMENTS

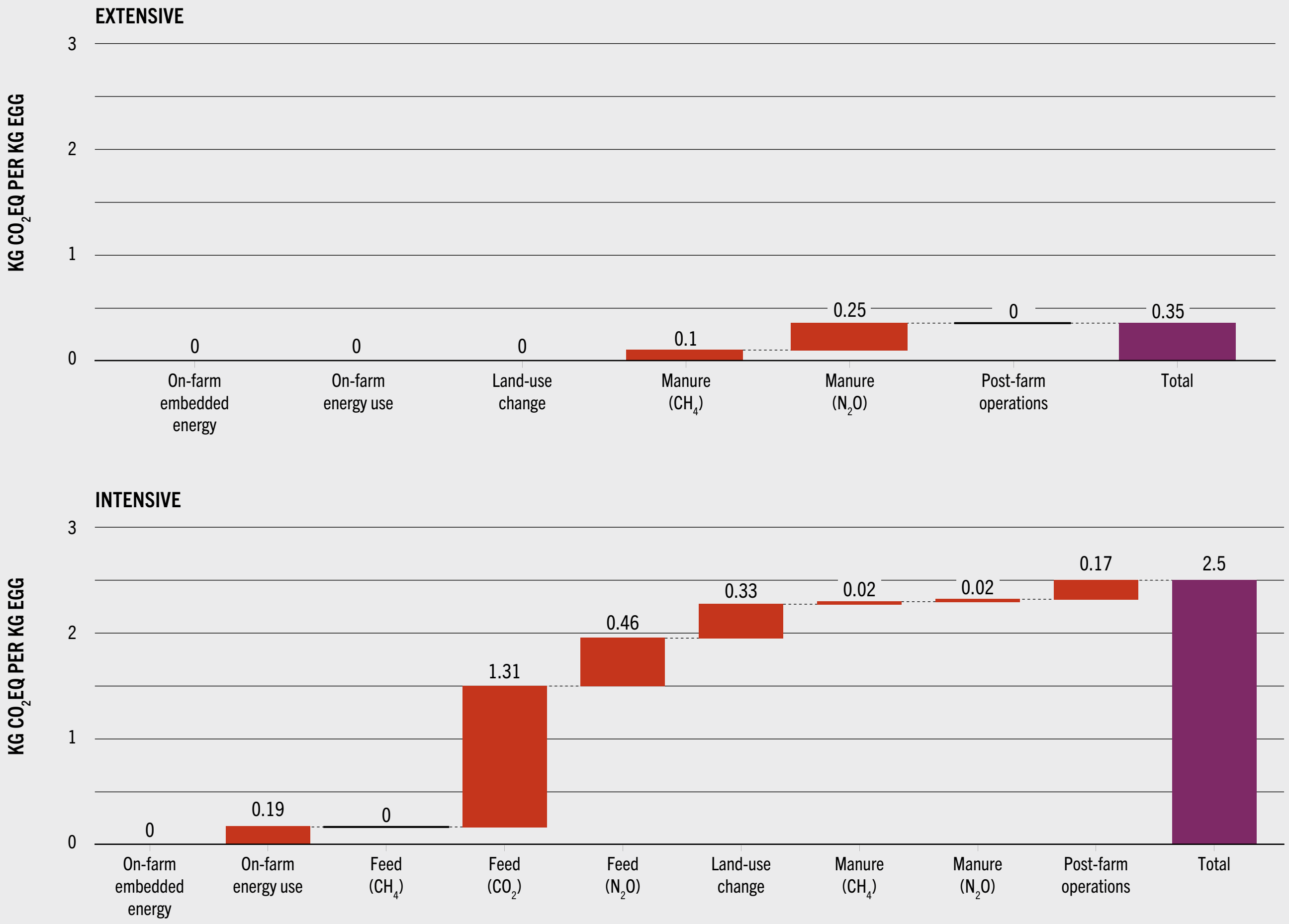
FAO's Global Livestock Environmental Assessment Model (GLEAM) uses life cycle assessments to quantify GHG emissions generated along livestock supply chains. Two examples are given to illustrate the variability in emissions across different livestock production systems and regions.

Example 1. Intensive versus extensive egg production in South-eastern Asia

Emission intensities per egg in an extensive system are much lower than in an industrial/intensive system.* This is partly because the feed used in the backyard/extensive system is produced locally and consists mostly of crop residues and food waste. Emissions related to these residues were already allocated to their main purpose (food production), so are not considered. In addition, no emissions occur from energy use in either on- or post-farm operations.

Industrial/intensive systems, in contrast, generate energy-related GHG emissions from packing and processing activities. Furthermore, these systems often import feed grown in areas that were cleared for this purpose and which emit GHGs from land-use conversion processes (for example, deforestation to grow soybeans). Figure A quantifies GHG emissions (in CO_2 equivalent) per kilogram of eggs along extensive (top) and intensive (bottom) value chains in South-eastern Asia. As expected, total emissions per kilogram of eggs are much lower in the extensive system. Emissions related to manure, however, are significantly higher due to the type of breed and feed used.

FIGURE A GREENHOUSE GAS EMISSIONS ALONG EXTENSIVE (TOP) AND INTENSIVE (BOTTOM) EGG PRODUCTION VALUE CHAINS IN SOUTH-EASTERN ASIA



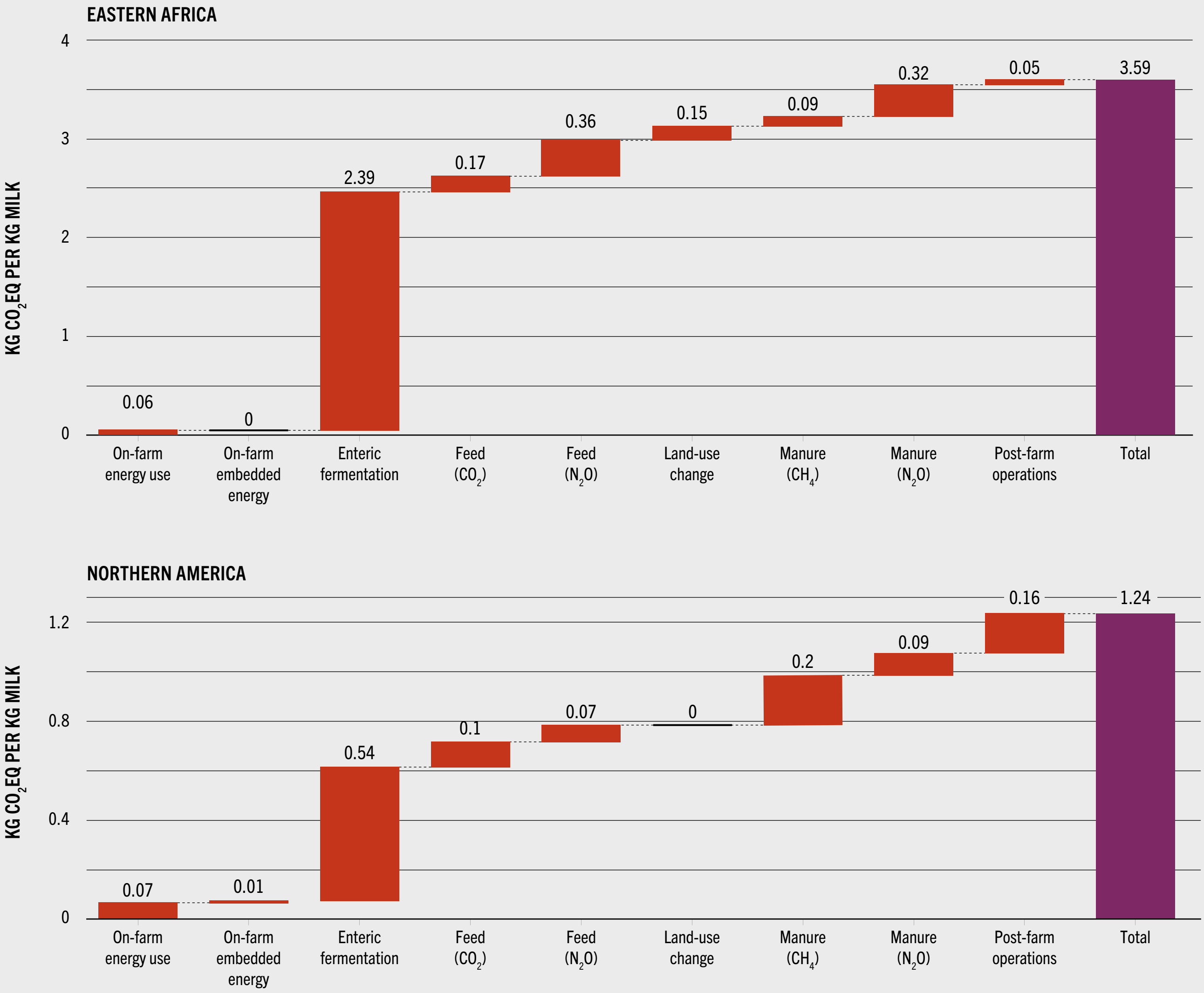
NOTES: * In GLEAM, extensive or backyard systems are characterized by freely living animals with a low percentage of commercial feed from local sources, simple housing and the use of products in local markets. Globally, fewer than 8 percent of all eggs are produced in backyard systems.
SOURCE: FAO. 2023. GLEAM 3.0 Assessment of greenhouse gas emissions and mitigation potential. In: *Global Livestock Environmental Assessment Model (GLEAM)*. [Cited 28 April 2023]. https://www.fao.org/gleam/dashboard/en

Example 2. Milk-related GHG emissions in Eastern Africa and Northern America
The intensity of GHG emissions also differs across world regions. In Eastern Africa, for example, most emissions per unit of milk are related to enteric fermentation, whereas in Northern America, emissions are further associated with post-farm activities and energy use. However, because emissions associated with enteric fermentation are lower in the latter – due to higher output per animal, and different breeds, feed inputs and management practices – total emissions per unit of milk are lower in Northern America.

This can be seen in Figure B, which breaks down the milk value chain in Eastern Africa (top) and Northern America (bottom) and quantifies the GHG emissions (in CO_2 equivalent) associated with each stage.

Decision-makers wishing to monetize GHG emissions from an economic activity (for example, egg or milk production) can do so by multiplying emissions with a social cost of GHG emissions, which may vary by context. However, looking at emissions alone is misleading, as this ignores important trade-offs and costs in other dimensions, such as costs related to land use, deforestation or the production and use of fertilizer and pesticides.

FIGURE B MILK-RELATED GREENHOUSE GAS EMISSIONS IN EASTERN AFRICA (TOP) AND NORTHERN AMERICA (BOTTOM)



SOURCE: FAO. 2023. GLEAM 3.0 Assessment of greenhouse gas emissions and mitigation potential. In: *Global Livestock Environmental Assessment Model (GLEAM)*. [Cited 28 April 2023]. https://www.fao.org/gleam/dashboard/en

» LCA analyses used to compare different egg and milk production systems in terms of GHG emissions. The two analyses, however, focus on emissions and disregard the other environmental impacts of livestock, so can only provide a partial representation of the environmental impact of livestock production systems. Thus, the analysis provides key inputs for a comprehensive TCA analysis, but needs to be complemented by other major impacts, including deforestation, biodiversity loss, nitrogen leakages, land change, water use and pollution.

Where data for such systemic TCA analyses are lacking, therefore, policymakers and stakeholders should start with data that are currently available. In this regard, FAO's GLEAM tool is already an important step, as it provides detailed, evidence-based information to key stakeholders on the impacts of the livestock sector on health and the environment (see Box 21 and Box 22). The results of the model can feed into hotspot analyses that can provide alternatives to full quantification when this cannot be achieved due to data scarcity. In a hotspot analysis, the relative importance of the different indicators is made explicit without fully quantifying them. It can be used when data are scarce, but also in other contexts where quantification is not possible, for example, if there are no methods to assess, measure or value certain variables, such as the dependencies and impacts related to some aspects of social capital.

Targeted TCA assessments in data-scarce contexts should also leverage existing tools in the field of sustainability. For example, the FAO Sustainable Food Value Chain framework, although it is not classified as a TCA framework, is very aligned conceptually with the TCA approach. It has been used to analyse food value chains along the three dimensions of sustainability: economic, social and environmental.[55] A prominent example of its use in agrifood systems transformation comes from the EU-funded FISH4ACP Project (2020–2024), providing a rigorous standardized approach for value-chain analysis and development in the capture fisheries and aquaculture subsectors. This methodology was field-tested in 12 countries in Africa, the Caribbean and the Pacific.[56] The FISH4ACP methodology starts with a functional analysis of the value-chain structure and dynamics, considering all the relevant elements, actors and stakeholders. Then, a sustainability assessment is conducted to assess the value chain's economic, social and environmental impacts and to identify critical sustainability hotspots. A value chain development plan is subsequently developed to address the identified hotspots,[57] including aspects such as capacity building, women's empowerment, responsible fish stock management, compliance with fisheries legislation and improvements in working conditions.[58]

The complementary role of standards and accounting services and the need for capacity building

Governments, research institutions and other agencies involved in setting standards for TCA studies play an important role in mainstreaming TCA through a combination of requirements and incentives. Governments can facilitate the integration of TCA into existing and upcoming sustainability and impact reporting mechanisms, as mentioned in the previous section. The recent approval of the Kunming-Montreal Global Biodiversity Framework by 196 countries is a positive step towards enhancing reporting obligations on sustainability challenges resulting from business activities. For example, Target 15 commits governments to requiring all large business and financial institutions to assess and disclose their risks, impacts and dependencies on biodiversity, while Target 18 promises comprehensive reform of environmentally harmful subsidies.[61]

However, these mechanisms and directives need to be supported by appropriate standards and indicators in order to be implemented successfully. Internationally agreed standards, such as those of the International Organization for Standardization (ISO), allow businesses, for example, to communicate transparently to external stakeholders about the claims they make about their operations.[62] Examples of such standards would be how climate change affects the value of the company and how company activities contribute to climate change.[63]

Another positive development regards the standards for corporate sustainability reporting elaborated by the Taskforce on Climate-related

Financial Disclosures (TCFD). The TCFD has further developed recommendations for companies on disclosing climate-related risks and opportunities, which have been widely adopted by businesses and investors, with more than 1 700 organizations endorsing them as of 2021.[17] Similarly, the Taskforce on Nature-related Financial Disclosures, a new global initiative, is drawing up recommendations, which are expected by September 2023.[64] While not a standard, the taskforce will provide a global framework designed to inform standards about nature-related risk management and disclosure. Therefore, while standard setters play a key role in drawing up standardization for various aspects of TCA, the extent to which these standards are implemented by agrifood systems actors (mainly producers and businesses) will depend on many factors, including the capacity of actors to implement them. Capacity building is certainly needed in this regard, particularly in middle- and low-income countries. The process can be facilitated by governments, who may decide to adopt the standards as mandatory, and could play a critical part in enabling capacity-building programmes in a period of transition.

Complementary to setting standards is the role of accounting services. Accounting firms and business consultancies have a function in developing assessment tools and accounting rules for TCA. By working closely with agrifood producers, businesses and other stakeholders, accounting firms and business consultancies can identify relevant hurdles in the application of TCA and support stakeholders in overcoming them. Here, again, capacity-building and knowledge transfer programmes are needed to adapt accounting services and business consultancies to the norm of TCA.

Financial institutions can facilitate the process through lending policies that increasingly favour sustainable agrifood businesses with the aim of mainstreaming them. In this context, the way credit rating agencies categorize companies based on creditworthiness must also be adapted to the new realities; costs, benefits, risks and assets from a non-financial perspective must be included in any assessment. An example of how this could work in practice is the Agri3 Fund for supporting sustainable agriculture and forest conservation.[65] The fund aims to mobilize up to USD 1 billion of public and private financing by "providing credit enhancement tools and technical assistance to enable a transition to more sustainable practices in agricultural value chains and avert deforestation".[66] However, the possibility of scaling up similar initiatives requires the availability of tools and data backed by robust research for evaluating the performance of potential beneficiaries. ■

CONSIDERATIONS WHEN CHOOSING POLICIES

The results and discussions of this report, as presented in Chapter 2 and Chapter 3, underscore how agrifood systems must be transformed to become sustainable. The results presented in Chapter 2 show how agrifood systems have substantial hidden costs that differ by context. In striving to reduce them, trade-offs will emerge. Agrifood systems must become environmentally sustainable, but they also must ensure food security and nutrition for all, provide livelihoods for farmers and others along the food value chain, and promote inclusive rural transformation.[67] Policymakers need to be able to navigate the trade-offs that emerge from this triple challenge and understand how actions in one area may affect outcomes in another.

Chapter 3 described the need to conduct targeted assessments and how such assessments should be scientifically rigorous and sociopolitically inclusive. It emphasized how policymakers should avoid focusing on one dimension and adopt a holistic approach to policymaking that considers the interdependencies of the economic, social and environmental dimensions of sustainability. This is essential to capturing potential synergies, so that trade-offs are minimized. For instance, a policy to promote healthier diets by changing the level and composition of food demand could lead to lower or higher GHG emissions, depending on the food items included in the healthy diets proposed. To ensure healthy diets while caring for the environment, policies should target diets with sustainability considerations. Such objectives will have implications for the policy measures required to address the trade-offs and achieve sustainability targets for both food security and

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GERMANY
Fruit market.
©Thomas Ulrich/Pixabay

» nutrition, as well as the environment.[67] Similarly, a policy to reduce resource stress could result in lower yield, which could increase food prices and harm the most vulnerable.[2] In this case, policies should navigate all available options to avoid such a scenario. Innovations and technologies may have a role to play in reducing the stress on natural resources without lowering yields, but in other cases, the need for social protection policies to mitigate possible short-term income losses might be inevitable.

When making decisions about agrifood systems, it is also important to recognize the interdependence of humans, animals and the environment. Not doing so may have disastrous consequences, as recently demonstrated by the COVID-19 pandemic. For this, the One Health approach – promoted by FAO, UNEP, WHO and the World Organisation for Animal Health (WOAH) – calls for a holistic and systems-based approach that recognizes the interconnection between the health of humans, animals, plants and the environment.[68] The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to promote a sustainable and healthy future through collaboration, communication, coordination and capacity building. If backed by appropriate regulatory frameworks, One Health can negotiate trade-offs and identify win–win solutions.

Against this backdrop, this section explores how to choose between policies and balance multiple policy objectives, so the transformation levers deployed work with, rather than against, each other.

Will addressing hidden costs raise the price of food?

A commonly asked question is whether addressing the hidden costs of agrifood systems will raise food prices. The answer is that it does not have to, but it will depend on the hidden cost being addressed and the instruments being used. A more comprehensive question might be whether people will be better off if these hidden costs are addressed. To answer this, it is helpful to consider the distinct categories of hidden costs being investigated: social hidden costs associated with distributional failures, which result in poverty and undernourishment; environmental hidden costs from damages linked to externalities; and health hidden costs due to dietary patterns that lead to obesity and NCDs. The way in which each of these categories is addressed has distinct implications for incomes and food prices.

Addressing the social hidden costs from distributional failure, for instance, could enhance productivity in the food and agriculture sector. Alleviating poverty and undernourishment would empower a segment of the population to become more productive, potentially leading to greater food supply. This rise in productivity could exert downward pressure on food prices, broadly benefiting consumers. However, taxpayers would shoulder the cost for such interventions, so it is important to design social protection programmes and investments that are effective in reaching population segments that most need support.

When it comes to environmental hidden costs, much will depend on the measures adopted and who bears the cost. There are two principles for addressing these externalities: the **polluter pays principle**, whereby the costs of achieving desired outcomes are borne by those responsible for creating them in the first place;[69] and the **beneficiary pays principle**, whereby the costs are covered by beneficiaries – usually the public, but also specific groups particularly affected by activities in which they are not involved.

Under the polluter pays principle, polluters are made to pay for the costs they impose on third parties, for example, through regulations stipulating less environmentally harmful farming practices, taxes or the creation of markets for the right to pollute or to gain access to resources such as fisheries. Examples of applications of the principle include levies and taxes on pesticides and fertilizers in some countries of the Organisation for Economic Co-operation and Development (OECD); the development of fishing licences in Namibia, Uganda and the United Republic of Tanzania; taxes on organic discharges in Colombia; and charges for wastewater in China and Malaysia.[70] The introduction of such measures normally raises production costs and, consequently, food prices. However, if these measures are accompanied by actions to support farmers in lowering their production costs, such as advice on better management practices, food price increases can be avoided. The issue of farmer support is critical, as many environmental hidden costs may be due to unsustainable farming practices, even though the private economic benefits of such practices are distributed along the value chain, all the way to consumers. Consequently, the polluter pays principle, if not complemented by advice on how to limit costs where the externality occurs, will be either absorbed further down the value chain or passed on to consumers in the form of higher food prices.

The alternative is to apply the beneficiary pays principle, which places the burden of covering the true costs of agrifood systems activities on the beneficiaries. In such cases, policies should not result in an increase in the price of food. One example is payment for environmental services (PES), where the beneficiary pays those parties whose activities may be damaging to the environment to modify their behaviour.

Examples of PES schemes relevant to agrifood systems are those linked to watershed protection, biodiversity conservation, carbon sequestration and landscape services. Similarly, governments can support and even subsidize the adoption of cleaner and less polluting practices without necessarily linking them to the environmental services provided. For example, in OECD countries where PES schemes are widely used, farmers receive tax discounts for investing in pollution reduction, and subsidies for investing in water-saving devices.[71]

In low- and middle-income countries, these mechanisms are less widely applied. When choosing a policy instrument to reduce hidden costs, governments need to analyse carefully the distributional implications. They also have to consider that subsidy-based schemes place a burden on already scarce fiscal resources and competing objectives might lead to trade-offs between, for example, social and environmental dimensions. The choice between the policy instruments will depend on equity implications, which, in turn, depend on who the beneficiaries are. Priority should be given to situations where synergies exist. For example, if a policy to reduce resource stress also raises agricultural productivity, food price increases can be avoided.[67, 72]

One set of policies involving a mixture of the polluter pays principle and the beneficiary pays principle is the repurposing of agricultural subsidies. Shifting underperforming agricultural subsidies to protect and restore degraded farmland can better support local communities and help countries achieve their climate, biodiversity and rural development goals. It is unclear, however, to what extent the costs of such policies fall on current polluters (who lose their subsidies) or on beneficiaries. Yet, repurposing can be designed in such a way that it does not result in losses for smallholder farmers;[73] for example, when objectives are led by local needs,[74] take into account how the incentives are perceived, and ensure participation of relevant parties.

Repurposing current public support for food and agriculture, if carefully designed and targeted, also has the potential to increase the availability and the affordability of healthy diets, in particular those that are environmentally sustainable. This can be an effective pathway for tackling the hidden costs associated with unhealthy dietary patterns, which this report has revealed to be substantial. For example, fats and sugars currently provide dietary energy at very low market prices, in part due to consumer subsidies in many low- and middle-income countries, fuelling the burgeoning obesity epidemic.[2]

Targeted TCA assessments can inform the design of taxation and repurposing schemes to change the relative prices of foods in favour of more nutritious and sustainable options. When tax revenues are directed to promote healthy and sustainable diets, household food budgets might remain unchanged. Moreover, in the long term, there will be an improvement in public health leading to increased productivity that could translate into higher household incomes. In this case, even if healthier diets may be costlier, the increase in incomes could help offset this additional expense. However, more research is needed to understand the cost of transitioning to healthy and sustainable diets, and its distributional effects.

Leveraging true cost accounting for handling multiple policy objectives

When there are multiple policy objectives, which is generally the case, compromise may be necessary. However, the extent of the compromise can be minimized if there are at least as many policy instruments as there are objectives. This is sometimes referred to as the Tinbergen Rule.[75] It is, therefore, desirable to have a policy package that allows different objectives to be addressed. So, for example, if a country seeks to restore fish stocks, but also address rural poverty, a one-measure blanket ban on catch could create an increase in poverty in artisanal fishing communities. Introducing a second measure, such as income support or alternative employment opportunities (or an exemption for small-scale fishers), would allow both objectives to be met.

Where the activation of levers might lead to trade-offs that negatively affect some stakeholders, social protection policies may be necessary, particularly to mitigate short-term income losses or negative effects on livelihoods.[2] In this regard, TCA – and, in particular, scenario analysis (see Chapter 3) – offers a way of capturing interdependencies and assessing trade-offs. The TEEBAgriFood rice study in Thailand (Box 11) is a case in point. In this study, a scenario analysis was carried out to demonstrate the potential synergies and trade-offs of extending organic rice production practices in Thailand. The results showed that organic rice practices generated positive externalities through health and environmental improvements, although yields were slightly lower. To compensate for the loss of income, the study showed that the price of organic rice should be at least 3.5 percent higher than that of conventional rice – and possibly much higher – as some uncertainty exists as to the extent of yield reduction when converting to organic. To induce farmers to adopt organic practices, subsidies also need to be reoriented, conditional on the adoption of sustainable agricultural practices.[76]

Furthermore, there needs to be coherence among policy responses. Here, TCA can also play a role. For example, policies can be leveraged to promote initiatives that sustain and maintain the ecological infrastructure upon which agriculture and rural livelihoods depend, as in the case of Uganda (Box 23). However, these should not be stand-alone efforts while support for unsustainable initiatives continues or even increases. In Uganda, subsidies for chemical fertilizers increased, while the government simultaneously invested in the restoration of watersheds, forests and land.

Another area for improvement involves early warning, early action systems, which are important mechanisms for mitigating the impacts of disasters. Assessing the true cost of disaster response is challenging, however, due to a lack of reliable data in affected countries. Yet, FAO's Data in Emergencies Impact (DIEM-Impact) assessments provide a granular and rapid understanding of the impact on agriculture and agricultural livelihoods and an estimate of damage to and losses incurred by the agriculture sector.[77] Drawing on the 2019–2021 desert locust upsurge in the Horn of Africa, which threatened the region's already fragile food security, Box 9 underscores the need for TCA to become part of the planning and preparation for disasters and emergencies. It can help explore the various options available and their potential impacts in all dimensions (environmental, social, health and economic) before a threat occurs. This can improve preparedness for threats by guiding investments in disaster risk reduction towards more sustainable solutions that can prevent economic losses without harming the environment and health. ■

CONCLUSIONS

This edition of *The State of Food and Agriculture* highlights the need for decision-makers – from governments to businesses, investors and consumers – to systematically account for the hidden costs and benefits of agrifood systems in order to guide structural change towards systems that deliver affordable healthy diets to all while respecting environmental limits. The report recognizes true cost accounting (TCA) as a fitting methodology for assessing these impacts. It proposes a two-phase TCA approach to capturing the complexity and interdependence of agrifood systems actors: starting with wider, national-level TCA assessments involving high levels of

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BOX 23 SCALING PUBLIC FINANCING TOWARDS SUSTAINABLE NATURAL RESOURCES MANAGEMENT – THE CASE OF UGANDA

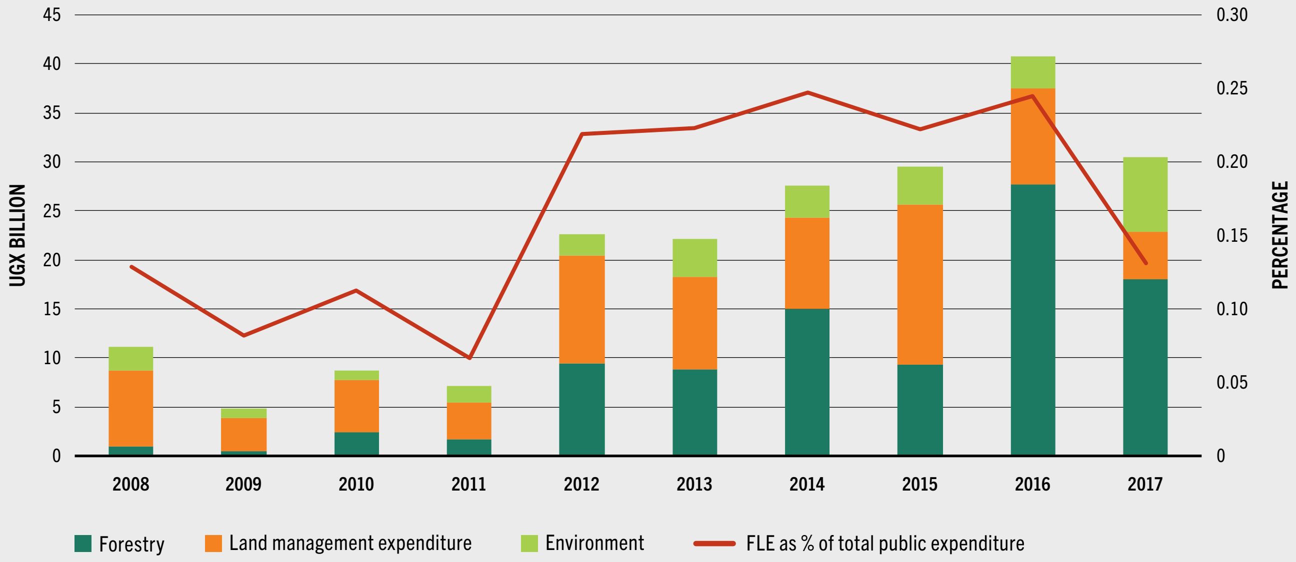
Agriculture and livelihoods in Uganda rely heavily on natural resources – from pastureland to cropland, forests and water. However, population growth, agriculture and biomass energy use have increasingly degraded these crucial assets. The agriculture sector is both a driver and a victim of natural resources degradation. While the sector has accounted for 85 percent of land degradation in recent decades, environmental degradation has generated significant productivity losses in agriculture.[78]

In response, the country has committed through different initiatives to sustain these natural resources and is scaling up public expenditure for the sustainable management of forestry, land and environment (FLE).[15] Ugandan total FLE expenditure increased threefold from 2008 to 2017 (see the figure). The highest increase was in forestry expenditure, mainly from funds to the National Forestry Authority, which manages central forest reserves, including natural forests and commercial plantations.[78] This increase in expenditure may have contributed to the decline in the country's deforestation rate since 2017, which, after increasing from 28 400 hectares (ha) in 2006 to 117 000 ha in 2017, gradually decreased to 49 000 ha in 2021.[79] Restoration efforts are also seeing tangible progress, with an in-depth assessment of the country's restoration potential carried out in 2016 identifying over 8 million ha of land for restoration, primarily focusing on agroforestry.[80]

Despite efforts to improve sustainability, however, Ugandan expenditure on agricultural input subsidies more than doubled, peaking at 24 percent of total agricultural expenditure in 2016.[81] This was partly due to the country's aim to incentivize staple food production and the export of commodities such as coffee, cotton, tea and cocoa, which, in addition to sugarcane and tobacco, have been associated with higher rates of deforestation.[82]

To fully realize Uganda's development and climate objectives, increased policy coherence is needed both within and across sectors. Efforts are ongoing to increase traceability and certification of Uganda's exports in order to eliminate deforestation from supply chains,[83] and projects are increasingly designed to strengthen the synergies between agriculture, forests and natural resources, such as the Farm Income Enhancement and Forest Conservation project. The project was implemented by the Ministry of Water and the Environment and aims to improve livelihoods through irrigation, agribusiness and sustainable natural resources management.

FIGURE PUBLIC EXPENDITURE ON FORESTRY, LAND AND ENVIRONMENT IN UGANDA, 2008–2017



NOTE: Forestry, land and environment (FLE) expenditures considered here are those directly linked to the food and agriculture sector in a broad sense, including expenditure from various ministries and public entities beyond agriculture.
SOURCE: Adapted from FAO. 2021. Uganda. In: *MAFAP Monitoring and Analysing Food and Agricultural Policies*. [Cited 27 July 2023]. https://www.fao.org/in-action/mafap/data/en

» uncertainty, and followed by targeted evaluations that account for context specificities to better prioritize solutions.

This last chapter discusses the different transformational levers that influence the inner workings of agrifood systems and how these can be strategically employed to propel systems to sustainability. Levers can target the activities of agricultural producers, agrifood businesses and consumers through supply- or demand-side interventions, or support agrifood systems through the provision of general services. No single lever is new, but the innovation lies in how they are used. While governments have the broadest and most influential toolkit, other actors, namely research institutions, civil society organizations, businesses and financial institutions, also play significant roles in shaping the performance of agrifood systems.

Given the role of agrifood systems assessments in informing decisions, TCA needs to become part and parcel of decision-making. This chapter recognizes the complexity of this exercise and suggests that TCA become the norm in analysing agrifood policies, measuring their impacts and reforming them to make the required transformation towards sustainability. This is certainly a complex challenge that requires collaboration between different local, national, regional and international actors, including governments, international organizations, private-sector entities and farmer associations.

The chapter ends with important considerations for choosing policies, including the need to handle multiple policy objectives, and how addressing the hidden costs of agrifood systems need not necessarily raise the price of food. Ultimately, the mainstreaming of agrifood systems assessment is critical to FAO's vision of transitioning to more efficient, inclusive, resilient and sustainable agrifood systems for better production, better nutrition, a better environment and a better life, leaving no one behind. The aim is to use this report as a starting point to build momentum and inspire all to undertake meaningful actions to scale up TCA to inform the transformation of agrifood systems towards sustainability.

The need for innovative solutions and strategies to transform agrifood systems has also been agreed in global processes such as the United Nations Food Systems Summit (UNFSS) in September 2021 and the United Nations Food Systems Summit + 2 Stocktaking Moment (UNFSS+2) in July 2023. Against this backdrop, FAO is investing in TCA as an approach to support decision-making. In doing so, for the first time ever, the next edition of *The State of Food and Agriculture* (2024) will be devoted to the same theme: assessing the impacts of agrifood systems – both positive and negative – to uncover the true cost of food and inform decision-making for agrifood systems transformation. The 2024 edition will build on the 2023 edition and aim to catalyse action and transformation by providing concrete examples of how assessments of the impacts of agrifood systems can affect change. In particular, it will provide insights into how TCA can be scaled up across a range of value chains and countries, even in data- and resource-constrained contexts.

By having two consecutive editions dedicated to this topic, FAO is paving the way for agrifood systems assessments to become an essential element in decision-making. It aims to mobilize resources to scale up such assessments and build momentum and engagement among Members and all stakeholders shaping future policymaking. The objective is to provide decision-makers with a systematic approach to evaluating the current state of their agrifood systems, identifying the most feasible and cost-effective solutions, allocating resources for implementing those solutions, assessing their impact over time and making adjustments as needed. ■

ESWATINI
Preparing boxes of chili sauce for shipping.
©FAO/Giulio Napolitano

ANNEXES

ANNEX 1

DESCRIPTION, DATA AND METHODOLOGY OF THE ESTIMATES IN CHAPTER 2

THE ENVIRONMENTAL, SOCIAL AND HEALTH HIDDEN COSTS OF AGRIFOOD SYSTEMS

Methodology

Steven Lord at the University of Oxford Environmental Change Institute developed a model for the Food System Economic Commission (FSEC) to value the hidden costs of agrifood systems across three dimensions: environmental, social and health.[1] The model was paired with FAO's Corporate Database for Substantive Statistical Data (FAOSTAT), and other global sources that had data available for multiple countries and time periods on the impacts of agrifood systems, including GHG and nitrogen emissions, land use, the burden of disease from dietary patterns and the incidence of moderate poverty and undernourishment. The model provides preliminary estimates of the annual *quantified* environmental, social and health hidden costs of national agrifood systems for 154 countries in 2016–2023. Referring to them as "quantified" acknowledges the data gaps in many countries that prevent the estimation of all hidden costs, such as those associated with pesticide exposure and land degradation. As the hidden costs are at country level and presented as a monetary measure, they can be aggregated at global, regional and income levels and compared with macroeconomic indicators such as GDP.

The annual hidden costs of agrifood systems are obtained by multiplying impact quantities (for example, of GHG emissions) by their respective marginal hidden costs at national level.

The hidden costs are measured in 2020 purchasing power parity (PPP) dollars, which represent the amount of a basic basket of goods and services that a single US dollar, once exchanged to local currency, would have purchased in a given country in 2020. In other words, PPP eliminates price level differences across countries and equalizes the purchasing power of currencies. The goods and services represent welfare through their consumption. Consequently, the measured hidden costs represent the reduction in welfare (welfare losses) due to a decline in purchasing power. An advantage of hidden costs measured as GDP PPP losses is their comparability with national accounts and other national spending measures. They also allow for the aggregation of results, across both cost categories (for example, between environmental and health costs) and countries. A disadvantage of measuring the hidden costs as GDP PPP losses is the inability to measure changes in income inequality. Another disadvantage is the assumption of perfect substitution between losses in natural, human and produced capital income flows. Finally, it is important to note that hidden costs differ from abatement costs (see Glossary), which are excluded from the analysis due to a lack of data and valuation factors.

To account for hidden costs that are borne by future generations, the model further employs as a reference a "middle-of-the-road" shared socioeconomic pathway (IPCC pathway SSP2) and assumes a Ramsey social discount rate with time preference of 0 and constant marginal expected utility of consumption of 1.5.[2] For a detailed description of how hidden costs are reconciled within the framework provided by SSP2, see Lord (2023).[1]

Scope of the analysis

Figure 5 in Chapter 2 illustrates the scope of agrifood systems covered by the analysis, as well as the hidden costs considered. In a nutshell, the analysis covers costs from GHG emissions, nitrogen emissions, blue water use, land-use transitions, and poverty, as well as productivity losses from dietary patterns and undernourishment. Due to data gaps, pesticide exposure and land degradation are not considered. Forestry is also outside the scope of the analysis, as estimates of the hidden costs associated with forestry-related economic activities (for example, logging) were not available. Specifically, and as identified in Figure 5, the analysis includes hidden costs related to the following:

i. **Environment** – external costs (see Chapter 1) of externalities from GHGs emitted along the entire food value chain from food and fertilizer production and energy use; nitrogen emissions (volatilized and runoff) at primary production level and from sewerage; and water use and land-use change at farm level.
ii. **Social** – as a result of productivity losses from undernourishment (as defined by FAO [2022][3]) or through the contribution of agrifood systems to moderate poverty. The hidden costs related to social harm are assumed to be driven by policies and institutions failing to address the issues of poverty and food insecurity. The rationale is the following: first, sufficient calories are available worldwide to achieve zero hunger, so the prevalence of undernourishment indicates the failure of agrifood systems to distribute available supply; second, poverty among agrifood systems workers is also an indication of the failure of agrifood systems given the substantial downstream profits made by wholesalers, processors and retailers of food products.
iii. **Health** – as a result of unhealthy dietary patterns that cause a burden of obesity and NCDs and, consequently, productivity losses. Specifically, unhealthy diets low in fruits, vegetables, nuts, whole grains, calcium and protective fats, and high in sodium, sugar-sweetened beverages, saturated fats and processed meat have been associated with preventable morbidity and mortality from neoplasms, cardiovascular disease and type-2 diabetes.[4] A wide range of market, institutional and policy failures (see Chapter 1) drive these dietary patterns by making foods of high energy density and minimal nutritional value more available, cheap and convenient.

Lord (2023)[1] discusses the distinction, at national level, between the production of hidden costs (cost production), the bearing of hidden costs that may have been produced by that nation or another nation (cost bearing), and those actors receiving free benefits from the cost bearing of other actors (benefit receiving).

IMPACT QUANTITIES DATA SOURCES AND COVERAGE

Impact quantities refer to by-products of activities in agrifood systems, such as GHG emissions, that result in hidden costs. Data on impact quantities were obtained over 2014–2020 for 154 countries. Missing data were interpolated using moving average or regional change rates. Data for 2021–2023 – including GDP and other macroeconomic indicators – were then extrapolated using specific statistical methods or projections provided by FAO and the World Bank. The following sections present the data sources and coverage across the three hidden cost categories (environmental, social and health). For a detailed description of the methods of interpolation and extrapolation, and data sources, see Lord (2023).[1]

Environmental impact quantities

Starting with **GHG emissions**, country-level data for (direct and indirect) tier-1 CO_2, methane (CH_4) and nitrous oxide (N_2O) emissions were retrieved from FAOSTAT for 2014–2020.[5] **Blue agricultural water-use** data at country level were taken from FAO's Global Information System on Water and Agriculture (AQUASTAT) between 2014 and 2020.[6] **Land-use conversion** data – that is, the conversion of forest and unmanaged grassland (a broad category including shrubland, grassland and unmanaged rangeland) to cropland and pasture, and cropland and pasture to forest and unmanaged grassland – from 2014 to 2019 were obtained from the HIstoric Land Dynamics Assessment+ (HILDA+) dataset.[7] **Nitrogen emissions** from volatilized ammonia (NH_3) and nitrogen oxides (NOx) to air from agricultural production and energy use in 2015 were obtained from the European Commission's Emissions Database for Global Atmospheric Research (EDGAR) v5.0 dataset.[8–10] Amounts of nitrogen runoff to surface waters and leaching to deep waters were calculated from Integrated Model to Assess the Global Environment – Global Nutrient Model (IMAGE–GNM) spatial datasets.[11, 12]

Social impact quantities

Country-level data on the prevalence of **undernourishment** and the number of undernourished for the years 2014–2020 were obtained from FAOSTAT.[13] Data on poverty gaps and the number of people in **moderate poverty** at the 3.65 per day 2017 PPP dollar income poverty line were obtained from the World Bank.[14] The share of agrifood systems workers in total employment is used as a proxy for the share of agrifood systems workers in moderate poverty.[15] For most countries with high levels of moderate poverty, this proxy is likely an underestimation, as most agrifood systems workers are in agriculture, which has a higher prevalence of poverty.[16]

Health impact quantities

For **dietary patterns**, the burden of preventable morbidity and mortality on human capital is measured by DALYs lost for each country between 2014 and 2019.[17] DALYs also estimate high BMI for each country in the same period.[17] Mediation factors are used to avoid double attribution of DALYs to both high BMI and dietary factors.[18, 19] This interdependence means that DALYs represent one impact quantity per country per year and that the burden of disease from obesity and NCDs attributable to unhealthy dietary patterns are not treated as two separate quantities. Another complication is attributing the burden of disease to the activities of agrifood systems actors, as poverty and genetics can be co-factors in obesity and NCD prevalence. In this study, 75 percent of DALYs are attributed to the failure of agrifood systems activities. This attribution level is varied in uncertainty analysis.[20]

Lord (2023) discusses the limitations in data and the costing methods in more detail. It presents the breakdowns of national hidden cost production and bearing not included in this report.[1]

MARGINAL HIDDEN COST DATA SOURCES AND METHODS

The marginal hidden costs are calculated in 2020 PPP dollars using the SPIQ-FS version 0 marginal damage cost model developed for the FSEC,[n] and are provided with uncertainty estimates in the form of parameterized probability distributions.[22–26] Damage to future economies is estimated based on business-as-usual future projections (SSP2).[2] Poverty is the exception, as it was costed directly using data from the World Bank; it was not modelled with uncertainty. As with the impact quantities, the following sections describe the data sources and method for valuing marginal hidden costs across the three dimensions.

Environmental marginal costs

For **GHG emissions**, SPIQ-FS resamples the simulations of the social cost[o] of GHGs in 2020 by the Interagency Working Group on Social Cost of Greenhouse Gases (IWG-SCGHG) in 2020.[28, 29] IWG-SCGHG simulations are provided for three discount rates (2.5 percent, 3 percent and 5 percent) and five socioeconomic scenarios. Using national GDP growth projections for SSP2 to 2100,[2] global rates matched a discount rate of 3 percent. Given this discount rate, the social costs of carbon under the five scenarios were sampled uniformly for additional uncertainty estimates of economic futures under SSP2. Social costs are given separately for CO_2, CH_4 and N_2O. Costs of a GHG emission in a country are borne globally through climatic changes. To attribute the cost of an emission as a cost to the country that caused the emission, it is assumed that economic actors in that country are required to pay an amount per emission equal to the social cost of the respective GHG. In principle, such funds would go to compensate the cost bearers of the emission inside or outside the country.

To cost **agricultural blue water use**, SSP2 discount rates were used for the impacts of future water scarcity. Marginal hidden costs are, however,

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[n] For an overview of the SPIQ-FS cost models, see Lord (2022).[21] More general documentation on SPIQ-FS can be found at: https://foodsivi.org/what-we-do/projects/spiq-food-system-v0

[o] Social costs represent marginal hidden costs under a future pathway of optimal economic abatement, reflecting increasing internalization of the costs of GHG emissions in emissions markets or state taxation.[27]

underestimated due to a lack of cost data on the loss of environmental flows. Cost of **land-use changes** in terms of lost, retained or returned ecosystem services per hectare per year are derived from the Ecosystem Services Valuation database.[30, 31] To the degree possible, carbon sequestration services were excluded from the valuation to avoid double counting with the costing of GHGs. National-level discount rates under SSP2 were used to discount lost ecosystem services from deforestation from 2020 to 2100 to obtain cumulative values per hectare of land-use change. For land being returned to its natural habitat, 14 years of gained ecosystem services were used to obtain cumulative value per hectare of land-use change. This was varied in uncertainty analysis. Costing **nitrogen emissions** relies on SPIQ-FS for the volatilization of NH_3 (ammonia) and NOx (nitrogen oxides) to air and the runoff of reactive nitrogen into surface waters and soil leaching, predominately soluble NO_3- (nitrate).

Social marginal costs

SPIQ cost modelling includes a model from the number of **undernourished** and DALYs from protein–energy **malnutrition** based on data from WHO. The productivity losses of protein–energy malnutrition are costed using historical labour productivity data from the International Labour Organization (ILO).[32] As for **moderate poverty**, data on the daily 3.65 2017 PPP dollar national poverty gap in 2014–2020 are from the World Bank,[14] and adjusted by inflation in PPP terms to 2020 PPP. Poverty gaps were converted into income shortfall per annum. The total attributable cost of poverty is defined as the income-equivalent welfare required to eliminate moderate poverty that is attributable to distributional failures in agrifood systems. It is calculated by multiplying the relevant moderate poverty headcount by the average income shortfall in PPP terms.

Health marginal costs

The **productivity losses** of diseases attributable to diets and high BMI are costed using historical labour productivity data from ILO.[32]

INTENSITY INDICATORS OF THE ENVIRONMENTAL, SOCIAL AND HEALTH HIDDEN COSTS OF AGRIFOOD SYSTEMS

Measuring the hidden costs of agrifood systems at national level in GDP PPP allows the costs to be compared to national indicators, such as agricultural gross value added (GVA) in PPP terms. This report, therefore, proposes three intensity indicators calculated as ratios between different types of cost (environmental, social or health) and different macroeconomic indicators.

The higher the value of these indicators, the more damaging the hidden costs being considered relative to the benefits brought about by the agrifood activities causing those costs. A zero value denotes zero net cost bearing, while a negative value represents net benefits. An example of the latter would be a gain in ecosystem services from the contraction of agricultural land and restoration of habitat.

Agricultural externalities impact ratio

The first indicator is the **agricultural externalities impact ratio (AEIR)**, which is obtained by dividing the present value of hidden costs from agricultural production and land-use change in GDP PPP by the GVA of agriculture, forestry and fisheries (AFF). GVA AFF data are retrieved from the World Bank for all 154 countries as a percentage of GDP and then multiplied by GDP PPP.[33] GVA AFF is averaged over 2016–2020, and the average is converted to 2020 PPP dollars for consistency with the numerator. And as hidden costs can be aggregated at the global, regional or national level, so can the indicator. The following formula shows how the AEIR indicator is calculated and how it is derived from other two indicators:

$$\text{AEIR} = \frac{\text{ALEC}}{\text{ALEB}} = \frac{\begin{array}{c}\text{Present value hidden costs from agrifood}\\ \text{production and land-use change}\end{array}}{\text{GVA AFF}}$$

where,

ALEC is the per hectare present value of hidden costs from agricultural production and land-use change, including agricultural water use, land-use changes (from forests to crops or pastures and vice versa), farm-level nitrogen emissions, and farm-level GHG emissions as an intensity measure of these hidden costs per unit of agricultural land (land being the primary factor of production in agriculture), and

ALEB is the per hectare GVA AFF, as an intensity measure of agricultural (primary phase) productivity.

Social distribution impact ratio

The third indicator is the **social distribution impact ratio (SDIR)**, which is obtained by dividing the sum of (i) the income shortfall of agrifood workers from the moderate international poverty line (at 3.65 per day in 2017 PPP dollars) and (ii) the present value of productivity losses driven by undernourishment, by the average income of the moderate poor. It is calculated using the following formula:

$$\mathrm{SDIR} = \frac{\mathrm{SDPOVA} + \mathrm{SDPOUC}}{\mathrm{SDINC}}$$

where,

SDPOVA denotes the income shortfall from the moderate poverty line of agrifood systems workers,

SDPOUC denotes the annual total productivity losses driven by undernourishment (assumed, for simplicity purposes, to be experienced by the moderate poor) using historical labour productivity data from ILO,[32] and

SDINC denotes the total annual income of the moderate poor.

SDIR is calculated as the average over 2016–2020. Income of the moderate poor is obtained from World Bank data and averaged over 2016–2020.

Dietary patterns impact ratio

The second indicator is the **dietary patterns impact ratio (DPIR)**, which is obtained by dividing the present value of productivity losses from obesity and NCDs driven by dietary patterns (in GDP PPP) by GDP PPP. The following formula shows how the DPIR indicator is calculated and how it is derived from other two indicators:

$$\mathrm{DPIR} = \frac{\mathrm{DPPCAP}}{\mathrm{GDPCAP}} = \frac{\substack{\text{Present value productivity losses} \\ \text{from dietary patterns}}}{\text{GDP PPP}}$$

where,

DPPCAP represents the per capita productivity losses from dietary patterns costed using historical labour productivity data from ILO,[32] and

GDPCAP represents the per capita GDP PPP.[p] ■

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[p] As agricultural land was a production unit for the AEIR indicator, people are the common unit for dietary intake.

ANNEX 2
STATISTICAL TABLES

TABLE A2.1 ENVIRONMENTAL, SOCIAL AND HEALTH HIDDEN COSTS (IN MILLIONS), 2020

COUNTRY/ TERRITORY	TOTAL HIDDEN COSTS	ENVIRONMENTAL				SOCIAL		HEALTH
		Climate	Blue water withdrawal	Land	Nitrogen	Agrifood worker poverty	Burden of disease (undernourishment)	Burden of disease (dietary patterns)
WORLD	**12 748 916**	**854 817**	**105 126**	**392 295**	**1 515 549**	**519 904**	**51 036**	**9 310 188**
AFRICA	**952 500**	**153 751**	**3 587**	**42 535**	**57 192**	**284 845**	**18 693**	**391 897**
Northern Africa	**213 839**	**17 625**	**3 343**	**474**	**19 819**	**9 430**	**674**	**162 473**
Algeria	32 272	2 763	427	219	3 321	120	–	25 423
Egypt	98 130	4 964	2 122	–	4 403	1 587	244	84 811
Libya	12 026	649	280	–	298	234	43	10 521
Morocco	39 400	2 225	332	146	7 857	793	105	27 942
Sudan	20 712	6 248	84	89	1 533	6 670	265	5 823
Tunisia	11 299	776	97	20	2 407	27	18	7 954
Sub-Saharan Africa	**738 661**	**136 126**	**244**	**42 061**	**37 373**	**275 414**	**18 019**	**229 423**
Eastern Africa	**264 926**	**45 390**	**91**	**11 983**	**11 906**	**138 081**	**8 256**	**49 218**
Djibouti	490	55	0	–	25	4	20	386
Eritrea	2 114	327	31	118	207	851	61	518
Ethiopia	51 033	10 489	47	6 185	3 201	24 643	1 468	5 001
Kenya	26 820	3 714	0	385	2 069	7 500	1 345	11 807
Madagascar	25 084	2 155	2	598	880	18 154	581	2 713
Malawi	12 807	1 024	0	318	250	9 890	176	1 149
Mozambique	23 070	4 363	1	78	635	15 188	541	2 264
Rwanda	5 342	473	0	22	184	3 741	186	737
Somalia	8 168	2 353	5	(6)	335	3 684	444	1 354
South Sudan	10 215	3 764	0	464	106	5 131	210	540
Uganda	22 698	2 972	0	343	902	15 863	550	2 067
United Republic of Tanzania	47 471	7 904	0	1 528	2 396	19 955	1 989	13 698
Zambia	16 018	4 475	0	984	355	8 492	174	1 538
Zimbabwe	13 596	1 323	5	967	362	4 983	513	5 445
Middle Africa	**160 550**	**53 474**	**0**	**20 248**	**4 159**	**51 130**	**3 633**	**27 906**
Angola	39 543	5 035	0	18 318	727	8 186	730	6 547
Cameroon	16 147	2 875	0	69	982	2 929	214	9 077
Central African Republic	5 586	3 068	0	153	198	1 477	175	515
Chad	12 891	6 189	0	(20)	348	5 051	372	951
Congo	4 696	746	0	223	133	1 061	195	2 337
Democratic Republic of the Congo	76 873	34 960	0	990	1 316	32 031	1 865	5 711

TABLE A2.1 (Continued)

COUNTRY/ TERRITORY	TOTAL HIDDEN COSTS	ENVIRONMENTAL				SOCIAL		HEALTH
		Climate	Blue water withdrawal	Land	Nitrogen	Agrifood worker poverty	Burden of disease (undernourishment)	Burden of disease (dietary patterns)
Equatorial Guinea	**1 456**	214	0	23	29	**364**	**41**	**785**
Gabon	**3 359**	388	0	491	425	**31**	**40**	**1 984**
Southern Africa	**107 298**	**9 911**	**95**	**2 520**	**10 821**	**3 973**	**675**	**79 302**
Botswana	6 106	2 583	0	(32)	111	107	55	3 282
Eswatini	1 182	137	1	20	91	139	11	783
Lesotho	2 292	102	0	182	75	331	111	1 491
Namibia	5 510	1 198	0	1 206	509	202	69	2 326
South Africa	92 208	5 892	94	1 144	10 035	3 195	429	71 420
Western Africa	**205 886**	**27 351**	**57**	**7 311**	**10 486**	**82 230**	**5 455**	**72 997**
Benin	6 083	1 036	0	96	467	1 191	121	3 172
Burkina Faso	9 782	2 011	0	187	541	5 258	219	1 566
Cabo Verde	290	21	0	–	16	9	6	239
Côte d'Ivoire	13 402	2 143	0	357	836	3 019	163	6 884
Gambia	733	123	0	33	30	319	26	202
Ghana	18 963	1 178	1	182	988	4 186	110	12 319
Guinea	6 268	2 038	0	868	552	1 800	92	919
Guinea-Bissau	1 442	229	0	633	40	327	33	181
Liberia	2 798	782	0	549	81	855	101	429
Mali	11 043	2 436	16	47	873	6 209	123	1 339
Mauritania	2 598	708	2	136	223	241	63	1 224
Niger	14 024	2 277	6	275	827	9 243	336	1 059
Nigeria	105 132	10 343	30	3 659	4 105	45 304	3 662	38 030
Senegal	7 608	1 236	2	213	575	1 225	201	4 154
Sierra Leone	3 126	428	0	44	186	1 736	127	605
Togo	2 594	363	0	32	145	1 307	72	675
AMERICA	**2 978 006**	**219 979**	**11 474**	**149 230**	**368 241**	**12 251**	**5 247**	**2 211 584**
Latin America and the Caribbean	**1 267 181**	**151 854**	**5 452**	**21 202**	**295 187**	**12 085**	**5 247**	**776 155**
Caribbean	**56 433**	**2 985**	**83**	**74**	**6 418**	**1 768**	**972**	**44 133**
Cuba	22 027	1 107	70	33	2 239	146	–	18 432
Dominican Republic	19 574	1 082	11	30	3 196	47	80	15 127
Haiti	9 173	500	1	13	391	1 524	870	5 874
Jamaica	5 660	296	0	(2)	593	51	22	4 700
Central America	**316 250**	**18 664**	**1 471**	**3 734**	**60 200**	**3 969**	**1 551**	**226 660**
Costa Rica	8 599	412	1	170	3 042	46	19	4 909

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TABLE A2.1 (Continued)

COUNTRY/ TERRITORY	TOTAL HIDDEN COSTS	ENVIRONMENTAL				SOCIAL		HEALTH
		Climate	Blue water withdrawal	Land	Nitrogen	Agrifood worker poverty	Burden of disease (undernourishment)	Burden of disease (dietary patterns)
El Salvador	5 023	348	0	154	995	73	28	3 425
Guatemala	23 381	1 237	2	287	5 963	945	361	14 588
Honduras	10 706	990	0	233	4 237	792	111	4 342
Mexico	249 713	13 122	1 468	2 672	42 231	1 886	896	187 437
Nicaragua	7 662	1 935	0	62	2 419	210	75	2 962
Panama	11 166	621	0	155	1 313	19	61	8 998
South America	**894 499**	**130 204**	**3 898**	**17 395**	**228 569**	**6 347**	**2 724**	**505 361**
Argentina	80 306	13 886	266	4 959	6 027	75	138	54 955
Bolivia (Plurinational State of)	15 801	6 100	63	2 162	1 423	207	76	5 769
Brazil	503 069	75 334	31	6 469	149 018	1 255	969	269 993
Chile	52 406	1 712	1 565	(483)	2 532	41	87	46 952
Colombia	93 118	9 932	11	668	34 678	2 281	465	45 082
Ecuador	30 284	2 804	28	(203)	7 206	680	299	19 469
Guyana	3 160	839	2	410	250	14	5	1 641
Paraguay	15 897	4 687	0	2 681	970	32	66	7 461
Peru	51 872	7 225	1 686	146	19 019	1 307	311	22 179
Suriname	1 732	549	0	4	65	6	5	1 104
Uruguay	15 013	1 738	1	29	2 639	2	–	10 604
Venezuela (Bolivarian Republic of)	31 840	5 397	244	551	4 742	448	304	20 153
Northern America	**1 710 825**	**68 126**	**6 021**	**128 028**	**73 054**	**166**	–	**1 435 429**
Canada	134 356	14 983	3	13 097	10 839	3	–	95 431
United States of America	1 576 469	53 142	6 018	114 931	62 215	164	–	1 339 998
ASIA	**5 857 373**	**355 716**	**84 389**	**59 423**	**815 020**	**222 209**	**26 913**	**4 293 704**
Central Asia	**115 935**	**9 456**	**4 818**	**2 766**	**4 985**	**937**	**86**	**92 888**
Kazakhstan	42 384	3 387	243	(1)	1 795	6	–	36 953
Kyrgyzstan	5 551	495	513	31	388	137	17	3 970
Tajikistan	7 640	528	590	18	778	399	47	5 281
Turkmenistan	14 961	1 230	524	144	405	56	22	12 579
Uzbekistan	45 399	3 816	2 948	2 575	1 617	338	–	34 104
Eastern Asia	**2 937 060**	**121 526**	**17 128**	**7 037**	**398 721**	**3 387**	**6**	**2 389 255**
China	2 555 424	103 937	8 729	5 624	382 139	3 289	–	2 051 706
Japan	267 867	9 503	7 385	921	8 549	68	–	241 441

TABLE A2.1 (Continued)

COUNTRY/ TERRITORY	TOTAL HIDDEN COSTS	ENVIRONMENTAL				SOCIAL		HEALTH
		Climate	Blue water withdrawal	Land	Nitrogen	Agrifood worker poverty	Burden of disease (undernourishment)	Burden of disease (dietary patterns)
Mongolia	9 534	3 425	0	361	2 108	22	6	3 612
Republic of Korea	104 235	4 660	1 013	131	5 925	8	–	92 496
South-eastern Asia	**722 709**	**85 223**	**3 684**	**5 544**	**140 405**	**20 877**	**2 946**	**464 029**
Cambodia	12 349	3 200	7	230	1 329	268	103	7 211
Indonesia	319 515	42 123	1 131	4 773	79 986	11 670	834	178 998
Lao People's Democratic Republic	6 546	1 549	2	(62)	749	566	32	3 710
Malaysia	49 577	5 828	1	184	3 680	1	–	39 883
Myanmar	55 026	12 014	15	267	8 909	1 417	178	32 227
Philippines	86 816	5 139	728	(41)	15 469	2 440	267	62 815
Thailand	106 258	8 162	614	102	13 702	53	697	82 928
Timor-Leste	816	93	0	(1)	119	111	31	462
Viet Nam	73 348	5 939	800	84	16 009	684	259	49 573
Southern Asia	**1 520 780**	**115 603**	**47 648**	**24 834**	**204 701**	**192 793**	**21 695**	**913 506**
Afghanistan	12 459	1 176	386	8	453	3 668	546	6 222
Bangladesh	110 210	8 101	316	340	16 821	16 293	1 399	66 942
India	1 123 226	77 396	36 322	24 051	144 209	157 360	15 253	668 635
Iran (Islamic Republic of)	91 702	10 758	5 392	427	31 828	494	176	42 626
Nepal	16 553	2 004	243	55	1 474	2 089	148	10 540
Pakistan	161 745	16 485	5 226	(76)	7 254	16 216	4 681	111 960
Sri Lanka	17 343	859	149	36	3 116	341	38	12 804
Western Asia	**560 889**	**23 908**	**11 110**	**19 242**	**66 208**	**4 216**	**2 181**	**434 025**
Armenia	7 919	191	301	55	445	21	12	6 893
Azerbaijan	27 835	891	401	283	1 683	129	–	24 450
Cyprus	3 671	95	50	23	396	–	–	3 106
Georgia	13 037	314	48	(0)	473	163	31	12 008
Iraq	67 095	2 402	1 029	97	3 777	123	793	58 874
Israel	17 015	788	232	–	1 253	3	–	14 738
Jordan	12 663	422	21	–	233	2	183	11 801
Kuwait	12322	438	85	–	637	–	30	11 132
Lebanon	4 508	270	38	10	161	1	36	3 993
Oman	11 418	794	288	–	282	37	123	9 893
Palestine	2 356	21	21	–	129	12	23	2 151
Qatar	6 455	909	2	–	152	–	–	5 392

TABLE A2.1 (Continued)

COUNTRY/ TERRITORY	TOTAL HIDDEN COSTS	ENVIRONMENTAL				SOCIAL		HEALTH
		Climate	Blue water withdrawal	Land	Nitrogen	Agrifood worker poverty	Burden of disease (undernourishment)	Burden of disease (dietary patterns)
Saudi Arabia	132 004	5 126	442	18	1 696	–	219	124 504
Syrian Arab Republic	5 330	768	167	93	193	428	61	3 620
Türkiye	189 781	8 146	7 257	18 545	54 042	207	–	101 585
United Arab Emirates	38 188	1 580	552	–	326	–	–	35 731
Yemen	9 291	753	178	119	327	3 090	672	4 153
EUROPE	**2 862 322**	**112 670**	**5 306**	**138 883**	**261 450**	**579**	**183**	**2 343 253**
Eastern Europe	**1 267 070**	**53 194**	**29**	**31 847**	**133 554**	**181**	**137**	**1 048 129**
Belarus	39 177	4 691	0	374	2 793	–	–	31 318
Bulgaria	36 197	849	3	1 592	1 145	8	22	32 578
Czechia	63 439	1 082	0	1 701	2 644	–	–	58 012
Hungary	76 253	1 464	1	2 212	4 476	8	–	68 091
Poland	208 925	7 626	1	6 986	8 847	11	–	185 455
Republic of Moldova	12 809	282	0	(151)	2 825	2	19	9 831
Romania	150 845	2 105	1	5 083	10 422	151	–	133 083
Russian Federation	533 602	29 309	12	12 215	74 169	–	–	417 896
Slovakia	35 198	336	0	1 796	1 967	1	33	31 065
Ukraine	110 626	5 450	11	40	24 264	–	63	80 798
Northern Europe	**422 109**	**19 241**	**117**	**47 037**	**35 768**	**45**	**–**	**319 901**
Denmark	21 175	1 273	6	567	5 528	2	–	13 800
Estonia	10 190	522	0	2 050	721	1	–	6 897
Finland	23 531	1 509	5	1 668	1 323	–	–	19 025
Iceland	1 049	130	0	–	184	–	–	735
Ireland	23 014	2 369	0	4 647	5 840	1	–	10 157
Latvia	18 564	581	0	4 118	918	2	–	12 946
Lithuania	22 366	1 225	0	1 378	2 671	2	–	17 091
Norway	15 127	2 196	28	137	1 603	1	–	11 162
Sweden	31 672	2 519	0	200	2 327	4	–	26 621
United Kingdom of Great Britain and Northern Ireland	255 421	6 917	77	32 274	14 654	32	–	201 467
Southern Europe	**528 530**	**15 610**	**5 139**	**35 123**	**39 726**	**329**	**47**	**432 556**
Albania	6 803	252	2	794	482	4	13	5 255
Croatia	26 209	462	0	666	1 686	4	–	23 392
Greece	51 087	1 282	2 108	4 241	4 778	35	–	38 643

TABLE A2.1 (Continued)

COUNTRY/ TERRITORY	TOTAL HIDDEN COSTS	ENVIRONMENTAL				SOCIAL		HEALTH
		Climate	Blue water withdrawal	Land	Nitrogen	Agrifood worker poverty	Burden of disease (undernourishment)	Burden of disease (dietary patterns)
Italy	200 877	5 908	567	3 313	15 177	106	–	175 805
Montenegro	2 343	49	0	249	222	3	–	1 820
North Macedonia	9 578	142	5	2 353	316	24	8	6 730
Portugal	41 508	935	239	5 823	3 019	11	–	31 480
Serbia	31 195	1 139	0	1 925	1 390	47	26	26 668
Slovenia	9 245	294	0	104	865	–	–	7 982
Spain	149 685	5 147	2 217	15 654	11 791	95	–	114 780
Western Europe	**644 613**	**24 625**	**22**	**24 875**	**52 402**	**24**	**–**	**542 666**
Austria	30 965	883	0	2 703	2 560	12	–	24 807
Belgium	34 685	1 311	0	796	4 982	1	–	27 595
France	177 505	8 226	20	17 791	17 166	10	–	134 294
Germany	328 407	10 027	0	2 813	17 245	1	–	298 321
Netherlands (Kingdom of the)	50 631	3 346	0	556	7 860	–	–	38 869
Switzerland	22 420	833	1	216	2 588	–	–	18 781
OCEANIA	**98 716**	**12 700**	**371**	**2 224**	**13 648**	**21**	**–**	**69 751**
Australia and New Zealand	**98 716**	**12 700**	**371**	**2 224**	**13 648**	**21**	**–**	**69 751**
Australia	76 709	9 473	360	2 397	6 826	21	–	57 632
New Zealand	22 007	3 228	11	(173)	6 821	–	–	12 119

NOTES: All values are expected values. Negative values for land hidden costs are driven by the hidden benefits – herein expressed as negative hidden costs – of afforestation and grassland recovery, which result in returned ecosystem services.

TABLE A2.2 INTENSITY INDICATORS OF ENVIRONMENTAL, SOCIAL AND HEALTH HIDDEN COSTS OF AGRIFOOD SYSTEMS, 2020

COUNTRY/TERRITORY	AEIR	ALEB	ALEC	SDIR	DPIR
WORLD					
AFRICA					
Northern Africa					
Algeria	0.05	1 491	80	0.04	0.05
Egypt	0.04	34 186	1 455	0.10	0.07
Libya	0.21	235	49	0.23	0.11
Morocco	0.23	972	227	0.13	0.10
Sudan	0.19	575	109	0.32	0.03
Tunisia	0.16	1 281	209	0.08	0.06
Sub-Saharan Africa					
Eastern Africa					
Djibouti	0.96	41	39	0.06	0.07
Eritrea	0.55	155	84	0.52	0.07
Ethiopia	0.22	2 109	455	0.37	0.02
Kenya	0.10	1 702	177	0.32	0.05
Madagascar	0.32	251	80	1.39	0.06
Malawi	0.22	1 144	247	0.92	0.04
Mozambique	0.70	232	162	0.94	0.06
Rwanda	0.07	3 623	271	0.54	0.03
Somalia	0.22	300	65	0.53	0.07
South Sudan	3.59	40	145	0.99	0.04
Uganda	0.17	1 506	257	0.64	0.02
United Republic of Tanzania	0.27	1 018	278	0.65	0.09
Zambia	2.50	100	249	1.09	0.02
Zimbabwe	0.58	270	156	0.66	0.10
Middle Africa					
Angola	1.22	345	419	0.63	0.03
Cameroon	0.22	1 646	366	0.30	0.09
Central African Republic	2.58	266	687	0.69	0.11
Chad	0.55	229	125	0.60	0.04
Congo	0.64	156	100	0.55	0.10
Democratic Republic of the Congo	2.04	535	1 092	0.64	0.06
Equatorial Guinea	0.39	3 393	1 310	0.56	0.03
Gabon	0.67	804	539	0.39	0.06
Southern Africa					
Botswana	3.70	29	108	0.18	0.08
Eswatini	0.23	693	158	0.30	0.07
Lesotho	2.50	111	277	0.47	0.25

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TABLE A2.2 (Continued)

COUNTRY/TERRITORY	AEIR	ALEB	ALEC	SDIR	DPIR
Namibia	1.49	49	73	0.38	0.09
South Africa	0.56	194	108	0.18	0.09
Western Africa					
Benin	0.13	2 616	343	0.26	0.08
Burkina Faso	0.29	696	200	0.53	0.03
Cabo Verde	0.11	2 752	303	0.12	0.06
Côte d'Ivoire	0.11	1 224	129	0.35	0.05
Gambia	0.16	1 720	275	0.30	0.04
Ghana	0.05	2 424	121	0.36	0.07
Guinea	0.44	489	216	0.32	0.03
Guinea-Bissau	0.56	1 667	937	0.36	0.05
Liberia	0.50	1 395	699	0.35	0.05
Mali	0.18	398	70	1.05	0.03
Mauritania	0.19	127	25	0.24	0.05
Niger	0.29	218	63	0.66	0.04
Nigeria	0.06	3 246	211	0.43	0.03
Senegal	0.21	901	193	0.24	0.07
Sierra Leone	0.08	1 932	146	0.41	0.04
Togo	0.13	873	111	0.40	0.04
AMERICA					
Latin America and the Caribbean					
Caribbean					
Cuba	0.48	773	369	0.14	0.13
Dominican Republic	0.33	4 207	1 369	0.21	0.08
Haiti	0.10	3 643	363	0.47	0.16
Jamaica	0.27	4 526	1 240	0.28	0.16
Central America					
Costa Rica	0.68	2 698	1 846	0.25	0.04
El Salvador	0.37	2 463	915	0.20	0.06
Guatemala	0.40	3 516	1 401	0.34	0.10
Honduras	0.80	1 818	1 460	0.41	0.07
Mexico	0.54	877	474	0.21	0.07
Nicaragua	0.67	1 119	746	0.30	0.07
Panama	0.50	1 389	694	0.48	0.07
South America					
Argentina	0.40	493	199	0.15	0.05
Bolivia (Plurinational State of)	0.78	307	241	0.45	0.06
Brazil	1.30	629	821	0.17	0.08
Chile	0.23	1 210	275	0.55	0.10

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TABLE A2.2 (Continued)

COUNTRY/TERRITORY	AEIR	ALEB	ALEC	SDIR	DPIR
Colombia	0.76	999	757	0.29	0.06
Ecuador	0.47	3 325	1 547	0.41	0.09
Guyana	0.63	1 694	1 073	0.26	0.15
Paraguay	0.76	562	425	0.24	0.08
Peru	0.86	1 153	986	0.31	0.05
Suriname	0.60	11 798	7 075	0.20	0.10
Uruguay	0.79	357	283	0.05	0.13
Venezuela (Bolivarian Republic of)	1.34	350	469	0.28	0.11
Northern America					
Canada	0.99	559	552	0.02	0.05
United States of America	1.15	457	526	0.38	0.06
ASIA					
Central Asia					
Kazakhstan	0.17	102	18	0.05	0.08
Kyrgyzstan	0.31	384	120	0.11	0.12
Tajikistan	0.22	1 373	307	0.21	0.16
Turkmenistan	0.22	277	62	0.23	0.14
Uzbekistan	0.14	2 522	364	0.18	0.14
Eastern Asia					
China	0.21	3 064	652	0.07	0.09
Japan	0.33	12 876	4 206	0.22	0.04
Mongolia	1.20	40	48	0.12	0.09
Republic of Korea	0.21	23 430	4 944	0.04	0.04
South-eastern Asia					
Cambodia	0.29	2 705	788	0.24	0.10
Indonesia	0.26	6 552	1 715	0.20	0.06
Lao People's Democratic Republic	0.23	4 054	950	0.28	0.06
Malaysia	0.11	8 124	924	1.12	0.04
Myanmar	0.31	4 438	1 393	0.19	0.12
Philippines	0.17	7 009	1 199	0.15	0.07
Thailand	0.18	4 594	806	0.99	0.06
Timor-Leste	0.28	2 047	581	0.34	0.10
Viet Nam	0.18	7 643	1 391	0.24	0.06
Southern Asia					
Afghanistan	0.09	513	48	0.23	0.08
Bangladesh	0.15	9 512	1 447	0.25	0.09
India	0.13	8 162	1 050	0.24	0.07
Iran (Islamic Republic of)	0.27	2 709	736	0.14	0.04

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TABLE A2.2 (Continued)

COUNTRY/TERRITORY	AEIR	ALEB	ALEC	SDIR	DPIR
Nepal	0.14	5 857	833	0.25	0.09
Pakistan	0.11	5 904	629	0.20	0.11
Sri Lanka	0.07	7 574	561	0.12	0.04
Western Asia					
Armenia	0.20	3 044	602	0.14	0.18
Azerbaijan	0.29	1 742	509	0.23	0.16
Cyprus	0.84	5 157	4 320	–	0.08
Georgia	0.15	1 523	228	0.25	0.22
Iraq	0.25	1 676	426	0.54	0.14
Israel	0.30	7 736	2 309	0.04	0.04
Jordan	0.08	4 370	368	2.05	0.10
Kuwait	0.67	6 318	4 241	–	0.05
Lebanon	0.09	4 559	419	1.95	0.04
Oman	0.19	2 225	425	0.19	0.06
Palestine	0.08	4 688	376	0.18	0.07
Qatar	0.37	8 150	2 988	–	0.02
Saudi Arabia	0.08	223	17	–	0.07
Syrian Arab Republic	0.04	1 381	57	0.17	0.07
Türkiye	0.45	3 674	1 658	0.09	0.04
United Arab Emirates	0.21	13 264	2 851	–	0.05
Yemen	0.08	524	42	0.25	0.06
EUROPE					
Eastern Europe					
Belarus	0.52	1 499	786	–	0.17
Bulgaria	0.63	1 155	725	0.22	0.20
Czechia	0.65	2 402	1 570	–	0.13
Hungary	0.69	2 090	1 432	0.12	0.22
Poland	0.68	2 163	1 466	0.16	0.15
Republic of Moldova	0.69	1 515	1 047	1.04	0.30
Romania	0.59	1 822	1 068	0.22	0.23
Russian Federation	0.55	692	381	0.03	0.10
Slovakia	1.13	1 762	1 997	0.79	0.18
Ukraine	0.35	1 274	446	0.16	0.15
Northern Europe					
Denmark	1.78	1 481	2 628	0.29	0.04
Estonia	2.71	1 043	2 823	0.20	0.14
Finland	0.66	2 786	1 838	–	0.07
Iceland	0.36	444	160	–	0.04
Ireland	3.16	872	2 754	0.20	0.02
Latvia	2.63	1 121	2 953	0.15	0.22
Lithuania	1.32	1 098	1 446	0.24	0.18

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TABLE A2.2 (Continued)

COUNTRY/TERRITORY	AEIR	ALEB	ALEC	SDIR	DPIR
Norway	0.36	6 659	2 385	0.13	0.03
Sweden	0.61	2 496	1 518	0.20	0.05
United Kingdom of Great Britain and Northern Ireland	2.03	1 067	2 167	0.22	0.06
Southern Europe					
Albania	0.21	6 090	1 276	0.27	0.13
Croatia	0.77	2 271	1 749	0.19	0.20
Greece	0.71	1 973	1 393	0.26	0.12
Italy	0.44	3 858	1 686	0.32	0.07
Montenegro	0.62	3 477	2 153	0.08	0.14
North Macedonia	0.54	2 276	1 239	0.22	0.19
Portugal	1.00	1 951	1 951	0.14	0.09
Serbia	0.43	2 229	954	0.45	0.21
Slovenia	0.74	2 618	1 936	–	0.10
Spain	0.60	1 931	1 158	0.28	0.06
Western Europe					
Austria	1.03	2 065	2 132	0.40	0.05
Belgium	1.59	2 909	4 637	–	0.04
France	0.83	1 664	1 381	0.20	0.04
Germany	0.76	2 020	1 540	0.06	0.07
Netherlands (Kingdom of the)	0.60	9 152	5 519	0.09	0.04
Switzerland	0.85	2 609	2 220	–	0.03
OCEANIA					
Australia and New Zealand					
Australia	0.63	82	51	0.37	0.04
New Zealand	0.84	1 148	961	–	0.05

NOTES: AEIR = agricultural externalities impact ratio; ALEB = agriculture value-added per ha of agricultural land; ALEC = present value of hidden costs per ha from agricultural production and land-use change; DPIR = dietary patterns impact ratio; SDIR = social distribution impact ratio.

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CHAPTER 1

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THE STATE OF
THE WORLD

2023
THE STATE OF FOOD AND AGRICULTURE

REVEALING THE TRUE COST OF FOOD TO TRANSFORM AGRIFOOD SYSTEMS

Agrifood systems generate significant benefits to society, including the food that nourishes us and jobs and livelihoods for over a billion people. However, their negative impacts due to unsustainable business-as-usual activities and practices are contributing to climate change, natural resource degradation and the unaffordability of healthy diets. Addressing these negative impacts is challenging, because people, businesses, governments and other stakeholders lack a complete picture of how their activities affect economic, social and environmental sustainability when they make decisions on a day-to-day basis.

The State of Food and Agriculture 2023 looks into the true cost of food for sustainable agrifood systems. The report introduces the concept of hidden environmental, health and social costs and benefits of agrifood systems and proposes an approach – true cost accounting (TCA) – to assess them. To operationalize the TCA approach, the report proposes a two-phase assessment process, first relying on national-level TCA assessments to raise awareness and then moving towards in-depth and targeted evaluations to prioritize solutions and guide transformative actions. It provides a first attempt at national-level assessments for 154 countries, suggesting that global hidden costs from agrifood systems amount to at least to 10 trillion 2020 PPP dollars. The estimates indicate that low-income countries bear the highest burden of the hidden costs of agrifood systems relative to national income. Despite the preliminary nature of these estimates, the analysis reveals the urgent need to factor hidden costs into decision-making for the transformation of agrifood systems. Innovations in research and data, alongside investments in data collection and capacity building, are needed to scale the application of TCA, especially in low- and middle-income countries, so that it can become a viable tool to inform decision- and policymaking in a transparent and consistent way.

ISBN 978-92-5-138167-0 ISSN 0081-4539

CC7724EN/1/11.23