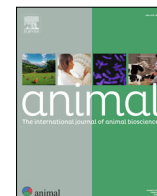




# Animal

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### Short Communication: True Cost Accounting (TCA) as a transformative approach for livestock agri-food systems



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#### ABSTRACT

Today, there is extensive debate about the sustainability of the food system. Numerous research and policy initiatives focus on transforming the food system to make it more sustainable. The method of True Cost Accounting (**TCA**) can reveal positive and negative externalities for natural, social, human, and economic capital in food production and consumption. Insight into and internalisation of these externalities in decision-making can contribute to making food systems more sustainable. This paper illustrates the use of TCA and presents a research agenda for TCA in livestock agri-food systems. TCA is based on environmental and social life-cycle assessments and, as a result, inherits some of their shortcomings. Monetising the impact of externalities is a methodological challenge, further complicated by the practical challenges of data availability. We recommend working towards a harmonised TCA approach with an interdisciplinary team of researchers to assess the true value of livestock agri-food systems.

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#### Implications

True Cost Accounting is a method endorsed by the scientific community (FAO, 2023) guiding the holistic sustainability transformation of the food system by measuring and monetising negative and positive externalities. Insights into the externalities and ways of internalisation are needed for decision making at different levels along agri-food value chains. Further methodological harmonisation and better data availability are required to improve the practical application of True Cost Accounting in public and private policy-making.

#### Introduction

The sustainability of the food system is at stake, not only with respect to climate change but also regarding land use, biodiversity,

animal welfare, human health, and other issues discussed below. Food production and consumption have environmental, social, human and economic side-effects, called externalities that can be positive, but are often negative for society. The global costs of food externalities are substantial, estimated at approximately 10 trillion USD annually, equivalent to about 27% of the gross domestic product in low-income countries (FAO, 2023). Livestock-derived food products have a particularly high environmental footprint compared to many other food products and are also associated with concerns regarding animal welfare and antibiotics use. Examples of positive externalities are limited: carbon sequestration of grasslands, flood control, soil health, viability of rural areas, landscape scenery and landscape maintenance, as well as healing of humans. Externalities are not reflected in prices and costs and, thus, are insufficiently considered by decision makers. True Cost Accounting (**TCA**) is a methodology to include such externalities in decision-making by monetising and weighing them by their impact on human welfare. The aim of this paper was to introduce the state-of-the-art of TCA methodology, and to set up a research agenda for TCA in the livestock agri-food system.

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## Material and methods

### The true cost accounting approach

This paper builds on research conducted in the past 10 years (see Gemmill-Herren et al., 2021; Hendriks et al., 2021) and that continues in three EU Horizon projects: FOODCoST (<https://www.foodcost-project.eu/>, 2021–2025), PATHWAYS (<https://pathways-project.com/>, 2021–2026), and STEP-UP (<https://horizon-stepup.eu/>, 2024–2027).

Fig. 1 illustrates the private production costs and the true costs and benefits. Externalities create environmental and social costs to third parties not involved in the transactions, but they can also create external benefits (= positive externalities). External benefits from production can be regarded as lowering marginal social costs, while external costs increase marginal social costs. Together with production costs, they are the true costs. Decision makers are encouraged to consider the true costs and benefits to realise a more sustainable livestock production.

### The four steps in a true cost accounting assessment

A TCA assessment has four steps, that are explained below: 1. setting goal and scope of the analysis, 2. determining the externalities to be considered, 3. determining the pathways and indicators and measuring the footprints, 4. monetising the footprints.

Step 1 sets the goal and scope of the analysis by defining the goal of the research, the target group, the product, and the system boundaries.

Step 2 concerns determining the externalities to be considered in the analysis. Table 1 lists 22 externalities that are currently considered in TCA in the FOODCoST project, grouped in environmental, social and human, and economic capital. These are meant to give a complete picture of the positive and negative externalities originating from food production and consumption along the total value chain without double counting. Note that these broad groups of externalities include multiple impact subcategories, e.g., toxicity includes freshwater ecotoxicity, human toxicity cancer, and human toxicity non-cancer.

In step 3, footprints in the analysis are measured using pathways and indicators developed in environmental and social life-cycle assessments (E-LCA and S-LCA). Pathways describe the relation between the externality and the impact on the capitals and indicators are used to value this relation. Such pathways should consider the time scale at which the impacts materialise, since impacts are more direct, such as land use change, and others only occur on the long term, such as climate change. Databases reporting E-LCA and S-LCA data, data on the health impact of diets, and data of animal welfare are used to quantify the footprints. With these pathways in mind, indicators are selected that show the relation between the externality and the societal impact (see ISO standards for LCA). Mostly, these indicators have a technical dimension,

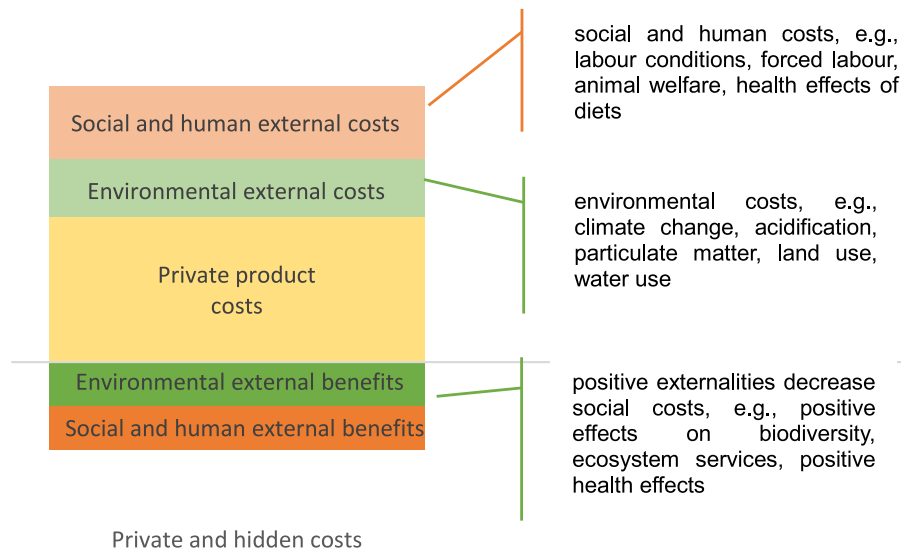


Fig. 1. Definition of true costs: private and external costs of livestock production and consumption (Source: Authors).

Table 1

List of externalities for global food production and consumption categorised by the capital approach (Environmental, Social & human, Economic capital) (Source: Authors).

Environmental capital	Social & human capital	Economic capital
Climate change	Labour rights and conditions	Spillovers (knowledge, infrastructure, human capital)
Acidification and eutrophication	Equity, living income	Monopoly power effect on market and institutional structure
Particulate matter	Local community rights	Food waste effects on market
Water stress	Consumer rights	Income transfers
Land use and land transformation	Food security	
Direct effects on biodiversity and ecosystems	Food safety	
Toxicity	Infectious diseases	
Non-renewable resource depletion	Health effects of diets	
Noise, smell, visual intrusion	Animal welfare	

such as CO<sub>2</sub> equivalents for climate change. Since the environmental and social assessment of the TCA methodology is based on E-LCA and S-LCA, some of the shortcomings of these methods are imported into the TCA methodology. For social assessment specifically, it is still unclear which externalities are most relevant for livestock production. Efforts in projects such as PATHWAYS and STEP-UP aim to identify these.

In step 4, monetisation of the footprints in the analysis is used to make impacts comparable. It is a form of weighing with human welfare as a reference. There are three TCA approaches to monetise the footprints: damage, abatement, and remediation costs. Damage costs refer to damage or benefit caused by the externality borne by those affected by it, external costs and benefits to society. Abatement costs are the marginal costs of achieving a specific reduction target for an externality such as an emission cap. Remediation costs postulate responsibility and focus on the negative effects of violations of human rights and legal requirements. The FOODCoST project compares these approaches for their suitability in the agri-food domain. Regarding the time scale at which impacts materialise, some approaches use a discount rate and others do not, influencing the weighting of externalities.

#### Added value of true cost accounting in measuring sustainability compared to other methods

There are other methods like Corporate Sustainability Reporting Directive (CSRD), The Economics of Ecosystems and Biodiversity for Agriculture and Food programme (TEEBAgriFood) Evaluation Framework, Human Rights Risk Assessment (HRRR), E-LCA, S-LCA, and Social Cost Benefit Analysis (SCBA) that can be used to measure and report on sustainability (Table 2).

True cost accounting offers a holistic picture of all environmental, social, human, and economic externalities and is not limited to one of these areas like HRRR, E-LCA, S-LCA. Like SCBA, TCA also weights all externalities. By expressing the weights in monetary terms, true costs can be compared with market prices (private costs). TCA is similar to SCBA but applies to products rather than projects. TCA also incorporates the technical information on impacts from E- and S-LCAs and is based on TEEBAgriFood Evaluation Framework.

## Results

### Findings of applying true cost accounting in livestock production

Regarding environmental externalities, much scientific literature is available that quantifies the negative impact of livestock production on the environment. However, studies analysed only a restricted range of externalities and not all externalities of Table 1. Positive externalities are rarely addressed. To ensure comparability of the outcomes, the same externalities should be studied, with the same TCA methodology and the same data quality.

Regarding social externalities, no method exists that can quantify all direct social impacts related to a product's life cycle, such as labour conditions, health effects of overconsumption of meat, and animal welfare. Monetisation factors for infectious diseases and food safety in livestock production are fully lacking from the current TCA methodology.

Regarding economic externalities, no literature related to TCA applied to livestock is available and a methodological approach how to deal with economic externalities is lacking.

### True cost accounting and sustainability transformation strategies through government policies and business practices

There are multiple strategies for improving the sustainability of livestock systems such as switching to organic production, using circularity principles, targeting higher efficiency, extensification and introducing cultivated meat. TCA has been used to a limited extent to assess the sustainability of these strategies and to identify trade-offs among externalities. The outcomes are sometimes contradictory because there is no harmonised TCA approach. More research is needed to estimate the real impact of these strategies.

When true costs are calculated, these can be used in public policymaking by internalising externalities through various instruments, such as market-based (taxes) and administrative-based instruments (public procurement, regulation, tradeable permits (Coinon et al., 2023)). TCA can also be used as a basis for product labelling like was suggested in the EU legislative framework for Sustainable Food Systems “to cover the provision of consumer

**Table 2**

Characteristics of several methods to measure and report on sustainability, especially within livestock agri-food systems (Source: Authors).

Characteristic	CSRD	Method to measure and report on sustainability					
		TEEBAgriFood	HRRR	E-LCA	S-LCA	SCBA	TCA
Weighing of externalities	No	No	Possible	Possible	Possible	Yes	Yes
Quantification	No	No	Partly	Yes	Yes	Yes	Yes
Monetisation	No	No	No	No	No	Yes	Yes
Generated information	Sustainability risks in companies value chain	Framework with overview of externalities	Social risks	Impact of product on environment	Impact of product on social issues	Societal impact of a governmental project	Private and public impact of production and consumption
Information used for	Strategic choices	Analysing (part of) food systems	Selection of countries, prioritising risks and mitigation measures	Choices for production process, product portfolio, and consumer communication	Choices for production process, product portfolio, and consumer communication	Selection of policy options	Policy evaluation; risk analysis; product development, Sourcing
Distinctiveness	Legal obligation	Taking into account environmental, social, human and economic issues	Details about human rights	Relation between company activities and environment	Relation between company activities and social issues	Assessment framework for governmental investments and projects	Assessment framework for sustainability of products and value chains

Abbreviations: CSRD = Corporate Sustainability Reporting Directive; TEEBAgriFood = The Economics of Ecosystems and Biodiversity for Agriculture and Food programme; HRRR = Human Rights Risk Assessment; E-LCA = Environmental Life Cycle Assessment; S-LCA = Social Life Cycle Assessment; SCBA = Social Cost Benefit Analysis; TCA = True Cost Accounting.

information relating to the nutritional, climate, environmental and social aspects of food products”.

Transitioning to sustainable agri-food systems through businesses requires business models and strategies which involve creating positive externalities, mitigating negative ones, and ensuring fair distribution of risks, costs, and benefits. Five main themes of business models and strategies to internalise externalities have been distinguished by [Mehrabi and Giagnocavo \(2024\)](#): (i) product and process innovation; (ii) re-arrangement or reconfiguration of the value chain, (iii) measurement and accreditation tools, (iv) consumer and market recognition, and (v) innovative financing.

True cost accounting can be supportive of these ways of internalisation by measuring the impact on the different capitals and by showing possible trade-offs of the internalisation of, for example, better animal welfare at the cost of more greenhouse gas emission per kg end-product. We recommend working towards a harmonised TCA approach with an interdisciplinary team of researchers to achieve the true value of livestock agri-food systems.

## Discussion: research agenda

Key knowledge gaps and challenges to be addressed within TCA are:

- Lacking consensus on the valuation approach for some key externalities such as biodiversity and positive externalities;
- Lacking methodologies to quantify and monetise social externalities such as infectious diseases and food safety, and to quantify economic externalities;
- Incomplete database(s) to value externalities and to monetise indicators.

Some of these gaps and challenges have been taken up in current Horizon Europe projects, such as harmonisation of TCA methodology (FOODCoST), developing methods for biodiversity (FOODCoST and STEP UP), prioritising important S-LCA issues for livestock production (STEP-UP), fitting of economic externalities in TCA (FOODCoST), and developing databases such as ecosystem services valuation database and the database developed in the PLAN' EAT project, but further efforts will be required.

There is an urge to measure sustainability in a harmonised way to support decision-making on the governmental and business level. Engagement of all types of professionals connected to the journal 'Animal' is required when tackling the above points.

## Ethics approval

Not applicable.

## Data and model availability statement

Data or models were not deposited in an official repository. No new datasets were created. Information can be made available from the authors upon request.

## Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) did not use any AI and AI-assisted technologies.

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## Declaration of interest

None.

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