Valuing the impact of food:

Towards practical and comparable monetary valuation of food system impacts

A report of the Food System Impact Valuation Initiative (FoodSIVI)

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GLOBAL ALLIANCE FOR THE FUTURE OF FOOD

FoodSIVI

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The market value of the global food sector is underpinned by costs externalised to society. Internalising those costs through improved products and practices, information, and intervention, can lead to a significant contribution to food system transformation and significant opportunity for leading companies. Valuations of food system impacts to account for costs and make them economically visible are a key component of internalisation. The report provides background on food system impact valuation and examines whether the way that carbon is costed in terms of social and abatement costs can be adjusted to estimate the costs of food production, processing, and consumption. Nine case studies from the global food system to food products highlight the variation in methods currently used. Recommendations are made toward a model of shadow prices and a food system non-financial accounting standard.

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TABLE OF CONTENTS

FoodSIVI Food System Impact Valuation Initiative

FoodSIVI is a collaborative initiative between academia, industry and civil society to promote standardised and pre-competitive monetary valuation of environmental, social and health impacts of food systems. FoodSIVI's overall purpose, working with other impact valuation and true cost accounting initiatives, is to champion **food system transformation through internalisation of the food system's environmental, social and health external costs**. It aims to:

- Improve and operationalise impact costing methods, promoting the development of standardised and comparable costings.
- Create a network to initiate and promote uses of food system impact valuation.
- Promote the inclusion of environmental, health and social data in food information and technology systems and undertake research on the utilisation of such systems for impact valuation.

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FOREWORDS

Michael Obersteiner

New science-based approaches to evaluate the performance of food systems are needed

Meeting the Planetary Sustainability Challenges requires food system actors to curb greenhouse gas emissions, conserve and restore biodiversity, promote human and animal health, boost rural economies, enhance resilience to climate change, ensure intactness of water resources, and help avoid pollution. Preparing to deal effectively with the hugely complex food system challenges of the 21st century is a major challenge for decision-makers in government, civil society and the private sector alike. There is an emerging realization that new science-based approaches to evaluate the performance of food systems are needed. Economic valuation approaches carry the potential to alter societal and economic metabolisms for superior sustainability outcomes. This report on valuing the impacts of food systems is an important contribution by FoodSIVI to a better understanding of how economic valuation and accounting standards for food systems could support a transformation towards more sustainability.

Michael Obersteiner, Director of the Environmental Change Institute, University of Oxford

Ruth Richardson

Time for metrics that matter: true cost accounting and food systems transformation

At the Global Alliance for the Future of Food we believe in the power and potential of true cost accounting (TCA) and its role in accelerating the transformation of our food systems. As both a methodology and a mindset, we champion its efficacy to better inform policy and practice and lead markets towards the healthy, sustainable, and equitable food systems we urgently need.

The economic reality in which our food and agricultural systems operate has a significant impact on urgent issues, like climate change, biodiversity loss, soil erosion, food insecurity, and public health crises. These issues affect us all in complex and, often, unequal ways. Yet, the status quo -- upheld by how we value our food systems -- is jeopardizing the efforts of many foundations, governments, businesses, and farmers alike, to promote food security, human health, and a sustainable environment. In particular, the narrow focus on productivity and “yield-per-hectare” distorts what we see and, therefore, what we value in our assessments of how our food is produced, sourced, processed, traded, sold, and eaten.

Pollution, ecological degradation, diabetes, farmworker exposure to toxins, displacement of Indigenous Peoples, and more, are all unaccounted for in the price of our food. These true costs are hidden behind tiny price tags and never found on business balance sheets. By applying TCA approaches to business analyses, dietary comparisons, farm typologies, policy analysis, and national or corporate accounting, we can surface these invisible costs and better measure, value, and manage food systems in the way we need to.

Valuing true costs so that we can mitigate harmful externalities is no small feat. But, until we do so, we will be unable to adequately wrestle with how to eliminate negative impacts of our food systems and also fail at enhancing the many positive impacts – from carbon sequestration, pollination services, health and well-being, and vibrant cultural traditions. We know this first-hand from our own work that TCA approaches deliver inspiring results. In 2018, the TEEBAgriFood evaluation framework was applied to two different corn production systems in the Mississippi basin, helping us to better understand the comparative impacts on social, human, produced, and natural capital.

Ultimately, both negative and positive impacts should be factored into how we as societies plan, support, monitor, and – ultimately – design our food systems. To this end, we need continued and robust global dialogue between all stakeholders on the importance of TCA for food systems. Moreover, we need the swift uptake and utilization of shared frameworks, alongside practical and comparable valuation approaches, that better inform our thinking, planning, and decision-making for the future. This new research report is a timely foray into this endeavour.

Ruth Richardson, Executive Director, Global Alliance for the Future of Food

Driving food systems transformation through a better understanding of the true value of food

Diane Holdorf

Our future depends on our ability to create a food system that supports healthy people and a healthy planet. Current food systems are outstripping the planet's resources while current diets are resulting in global health crises of both over- and undernutrition. Impacts from climate change and nature loss, continuing population growth and changes in dietary habits will amplify these crises. The external environmental and social costs of food systems pose significant risk to both business and society, preventing us from fully understanding system value creation, and how this is distributed through the value chain. In accounting terms these relate to 'externalities'. Externalities inhibit action on a range of food system challenges including masking the costs of unhealthy diets, preventing dietary shifts, as well as diminishing the visible cost of food waste incurred through social and environmental damage such as methane production.

This report by the University of Oxford based Food System Impact Valuation Initiative (FoodSIVI) provides the technical foundations for moving towards comparable monetary valuation of food system impacts which includes externalities. It also provides advice on how to conduct monetary impact valuations for companies in the food system value chain and highlights why developing a non-financial capital accounting standard is an important next step. When supported by policy and finance mechanisms recognizing the true value of food, we will see new business models and value chain collaborations that promote food system transformation. Businesses that recognize hidden costs and create opportunities in the transition to a more sustainable world will generate a strategic advantage in comparison to peers, be able to access capital at a rate that reflects their lower risk profile, and be well positioned to drive long term value creation for society and shareholders.

Through its Redefining Value and Food & Nature programs, WBCSD will advance this work by developing practical guidance for businesses to apply these concepts to internal strategy and decision-making, which in turn will help them communicate more effectively with investors and policymakers, demonstrating value creation and risk mitigation for their business as well as for society and the planet. Wide-spread, rigorous impact valuation will help transform the food system from the inside-out, as outlined in WBCSD's CEO Guide to Food System Transformation.

The foundational principles contained within this report will boost the quality and robustness of impact valuation data, acting as a critical enabler for the next steps for food system impact valuation. These must be to:

1. Overcome technical challenges including harmonization of footprint metrics and impact pathways;

2. Establish dialogues between food and agri-businesses and financial markets around the pricing of value and risk; and

3. Promote better integration of the true value of food into mainstream business processes – particularly enterprise risk management and management accounting practices.

These three actions will be essential in facilitating the uptake of true cost accounting by business, scaling the impact of this practice to achieve the food systems transformation we so critically need.

Diane Holdorf, Managing Director, Food and Nature,
World Business Council for Sustainable Development

SUMMARY

There are many reports on the impacts of food systems and its multiple dimensions. Besides CO2-eq emissions, the food system is the main source of global land-use change, biodiversity loss from pesticide and nutrient application, and renewable and non-renewable water extraction. Agricultural communities and workers are associated to poverty, social stress and high accident and suicide rates. Dietary risk factors are now the largest global cause of preventable disease and death. Antibiotic use and emergence of exotic pathogens from animal production are additional human health concerns. Recent studies suggest that annual costs from natural, social and human capital changes due to the activities of food system equate to 11% of global GDP. Most costs are external and less than one-third of the costs are associated to CO2-eq emissions.

Internalising costs through market measures, improved products and practices, information, and intervention, could lead to a significant contribution to food system transformation. It could also be a significant opportunity for leading companies. The science on the impact of food systems is clear but the economic response remains marginal. Market incentives and investment in malnutrition, diabetes and obesity, regulations for water use and nutrient pollution, food policies, uptake of Pigouvian taxes, subsidy changes, and other corrective measures remain disproportional to the impact. Food system science is pointing in one direction but, on present course, our economic system is heading in another. Impact valuations provide an estimate of the costs, and benefits, from food system activities. They account for impacts not costed into market transactions. Impact valuations can guide where internalisation and incentives are required and in what amount.

The costing of carbon describes how activity, measured by carbon footprints, can be translated into a monetary estimate of the longer-term and externalised costs of carbon production. This report examines food impact valuation as social and abatement costing of externalised costs of food production, processing, and consumption. Costing carbon, which the report reviews, involves ethical choices such as intergenerational equity and large uncertainty. Similar ethical aspects and uncertainties for social and abatement costs associated to food's production, processing and consumption are examined. Another major complication to social and abatement costing is that food impacts have multiple footprints and the impact from a footprint such as water or nitrogen waste is heavily dependent on where the footprint is incurred and on the manner of extraction or waste. Setting footprint reduction targets and costing the reduction is further complicated by trade-offs and co-benefits. That is, one footprint or impact may increase, or decrease respectively, as another is reduced.

The complications lead the report to recommend a footprint protocol, formalising impact pathways, and a process for setting and updating marginal social and abatement costs with estimates of their uncertainty. A model is suggested using marginal social or abatement costs. Non-linear corrections for scarcity and interactions between food's multiple footprints are indicated, and risk-based corrections using estimates of uncertainty.

Before considering marginal social and abatement costing the report places them in context. Using footprints as quantities to link impact and activities in the food sector is not a universal approach. The report breaks down valuation according to a common process in impact frameworks to avoid duplicating existing frameworks. It places social and abatement costing within the breakdown. To help bridge food system science and economic theory the report also discusses the economic theory of change and the evidence that costing impact will contribute to food system transformation.

In more detail, the report makes three contributions to valuing the impact of food:

1) Background to make the link between food system science and contributions to food system transformation from economic change. Correcting market dynamics by estimating

impacts not costed into market transactions can align financial gains with gains in human and social well-being. The explanation of the economic theory of change given in the report is simple. More links with welfare economics, economic valuation, and accounting, could be done in subsequent studies.

- Comparable and agreed valuations of the major external costs introduced by the food system are likely to have the most effect on reducing impact. Comparable valuation is needed for external correction such as impact investing and government policy. As evidenced in the report by the variation in nine case studies, and the discussion of ethical choices and uncertainty implicit in valuations like the social cost of carbon, it is difficult presently to compare food system impact valuations.
- Economic theory indicates that internalisation by itself may not result in reduced food system impacts, or it may transfer the impact on social and human well-being to another sector rather than reduce it. Additional research is required on which economic changes to the food system will achieve reduction in impact. Research needed: i) estimates of the reduction in impact that could be achieved through efficiency gains in the present market; ii) dynamic economic modelling of the follow-on consequences from large fiscal or policy interventions suggested by impact and attribution studies, and iii) merit order curves, similar to abatement curves from climate science, with economic trajectories for food system transformation that consider co-benefits and trade-offs.
- Realising market corrections requires synergy between a triad of food system science, economics and users. A short survey of current activity around the triad shows a body of existing activity. A network can bring the triad closer together. Investment can enable the community to develop and promote measures for economic correction of food system impact at scale.

2) Advice on doing monetary food system impact valuations. Existing impact frameworks such as the Natural Capital Protocol and The Economic of Ecosystems and Biodiversity (TEEB) AgriFood Evaluation Framework use a natural, human and social capital approach. They describe monetary and non-monetary valuation of changes to capital due to the activity of business, government, and society. The existing frameworks are aligned, describing similar steps such as setting the scope and acquiring data, but are not specific on comparable monetary valuation.

Based on the impact frameworks we phrase impact valuation in terms of footprint created by activities (quantities associated to impact such as tonnes CO2-eq emitted or kg reactive nitrogen leached), the capital change attributable to the footprint, and the value change from the capital change (Figure A on the next page). The activity might be the annual operations of a food company, the lifecycle of a food product, the production of a tonne of an agricultural commodity, or a change in farming practice. The impact valuation indicates the change in economic value due to the activity, factoring through the footprint quantities produced and changes to natural, social and human capital. Footprints become the quantities associated to and increase or decrease in economic value. In economic theory quantities should either be produced or reduced to maximise economic value overall.

A shadow price, or marginal valuation, or valuation factor, is the estimate of the cost of one more unit of footprint produced or reduced, depending on whether the marginal valuation is a social or abatement cost respectively. Marginal valuations combine the attribution of capital changes and the value of the capital change together (Figure A on the next page).

Examination of the social and abatement costs of carbon and case studies finds fundamental ethical choices and a large amount of variation and uncertainty in the steps of an impact valuation. In choosing which footprints to include and associate to impact, in an actor calculating footprint, and particularly in estimating capital changes and economic changes.

Estimating economic value involves a monetary representation of social and human well-being which is often implicit in valuations. Parity is the choice of how to compare economic value between economies, usually national economies. Discounting is the choice of how to compare economic value between an economy now and an economy in the future. Monetary representation of well-being, parity and discounting are all ethical choices which are shown from literature studies to produce order of magnitude differences to marginal valuations. Some of these conclusions are from studies on the social cost of carbon, but the report considers the evidence of intergenerational effects in other dimensions of food impact such as obesity and rural poverty, and international effects embedded in food's global value chains. Choices of parity and discounting will likely result in potential order of magnitude differences in an overall food system impact valuation.

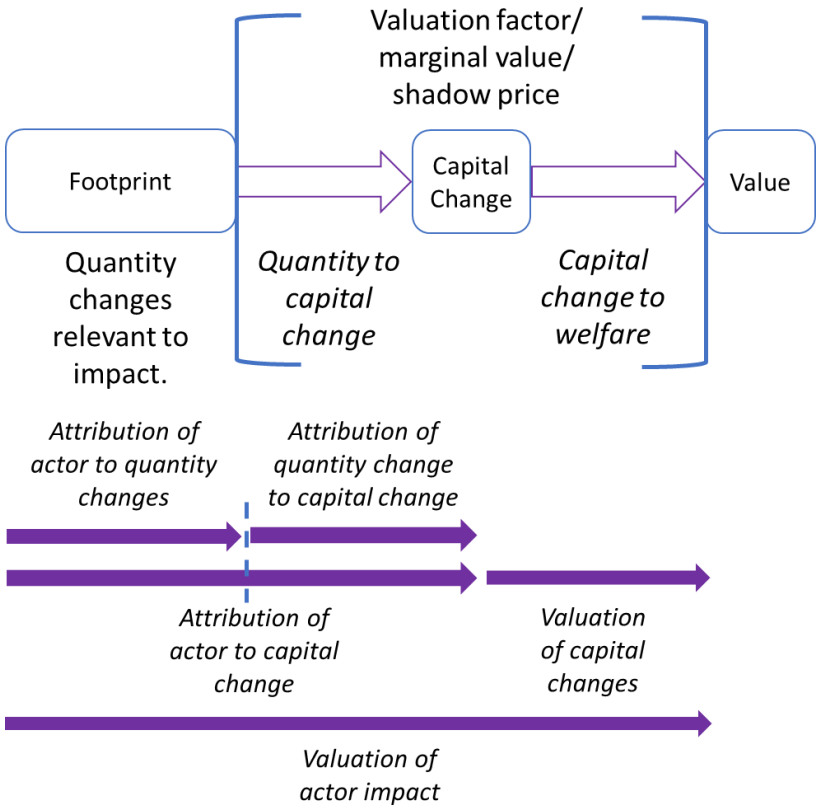

Figure A: the components of impact valuation, which is an estimate of the changes in economic value (the impact) due to an activity, factoring through the footprint quantities produced and changes to natural, social and human capital.

Most of our knowledge about capital changes comes from scientific models and observed or interpolated data. Examples of modelling are given, and evidence of variation produced by different models. The report outlines the complexity of the impact pathways associated to food's footprints. This complexity can produce ambiguity and modelling uncertainty above the inherent error (goodness of fit) in models integrated to represent the impact pathway. The need and use of scenarios of socio-economic drivers and estimates of the total societal footprint is discussed.

Based upon examination of the inherent ethical choices, uncertainty in costing, and on the variation observed across the nine case studies, the report concludes and suggests the following:

- Comparable valuation that has the most effect on reducing impact will likely involve a limited number of use cases, but with frequent application. The limited number of use cases provides an opportunity to fix and standardise the scope and framing associated to those uses. That is, fixing the footprints and the impact pathways associated to the major external costs introduced by the food system. Fixing the footprint is the basis for consistent marginal valuation with respect to those footprints. The frequent application provides an opportunity to address the variability and uncertainty in marginal valuation.
- The variety of data, models, tools, scenarios, and valuation methods already used in impact valuation, and fundamental uncertainties in ethical choices as well as scientific estimates, make it unlikely that agreement can occur on single values or single methods for marginal valuations.
- Fixing single values would ignore the risk being passed to society by business inherent in the production of footprints. An improvement would be to consider the distribution of valuations and price the risk transfer to society within the impact valuation. The risk premium is how much society should "charge" to take on the uncertainty in impact associated to the footprint produced by a product, practice, or company.
- The nine case studies show the variation in practice in footprint, models and data, and valuation methodology, and a precedent for pricing uncertainty.
- Businesses have the same playing field if shadow prices and their uncertainty were agreed. This incentivises the food sector to contribute to a societal process for better information about impacts and valuation to reduce the uncertainty and so reduce the risk premium on shadow prices. The business also avoids the ethical choices implicit in choosing shadow prices.
- Businesses can compete on footprint reduction and on disclosure. Disclosure reduces the uncertainty in footprint. Through the pricing mechanism disclosure reduces the risk price. Calculating footprint is closer to the activity of the business itself. Methods for footprint calculation such as lifecycle analysis (LCA) are already well developed.
- Some challenges in doing valuation are not new to food systems. They include aggregation, double-counting, bias, error-bars, and substitution. If valuation is going to have traction toward reducing impact the challenges need to be addressed. Ambiguity and errors lead to mistrust and an inability of parties to subscribe to and use valuations. Some of the challenges cannot be solved. That is, the shadow prices will never be "correct". How to deal with them as issues in a consistent and agreed way is part of the rationale for risk pricing. Synergy between a triad of food system science, economics and users is as important for potential change in the food system as incremental improvements in modelling or economic growth projections.

Social and abatement costing

The costing of carbon considers both marginal social and abatement costs. These are two different marginal valuations. They lead to two different impact valuations when applied to the same footprint.

A marginal social cost is the change in economic value that would result if the footprint was produced. A marginal abatement cost is the cost incurred (which is also a change in economic value) to reduce the footprint. Reducing the footprint avoids incurring the social costs. Marginal abatement costs are usually derived from portfolios of abatement measures designed to achieve a footprint reduction target for the least cost.

Sustainable food and agricultural products, and companies incorporating sustainable practices or sustainable sourcing, offer abatement of footprint compared to their unsustainable counterparts. The additional cost of the sustainable products and practices is their abatement cost. In this view sustainable products and practices are abatement measures. The reduction

in footprint from substituting the unsustainable product or practice is called the abatement. The social benefit associated to the abatement is called the abatement value.

An impact valuation using marginal social costs and abatement as footprint calculates the abatement value of the sustainable product or practices.

An impact valuation using marginal abatement costs and abatement as footprint indicates the cost-effectiveness of the sustainable product or practice as an abatement measure contributing to a footprint reduction target.

The two are complementary views of the value of sustainable food and agricultural products. Both can be used to set incentives.

Challenges in social and abatement costing for longer-term and externalised costs of food production, processing and consumption are reviewed in the report. Many of the challenges in social costing relate to discounting and uncertainty in models. Abatement costing does not avoid uncertainty, however. Setting consistent footprint reduction targets across food's multiple footprints is difficult. Reports from the EAT-Lancet Commission on healthy diets from sustainable food systems, the IPCC, and the FABLE consortium, have laid the foundation for global footprint targets. One of the major uncertainties is whether abatement measures such as dietary changes will be realised. Dietary changes are necessary to reach global footprint targets. Realising abatement from some measures is therefore dependant on demand for sustainable products and practices. This demand depends on the response of business and consumers, which is uncertain.

At the risk of being obvious, total abatement of food system impacts are currently low because demand for abatement measures or the abatement they offer is low. The most useful measure for society and governments is total abatement which is needed to calculate abatement portfolios. The total abatement offered is the marginal abatement multiplied by the quantity sold in the market (in terms of units of sustainable product substituting a less sustainable counterpart). Calculating total abatement therefore depends on projecting demand.

Demand projections are illustrated by looking at scenarios for replacing animal protein by plant protein between the "Current Trends" (worst case/status quo) and "Better Futures" (best case/vision) scenarios of a September 2019 Food and Land Use Coalition Report: "Growing Better: Ten Critical Transitions to Transform Food and Land Use". The uncertainty in forward demand can become part of the risk pricing. If there were a mechanism to internalise the social or abatement costs, then the risk price would reduce (as would mean shadow prices toward effective prices) with the reduced uncertainty in total abatement meeting food system transformation targets. In this way risk to society of status quo in unsustainable products is transferred to venture investment (through the internalisation mechanism) for sustainable alternatives.

The case studies consider mostly abatement value. That is, they use marginal social costs in the impact valuation. Abatement costing has further technical complications mentioned in the report, but it should be further developed for two reasons: one, to inform costs of tangible action and economic trajectories for food system transformation; two, to improve cost-effectiveness measures of the value provided by sustainable food products and practices to accelerate investment in them.

Model

Spatial and contextual distinction in shadow prices is essential. The social cost of carbon avoids this because of its global impact. Other shadow prices, for example for water, nutrient pollution, and malnutrition, are highly dependent on context. The social cost(s) of obesity, like carbon, have intergenerational components. Carbon has a clear footprint unit (t CO2-eq emitted). Additional research will be required to develop footprint and impact pathways with

spatial and contextual distinctions for social and health impacts. The report provides an argument for practical impact valuation to have spatially and contextually explicit footprints up to broad boundaries such as food basin, ecosystem, catchment, agricultural land use, etc. currently used in global modelling. Though the resolution is coarse, the spatial and contextual detail suggested will still guide initial and effective corrections to incentivise footprint reduction.

The report outlines a linear approximation to estimating economic value change from footprint changes. The shadow price for that footprint quantity (e.g. CO2-eq emissions or water extracted in a specific catchment) is multiplied against the footprint incurred. The result is then summed across all the footprint quantities. This linear approximation is the basis for using marginal valuations. It is the impact valuation method used in every case study observed. Non-linear corrections to impact costing for scarcity and interactions created by food's multiple footprints are indicated. A practical model for risk pricing is also sketched, which replaces terms in the linear model with random variable equivalents (uncertain shadow prices, uncertain footprints, etc). It is described how correlations between shadow prices, and other factors such as economic growth trajectories related to discounting, need to be included. A risk-based correction to an impact valuation can be calculated to account for uncertainty in shadow prices and correlations in impact.

The linear model is agnostic to whether the marginal valuations are social or abatement costs. The report discusses why a valuation should use either all marginal social costs or all marginal abatement costs. They should not be used together.

3) Implications and arguments for a food system non-financial capital accounting standard. The report collates a table of the methods, data, and models, described through the report. It concludes by listing implications for impact reporting in the food sector. The same section summarises the argument for a consortium of intergovernmental and institutional actors and experts to develop a footprint protocol and set and update shadow prices for food impact costing.

One of the implications relates to the trend to report on "total" or "true" value by adding up social and private benefits related to wages and revenue and subtracting natural and social capital costs. The subtraction is implicit in the linear model. Often social costs are incurred on the other side of the world from the social benefits; it is extremely unclear if they are substitutable which is what the subtraction implies. Keeping benefits and costs spatially and contextually distinct and investing in methods to understand and implement their substitution would avoid mistrust from society that valuations are obscuring the balance sheet. While one of the advantages of valuation is to put things into monetary terms to make them more comparable, this does not imply everything is exchangeable for money without an appropriate use of parity. Without further consideration or agreement, it is unclear why purchasing power parity, based on substitution of money for produced goods, is appropriate for exchange of value in other capitals.

One recommendation that the report makes is to use equity statistics to report alongside totals of natural, social and human capital costs. The statistics are based on the temporal, spatial and contextual detail provided by shadow prices in the model outlined. Three forms of equity are suggested. First, intergenerational equity as the amount of impact occurring in present time periods compared to later time periods. Second, the certainty of costs compared to the uncertainty in benefits. Third, national transfers of costs from natural, social and human capital changes to benefits from produced capital changes.

Forms of the linear model are already used in lifecycle analysis software. The suggested second order non-linear corrections could also be implemented in lifecycle analysis software. The use of software and private methods for shadow pricing could become *de facto* standardisation without investment in a societal process. This risks bias in valuations which

may systematically under or overestimate cost of impacts. The result would be too much or not enough economic adjustment. A staged process is recommended of pragmatic solutions that can sponsor business and government uses. This graduates to a societal process for agreed valuations with increasing use.

There is no standard scheme of food system footprints equivalent to carbon footprints yet, and few disclosure and offset opportunities equivalent to carbon disclosure or carbon offset. While the food sector is increasingly discussing carbon neutrality, an integrated form of impact neutrality across health and other impact dimensions is not prominent. A food system non-financial capital accounting standard would guide what to measure and disclose in terms of footprint and provide a set of quantities on which to base shadow prices. The report argues that the SEEA-EEA, the ecosystem component of the UN System of Environmental Experimental Accounting, and the Sustainability Assessment of Food and Agriculture systems (SAFA) terminology from the Food and Agriculture Organization (FAO), offer a blueprint and basis for an eventual standard that:

- has a footprint protocol agreeing the spatially and contextually explicit footprints needed to incentivise footprint reduction and track progress toward food system transformation targets
- defines the format required for a database of shadow prices associated to the footprint quantities
- formalises impact pathways through which major impacts occur (exchanges and contributions between footprints, capitals, footprint to capital and capital to human well-being relevant to impact).
- is supplemented by scenarios for estimating lock-in impacts and projecting demand of categories of sustainable food products.

With an accounting standard, existing features of the market can be used for disclosure of footprint. For example, certification of sustainable products could be associated to footprint ranges. Calculating footprint is within the competitive space.

The report discusses global footprints targets. A footprint protocol would allow progress toward global footprint reduction targets for the food system to be tracked, while also informing context specific economic corrections and incentives.

PREVIOUS SECTION: 1. EXECUTIVE SUMMARY

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NEXT SECTION: 3. INTRODUCTION AND GLOSSARY