EXPLORING THE TRUE COST OF BEEF IN EGYPT

TRUE PRICING FROM FARM TO FORK

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NFP Netherlands Food Partnership

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EDITORIAL NOTE

Report: THE TRUE COST OF BEEF IN EGYPT - EXPLORING TRUE PRICING FROM FARM TO FORK (Version 0.4 April 2025)
Project name: True price study of organic and conventional beef as part of the NFP true pricing seed fund project.

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MEET THE ORGANIZATIONS BEHIND THIS REPORT

RDNA

RDNA, Cairo's premium health food store, is dedicated to providing its customers with clean, organic, and sustainable products. In line with this commitment, RDNA, alongside SEKEM, a sustainable development initiative, aim to advance sustainable beef production in Egypt.

www.rdnastore.com

True Price

True Price is a social enterprise based in Amsterdam, the Netherlands, dedicated to realizing an economy built on true pricing. Over the past decade, True Price has established itself as a leading organisation in true cost accounting and true pricing providing data, software, and tools. The True Price Foundation is a nonprofit organisation that works to promote the understanding and implementation of true pricing through the true price partnership.

www.trueprice.org

Netherlands Food Partnership (NFP)

NFP is committed to creating a world without hunger by ensuring everyone has access to sustainable, healthy, safe, and affordable food, NFP strengthens relationships between partners from the Global South and the Netherlands, fostering collaboration across the private sector, knowledge institutions, civil society, and government. By connecting people and knowledge, we contribute to creating more just and sustainable food systems in Low and Middle-Income Countries.

www.nlfoodpartnership.com

NFP's True Pricing Seed Fund

NFP launched the True Pricing Seed Fund for the first time in March 2024. The aim of the fund is to stimulate new initiatives or boost components of existing initiatives that focus on true pricing or true cost accounting within food value chains that have significant impact on social and/or environmental costs in LMICs.

Content

EXECUTIVE SUMMARY

Introduction

RDNA, Cairo's premium health food store, is dedicated to providing its customers with clean, organic, and sustainable products. In line with this commitment, RDNA, alongside SEKEM, a sustainable development initiative, aim to advance organic beef production in Egypt. This report presents a baseline assessment of the true cost of beef production, aiming to inform strategies that promote more sustainable practices within Egypt's meat production sector.

Data approach

We use the True Price Assessment Method and data from Poore and Nemecek (2018) to estimate the environmental cost* of beef production, focusing on climate change, air pollution, and land use (including biodiversity) impacts. Additionally, a separate analysis of animal welfare loss is included to capture the broader impacts of beef production.

Key Findings

The environmental cost of beef can be multiple times higher than its market value; variability is high across farms. This baseline global assessment reveals external environmental costs ranging from €17 (E£560) to €50 (E£1,600) per kilogram of beef.

Studies on European countries included in our assessment show that organic farming has lower environmental costs per hectare, but higher external environmental costs per kg of beef.** For organic beef, the external environmental costs are estimated at €27 (E£880.42) per kilogram and €3,100 (E£103,000) per hectare. Data specific to the organic value chain in Egypt was not available.

At SEKEM farm, a key supplier for RDNA, beef is produced on land reclaimed from the desert, reducing the environmental cost of land use. While this approach presents promising sustainability benefits, the trade-offs related to water scarcity require further exploration. In terms of animal welfare, SEKEM's practices, such as providing 30 square meters of open field per animal year-round, result in minimal animal welfare impacts (€0.001 / E£0.04 per kilogram of beef), setting a benchmark for sustainable production.

Next steps

The true costs of beef production globally are linked to significant environmental and animal welfare challenges. This report explores these challenges and frames them within the context of Egyptian production and RDNA's supply chain. The findings will guide RDNA and SEKEM as they continue to implement sustainable practices and drive positive change in Egypt's beef production sector.

*Environmental costs: costs to society that arise through a direct effect on the environment.** This is linked to the fact that organic systems often have higher land use per unit of output; however, further analysis is required to draw conclusions. An exchange rate EUR/EGP of 33.186 (average in 2023) was applied.

Introduction

01

INTRODUCTION | TRUE PRICING FROM FARM TO FORK

A baseline assessment on the environmental cost of beef to advance organic meat production in Egypt.

- RDNA, a premium health food store in Egypt, is actively engaged in the organic meat value chain, collaborating with SEKEM's Demeter-certified farms to promote more sustainable cattle raising (see **Appendix A**). However, the true cost of beef production—both conventional and organic—often remains hidden, making it difficult for consumers and businesses to fully understand its environmental and social impacts.
- Without clear data on the social and environmental impacts of food production, informed decision-making and sustainable consumption practices are hindered. To address this challenge, True Price has partnered with RDNA to conduct a baseline assessment of the environmental cost of beef.*
- This study aims to provide valuable insights that support RDNA's efforts to advance sustainable beef production in Egypt. Additionally, RDNA seeks to make the concept of true pricing more relatable to consumers, fostering informed and responsible choices.
- This report is part of the Netherlands Food Partnership (NFP) True Pricing Seed Fund (2024).

RDNA, pronounced ardena, is the Arabic word for our land or our soil. RDNA is a leading specialty grocery store of organic meat, organic dairy and other organic and natural products in Egypt.

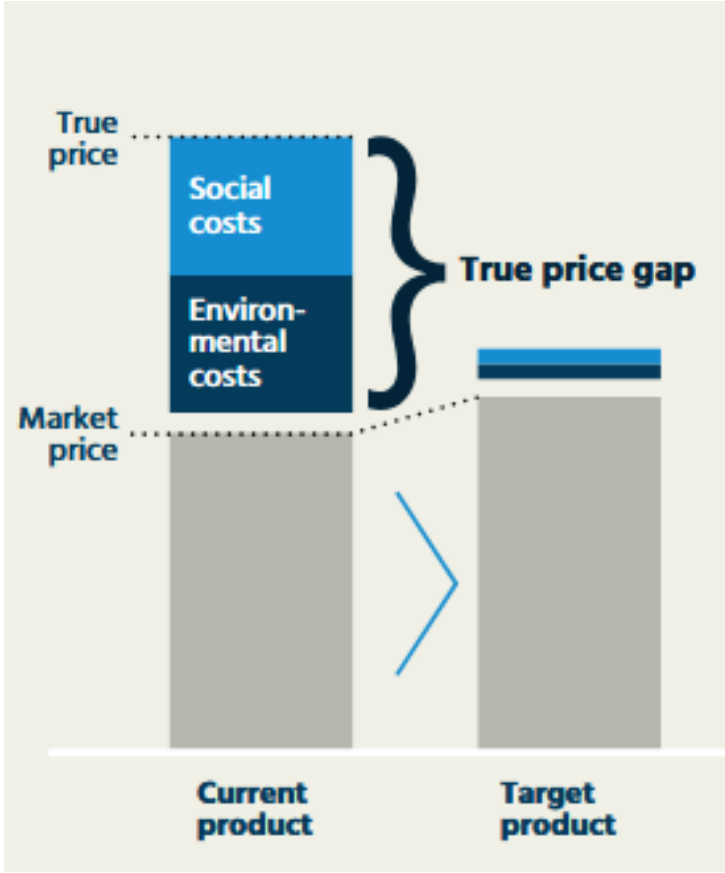
*A previous true cost accounting study by Seada et al. (2016) assessed organic versus conventional farming in Egypt for five key strategic crops—cotton, maize, potatoes, rice, and wheat. However, no similar study was found for beef.

INTRODUCTION | ABOUT TRUE PRICING

The goal of true pricing is not to make things more expensive, but to reduce and eliminate the hidden social and environment impacts of products over time.

- True pricing is an approach to calculate and present the external costs – the hidden social and environmental impacts of products that are not included in prices – and take action to eliminate or reduce them as much as possible.
- At its core, true pricing is about comprehensive transparency on products, how they are made, and what additional costs might be associated with transitioning to a food system that respects the rights of people and ecological boundaries. It is also about closing the gap between market price and true price, or in other words reducing, restoring, compensating or preventing environmental and social damage through, among others, remediation.
- The true price is the sum of the current price of a product plus the external "hidden" social and environmental costs. The external costs of a product are called the true price gap and include all major impacts, such as contribution to climate change, water pollution and occupational accidents. All external costs are expressed in the same (monetary) unit. In that way, they can be compared to each other, as well as to conventional prices.
- **Figure 1** illustrates the concept of the true price gap, which is the difference between a product's market price and its true price, which includes social and environmental costs. The current product has a higher true price due to these hidden costs, while the target product aims to reduce these external costs, narrowing the true price gap. The goal is to create products that align their market price more closely with their true price by minimizing social and environmental impacts.

Figure 1. Visualization of the true price and the goal of true pricing



INTRODUCTION | BEEF PRODUCTION IN EGYPT

Challenges and shifts in Egypt's beef production: balancing food security and sustainable agriculture.

- Egypt is the most populous country in the MENA region and its agricultural sector is critical for food security, livelihoods, and economic stability. However, the country's dry climate presents significant challenges, including limited access to water and fertile land. With one of the lowest shares of arable land per capita globally (0.03 ha), Egypt faces unique constraints in scaling sustainable agricultural practices, including beef production.*

Beef production in Egypt

- Egyptians consume red meat from locally produced fresh beef, imported feeder cattle, imported cattle for immediate slaughter, and frozen beef. According to FAO data from 2022, most of the beef consumed in Egypt is locally produced, totaling 611,000 tonnes, while imported beef accounts for 349,000 tonnes annually.** Due to recent currency fluctuations however, Egypt has shifted from being a leading importer of bovine meat to focusing on increased domestic production and stocks.
- Local beef production varies across large specialized producers and small-scale farms and households. The intensive beef production system (characterized by high input and output livestock holdings) is an important source of quality beef for Egyptian consumers.*** Extensive production provides income and beef for a large share of households in rural areas.
- Animal husbandry techniques have boosted meat production but have also sparked concerns about animal welfare and the potential health risks associated with antibiotics, growth hormones, and other chemicals frequently used in industrial meat farming.****

Table 1. Egypt's Live Cattle and Frozen Beef Imports by Value (2023)

Live cattle – value imported in 2023 (USD thousand)	Frozen meat (bovine) – value imported in 2023 (USD thousand)
- Colombia (94,396) - Brazil (93,610) - Ukraine (20,069) - Spain (17,596) - Romania (795)	- India (522,528) - Brazil (252,295) - Colombia (9,907) - Paraguay (5,890) - South Africa (5,890)

Source: International Trade Centre (ITC).

*Challenges for livestock production in Egypt include lack of available fodder resources, low productivity, health and reproductive health, climate changes and limited water resources available. Source: Shoukry, M. (2021). ** Source: FAO (2023). *** FAO (2018). **** Seada et al. (2016).

INTRODUCTION | BEEF CONSUMPTION IN EGYPT

Due to economic pressures, beef consumption in Egypt has declined, but demand for animal-sourced foods is expected to grow in the future.

- Beef consumption in Egypt has been experiencing a decline in the recent years. Per capita annual beef consumption was approximately 7 kg in Egypt in 2022.* Compared to 2015 beef consumption decreased by almost 35%, as consumption was approximately 10.7 kg per capita.
- This steep decline in beef consumption is mainly because of several economic challenges, such as high inflation (up to 35%).** In addition, relatively, meat prices increased more compared to other protein alternatives.***
- However, as the population increases and incomes rise, the demand for animal sourced food is expected to increase.**** Therefore, it is important that policymakers, businesses, and society work together to ensure the sustainable development of the livestock sector.
- By adopting sustainable practices, promoting resource efficiency, and reducing environmental impacts, Egypt can address future demand while protecting its ecological and economic well-being. True pricing can play a crucial role in these efforts by providing transparency and aligning activities with environmental and social goals, and ensuring that consumer demand does not come at the expense of long-term sustainability.

*Source: World Population Review (2023); ** OECD (2015) *** OECD (2023); **** The country's population is projected to reach 150 million in 2050 and demand for animal source foods, including livestock and fishery products is expected to exponentially increase, Source (FAO, 2020).

Approach

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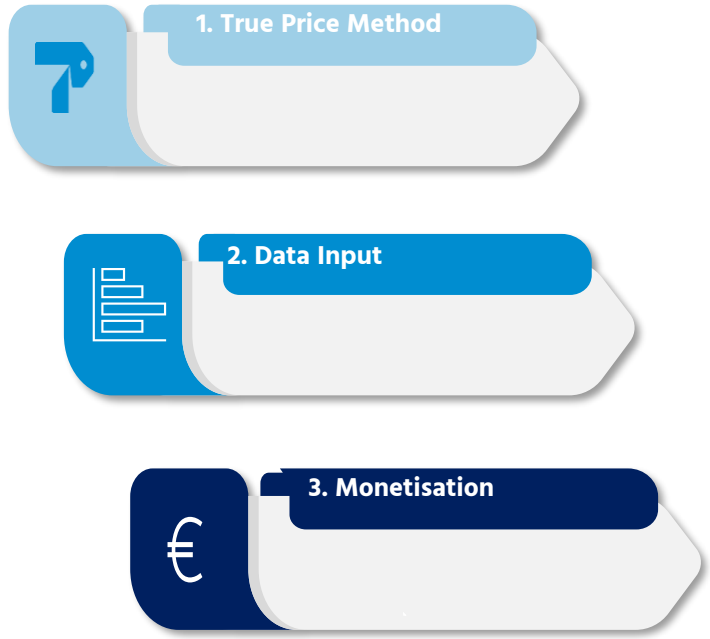
APPROACH | TRUE PRICE ASSESSMENT METHOD

Overview of the methodological approach used to calculate the true cost of beef production.

- **Method:** This analysis follows the True Price Assessment Method* to evaluate the environmental and animal welfare costs associated with the production of (organic) beef. This methodology provides a systematic and standardised approach to determining the true price of various commodities.
- **Data Inputs:** To conduct the quantitative assessment, a diverse array of data sources was employed to compile the necessary input data (see **Appendix**). By applying this data, the environmental footprint of beef were quantified using global data. Animal welfare loss was calculated using the methodology developed based on an LCA adjusted method (Impact Institute 2023).** The animal welfare model is based on secondary data supplemented by primary data provided by RDNA.
- **Monetisation:** Every footprint indicator can be converted to a monetary unit using the corresponding monetisation factor. Monetisation factors are estimates of the remediation cost of the social and environmental impacts that must be included to estimate the true price of a product.*** Each environmental and social footprint was monetized and then aggregated to calculate the final true price gap of beef.
- See **Appendix** more details on the methodology.

Figure 2. Method, data and monetisation to explore the environmental & animal welfare cost of beef



* The True Price Assessment Method for Agri-food Products (2023) was developed by True Price and Wageningen Economic Research within the Public Private Partnership True and Fair Price for Sustainable Products (PPS Echte en Eerlijke Prijs voor Duurzame Producten)
** Country-specific taking into account the proportion of land and ecosystem service in the country.***For more information see Monetisation Factors for True Pricing (2023)*

APPROACH | DEFINITION OF IMPACTS IN SCOPE

Impacts in scope of the true cost of beef – a baseline assessment.

Table 2. Definition of impacts in scope

	**Contribution to climate change**	Contribution to climate change from emissions of greenhouse gases (carbon dioxide, methane, nitrous oxide and others). Emissions of greenhouse gases increase their atmospheric concentration (ppb), which increases the radiative forcing capacity and consequently increases the global mean temperature. Ultimately, extreme weather patterns, reduced agricultural yields and increased frequency of natural disasters can result in damage to the economy, human health – e.g., increased risk of diseases, natural disasters - and ecosystems (Huijbregts et al. 2016).
	**Land use and biodiversity**	The decreased availability of land for purposes other than the current one, through land occupancy. Land occupation by agriculture displaces habitats and ecosystems and therefore leads to biodiversity loss and loss of ecosystem services (Milà i Canals et al., 2007; Alkemade et al., 2009; De Groot et al., 2012). In this calculation, the impact of land use in hectares is adjusted for the type of biome (e.g. inland wetlands, grasslands, etc.) and the biodiversity loss coefficient (1 – Mean Species Abundance) (more information in the "True pricing method for land use, land use change, biodiversity and ecosystem services" **).
	**Air pollution**	Impacts caused by emissions to air other than climate change, namely acidification and particulate matter formation, as defined in LCA methodologies.
	**Animal welfare loss**	The animal life years suffered as a result of low life quality conditions during the entire production cycle. Factors considered are animals' life quality, slaughter age, slaughter duration (including transport time), number of animals affected per unit of output, and the number of neurons of different animal types.* *Approaches to quantifying these impacts are still under development, and this is not yet a standardized methodology. For a detailed explanation of the methodology.* For a detailed explanation of the methodology see **Appendix.**

*In simple terms, we can judge the moral value of animals by comparing their brain size, the number of brain cells, or how many of those cells are involved in thinking. This comparison is used to decide how similar animals are to humans in terms of intelligence and morality. **all natural capital modules for true price assessment can be found on the True Price website.

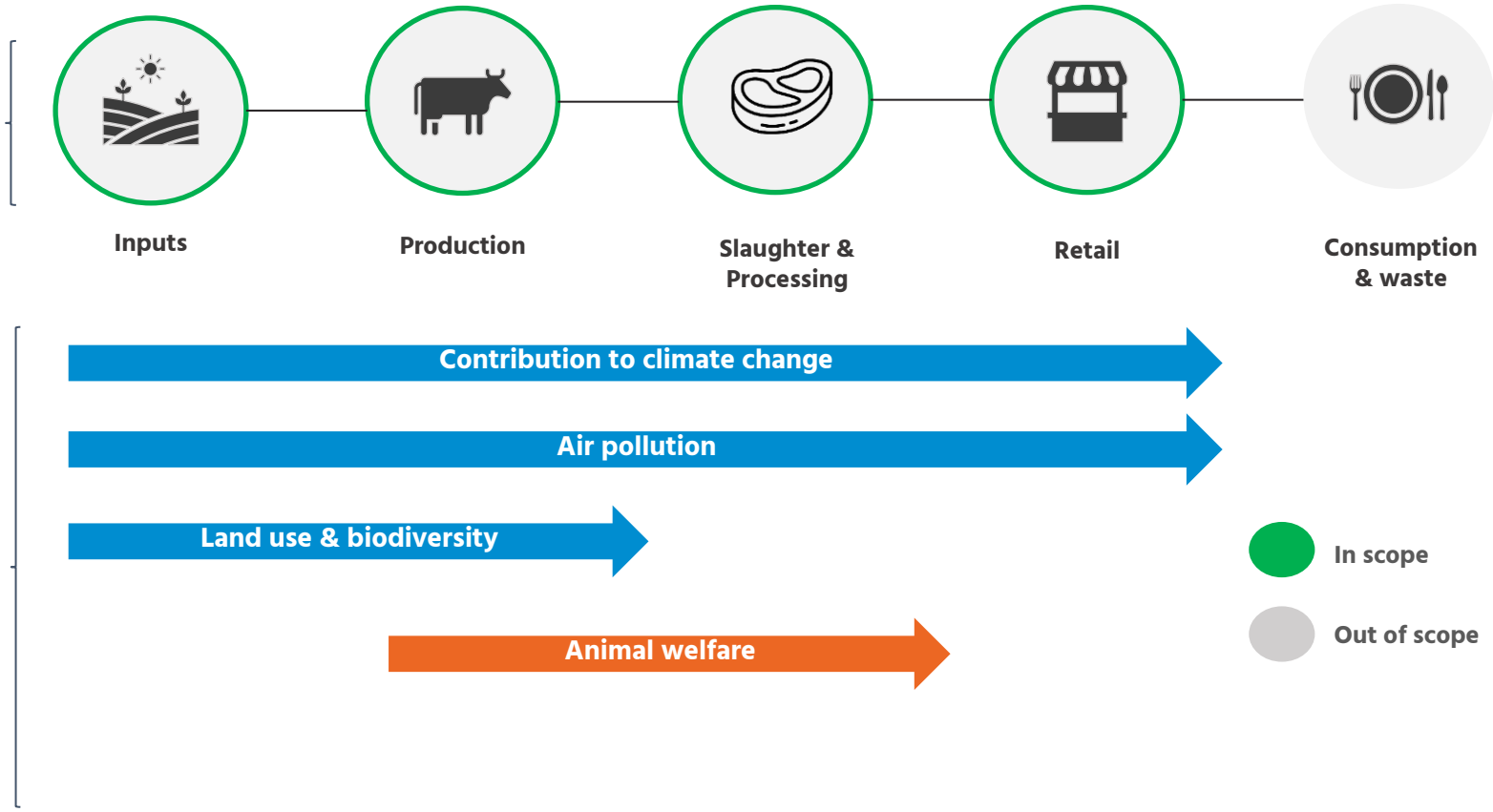
APPROACH | VALUE CHAIN SCOPE & IMPACTS IN SCOPE

A simplified value chain of beef produced in Egypt, both organic and conventional.

We use data from Poore & Nemeck (2018) for all environmental impacts in scope for both organic and conventional beef production. Data was available until retail level (including transport) Our assessment focuses exclusively on beef cows, excluding dairy cows.

Impacts were selected based on data quality and availability of resources, as well as expected materiality based on previous research and true price calculations.

Impact materiality* refers to the significance or relevance of an impact on the total true price gap. Impact materiality helps determine which impacts (e.g., water pollution, land use, underpayment) should be included in an assessment.



*Scientific articles and previous true price calculations show that the most material impacts for beef production are contribution to climate change, air pollution and land use. In addition, animal welfare was found to be the most significant impact across all protein types. Sources: LIKE-A-PRO & Impact Institute (2024) & Poore & Nemecek (2018).

APPROACH | SYSTEM DESCRIPTIONS

This report presents results for three different scenarios based on data availability and project goals. Given that beef consumed in Egypt originates from multiple sources, as noted in the introduction, using a global proxy offers a reasonable representation of production impacts.*

Table 3. System descriptions

	Description	Geography	Feed	Proxy approach
Global	A global average of the environmental impact of conventional farming.	Global	A mixture of pasture and crop feed	The global database by Poore and Nemecek (2018) was used (see **Appendix).** All systems were included that produce beef. Dairy farms were excluded. In total, 114 studies were included from 16 different countries. One study may contain data from several farms.
Exploration of Egypt and reclaimed land	Conventional farming of beef in Egypt.	EU-Egypt	Because of the dry climate Egypt farms generally have little pasture and feed their cows mostly by crop feed	Cattle can be fed through grazing (pasture) or feed. Because of limited pasture in Egypt, for the exploration of the Egyptian system we have more interest in feed-raised cattle. Therefore, a selection of farms was made with low pasture to explore the impact of Egyptian beef. See **Appendix** for more details. Of the global average an inclusion criterium was applied of farms with less than 30% pasture. These findings are based on a few case studies rather and cannot be used as a robust approximation of Egyptian beef.
Conventional and organic beef in the EU	Organic farming with low pasture and organically produced feed.	EU	Straw, hay, grasses, sorghum, clover, corn, oil seed cakes	As there was a lack of data in Egypt, the impact of organic farms** in Europe was analysed compared to conventional farming in the same geographical scope. This can only be used as a comparison of organic farming to conventional farming, not as an estimate for organic farming in Egypt, because of large differences in energy and water use, impact on land use and biodiversity as well as water scarcity.

*Additionally, Egypt has historically sourced meat from Europe, further supporting the relevance of a global benchmark. **Organic farming is defined as intentionally avoiding synthetic inputs like fertilizers and pesticides, excluding systems that do so due to lack of access. Conventional farming typically employs synthetic inputs, with practices varying by region.

METHOD | INDICATORS AND MONETISATION FACTORS

Below the footprint indicators and monetisation factors are reported used in this true price assessment.

Table 4. Footprint indicators of impacts in scope

Impact	Sub-indicator	Footprint indicator
Land use and biodiversity loss		Bio-ha (biodiversity adjusted hectare)
Contribution to climate change		Kg of CO2-equivalent
Air pollution	Acidification	Kg SO2-equivalent
	Particulate matter formation	Kg PM2.5-equivalent
Animal welfare loss	Time spent in open field	Days
	Product fraction	Ratio of kg beef per animal
	Slaughter age	Years
	Slaughter duration	Years

Table 5. Monetisation factors of impacts in scope.

Impact	Subindicator	Monetisation factor 2023	Geography
Land use and biodiversity loss		€1.880,96 - €6.294,97 / Ha	Country-specific*
Contribution to climate change		€0,17 / Kg of CO2-equivalent	Global
Air pollution	Acidification	€5,22 / Kg SO2-equivalent	Global
	Particulate matter formation	€72,33 / Kg of PM2.5-equivalent	Global

*Note: For animal welfare monetistion factor and methodology see **Appendix.***

**Source: Monetisation Factors for True Pricing (2023)* Country-specific monetisation factors take into account the proportion of land and ecosystem service in the country. The Egypt monetisation factor for land use is high, approximately € 9000 euro. For reclaimed land from the desert, the monetisation factor would be close to zero because of minimal impact on the local ecosystem (or even an improvement of biodiversity). In the calculation (results on pg. 22- beef reclaimed land from desert), we assume a monetisation factor of 0.

Results

03

RESULTS | INTRODUCTION

The results of this assessment provide estimates of the environmental and animal welfare cost of 1 kg of beef across different production systems.

- This section presents the **environmental costs** of beef, highlighting the true cost results and analysis for each type of impact (climate change, land use and biodiversity, air pollution and animal welfare impact).
- A first overview of results for beef globally is followed by several comparisons. It consists of four parts:

1. **Environmental costs of beef (global estimate)**
2. **Environmental costs of beef in Egypt – exploration of minimal grazing systems & reclaimed desert land**
3. **Environmental costs of organic beef – per kg and per ha results**
4. **Animal welfare loss from beef production across different systems**

- The results on the following pages reflect estimations. They are based on a collection of secondary data sources (see **Chapter 2** for more information).
- It is important to note that due to a lack of specific secondary data, the environmental costs of Egyptian beef could not be directly estimated. Instead, an exploratory analysis was conducted using global data to provide an indicative estimate of the potential magnitude of Egypt's environmental costs for beef production.
- All results are expressed in 2023 euros and rounded to significant digits.
- An exchange rate EUR/EGP 33.186 *was used (see also limitation pg. 26).

*exchange-rates.org (2023).

RESULTS | EXPLORATION OF THE TRUE COST OF BEEF (GLOBAL)

Environmental costs of 1 kg of beef are between € 17 – 50 / E£ 560 - 1,600.

Data approach

- **Figure 3** shows the middle range of the environmental costs of beef globally. The analysis includes farms that produce conventional beef, based on data from 114 studies and 16 countries. Each study may contain data from multiple farms. See **Appendix** for a list of countries and the number of studies per country.

Exploratory results

- Beef production has a high environmental impact. The middle range of environmental costs is between €17 (E£560) and €50 (E£1,600) per kg of beef.* The actual true price gap of beef in a specific situation is dependent on the location, the type of agricultural system used and the productivity of animals.**
- The highest impact is land use and biodiversity (€5.20 – €30 or E£170 - E£1,000 per kg beef). This includes both cropland to produce feed and pasture for grazing. This impact depends on the amount of land required, and how much biodiversity is left on that land.
- Contribution to climate change is also a significant impact. It covers all greenhouse gas emissions. Feed production, cows' enteric fermentation and manure management have the biggest contribution. Cows emit methane and potent greenhouse gasses as they digest their food. Methane is also emitted from manure. Additionally, greenhouse gas emissions are emitted from fertilizers during feed production.
- Air pollution shows the cost of ammonia emissions to human and ecological health. These emissions can cause acid rain and respiratory problems.
- These findings underscore the importance of considering the true environmental costs of beef production, while also highlighting the need for further data to refine and improve these estimates.

Figure 3. Environmental cost of 1 kg of beef – middle range

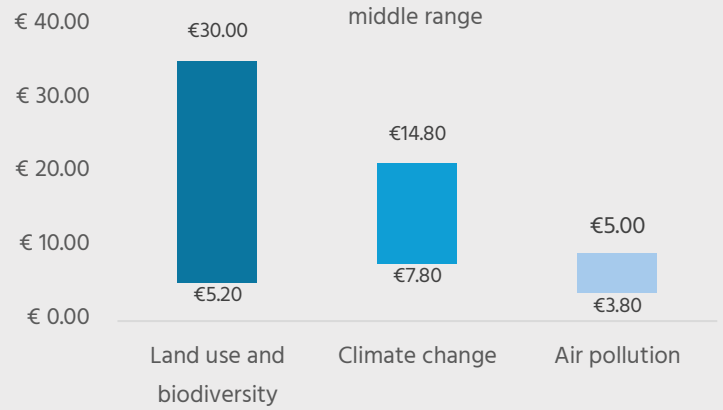


Table 6. Middle range boundaries of the environmental cost of beef

Impact	Middle range lower boundary (1st quartile)	Middle range upper boundary (3rd quartile)
Land use and biodiversity	€ 5.20	€ 30.00
Climate change	€ 7.80	€ 14.80
Air pollution	€ 3.80	€ 5.00
Sum	**€ 16.80**	**€ 49.80**

*Environmental costs of beef production: range reflects the range where the middle 50% of the datapoints falls (1st to 3rd quartile). For non-monetized results see p. 39 in the Appendix. **Factors include physical conditions (e.g climate, soil), animal species, production purpose (dairy or meat), farming practices and manure management (e.g. organic vs conventional).

RESULTS | EXPLORATION OF THE TRUE COST OF BEEF IN EGYPT

Minimal grazing systems have 50 euros (~ E£1,700) environmental costs; reclaimed land expectedly drives costs down.

Data approach

- No secondary life cycle assessment (LCA) data was found regarding the environmental impacts of beef production in Egypt. **Figure 4** shows the average environmental costs of 1 kg of beef from minimal grazing systems based on global data. A characteristic of Egyptian beef production is that cattle are not kept on pasture land. Therefore, Egyptian farms rely more on cropland to feed cattle.
- To get some insights into the possible environmental costs of Egyptian beef, we focused on studies in the dataset where a maximum of 30% of total land use is associated with grazing. The remaining land use is dedicated to feed production, livestock keeping, and other land-related activities. We called this subset "**minimal grazing systems.**" Studies in this subset include farms in 5 countries only (see **Table 7**). Only the study from Germany had data for air pollution impact.

Exploratory results

- The environmental costs of minimal grazing systems are €50 (E£1,700) per kg of beef. To put this into perspective, in May 2023, the average price of local cow and buffalo meat was €9.3 per kg*, meaning the true price gap would be approximately 5.4 times the market price of beef. As the price of beef was highly fluctuating, this can be merely used as an indication of its size.
- These estimates represent a conventional system. Farms with little mechanisation, irrigation, no pesticide use, and mixed crops have minimal impact on land use and biodiversity. Therefore, organic farms are estimated to have lower than the current estimation
- With the Reclaim The Desert Project SEKEM has reclaimed 315 ha of desert. In the True Price method, land use cost represents the opportunity cost of land that is necessary to produce feed and keep cattle instead of natural ecosystems. We expect the external costs of land use and biodiversity on reclaimed land to be close to zero, but likely not eliminated entirely (**Figure 4**).** However, reclaiming land increases other environmental pressures such as water scarcity. Reclamation of land also relies on the use of compost, which can lead to air pollution. More research is necessary for a full assessment of the impact of reclaiming land from the desert.

Figure 4. Environmental cost of 1 kg of beef
Minimal grazing systems

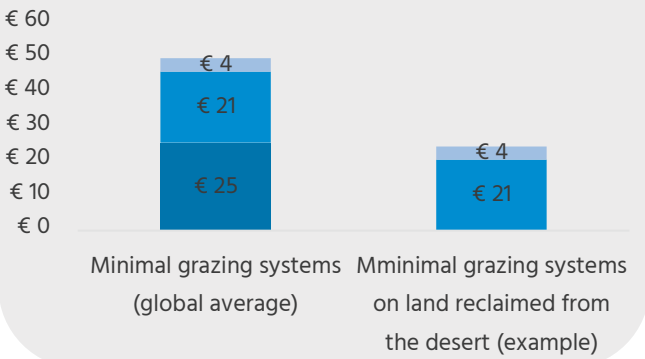


Table 7. Environmental cost of minimal grazing systems

Country	Land use and biodiversity	Climate change	Air pollution
Chile	€ 16.50	€ 16.30	No data
Indonesia	€ 34.30	€ 32.80	No data
USA	€ 28.40	€ 10.60	No data
Germany	€ 2.90	€ 5.80	€ 3.80
UK	€ 4.40	€ 2.80	No data

*Statista (2023) **The Egypt monetisation factor for land use is high, approximately €9000 (E£3000,000). This is higher than all countries included in this dataset. In Egypt, there is little land available, that is close to rivers. For reclaimed land from the desert, the monetisation factor would be close to zero because of minimal impact on the local ecosystem (or even an improvement of biodiversity). In the calculation, we assume a monetisation factor of 0. While land reclamation can enhance biodiversity by transforming desert areas into farmland, it also results in the loss of native desert ecosystems and heightens irrigation demands.

RESULTS | EXPLORATION OF THE TRUE COST OF ORGANIC BEEF

Studies on European countries show that organic has lower environmental costs per hectare, but higher external environmental costs per kg.

Data approach

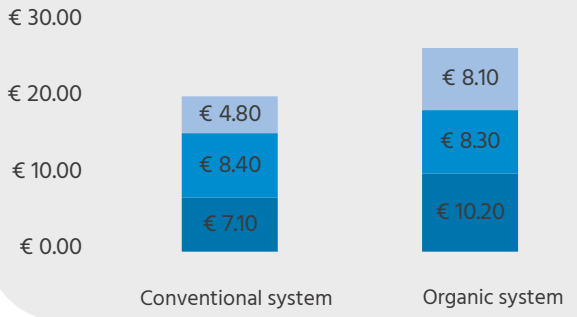
- Current food sustainability assessments often underrepresent the significant environmental and health benefits of organic agriculture, including enhanced biodiversity, improve soil health, reduce greenhouse gas emissions. However, current assessment frameworks tend to prioritize product-level efficiency metrics, such as GHG emissions and land use per kilogram.* Therefore, we present results on both a per-kilogram and per-hectare basis.
- Environmental footprint data for organic beef was only available for four European countries in the global database by Poore and Nemecek (2018). For the list of countries and country-level results, see next page.

Exploratory results

- The average environmental cost of organic beef is €27 (E£880) per kg, and €3,100 (E£103,000) per ha. Of conventional beef the environmental costs are €20 (E£670) per kg, and €3,400 (E£110,000) per ha. On a per-hectare basis, **Figure 5a** shows that the environmental costs of organic beef are slightly lower.
- On a per kg basis the results for climate change are similar for both organic and conventional systems **(Figure 5b)**. This is in line with the findings of other researchers.** Organic agriculture is less productive, and therefore emissions per unit of product are not necessarily better for organic beef. Additionally, organic farms often have lower stocking density (more space per animal), and produce less crop output using the same land, therefore the land use is higher than conventional on a per kg basis. However, they usually have a higher biodiversity impact. A comprehensive understanding of this trade-off would require further research using local data, as it becomes available.

Figure 5a. Environmental cost of beef production per ha
Selection of European countries in Poore & Nemeck (2018)

Figure 5b. Environmental cost of 1 kg of beef
Selection of European countries in Poore & Nemeck (2018)



*Impact Institute & True Price Foundation (2025). ** LCAs often fail to capture the unique characteristics of farming systems, particularly neglecting the effects of pesticide use in conventional production and the environmental impacts of organic farming, creating knowledge gaps Sources: Meier et al., 2014; Knudsen et al., 2020; Seufert & Ramankutty, 2017 from Impact Institute (2023).

Note: The x-axis in Figures 3a and 3b represents different units. The scales of these figures are not directly comparable, and visual differences should be interpreted within the context of their respective units.

RESULTS | ENVIRONMENTAL COST OF ORGANIC BEEF BY COUNTRY

Table 8. Environmental costs per kg of beef by impact for all countries with data from the organic system.

Country	Land use	Climate change	Air pollution
Organic			
France	€ 8.90	€ 10.50	No data
Ireland	€ 15.70	€ 6.00	No data
Sweden	No data	€ 7.80	€ 4.70
Switzerland	€ 8.80	€ 7.70	€ 11.50
Conventional			
France	€ 5.80	€ 8.70	€ 4.60
Ireland	€ 9.60	€ 6.50	No data
Sweden	€ 25.00	€ 9.40	No data
Switzerland	€ 6.00	€ 7.60	€ 7.40

Table 9. Environmental costs per ha by impact for all countries with data from the organic system.

Country	Land use	Climate change	Air pollution
Organic			
France	€ 870	€ 1,000	No data
Ireland	€ 1,600	€ 600	No data
Sweden	No data	No data	No data
Switzerland	€ 940	€ 800	€ 1,200
Conventional			
France	€ 960	€ 1,500	€ 700
Ireland	€ 1,700	€ 1,100	No data
Sweden	€ 1,300	€ 868,43	No data
Switzerland	€ 1,100	€ 1,400	€ 1,300

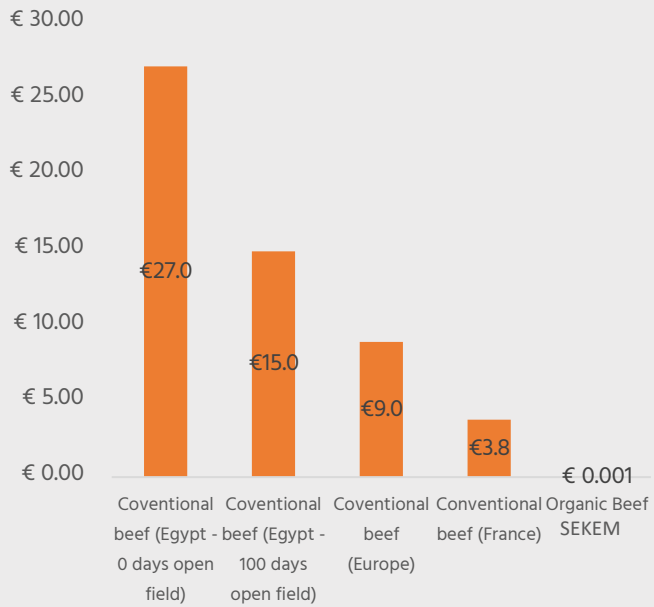
- The environmental cost of beef per kilogram are presented in **Table 8**, while costs per hectare are shown in **Table 9**. **Table 8** shows that air pollution cost seem higher for organic than conventional. This can be related to the fact that organic cattle have lower productivity. However, the results exhibit high variability, and the sample size is limited (two studies for organic and six for conventional, with only two countries represented). **Therefore, while these findings provide some insight, caution is advised when drawing conclusions, as they may not be broadly representative. In addition, farms that implement biodynamic approaches to manure management could help reduce the overall impact within organic systems.**
- In situations where land is reclaimed from the desert, the impacts on land use and biodiversity may be lower. However, desert reclamation presents a significant trade-off: high irrigation demands can intensify Egypt's water scarcity and potentially disrupt fragile desert ecosystems, requiring a careful evaluation of the overall environmental impact.

RESULTS | ANIMAL WELFARE COST OF BEEF PRODUCTION

Animal welfare cost of beef production: comparative analysis across production systems.

- Animal welfare impact in Egypt is estimated at €27 (E£ 900) per kilogram of beef when cattle have no access to open fields – see **Figure 6**. In the country, there is limited animal protection law and enforcement.* In many conventional farms, cattle are kept in feedlots with very limited space to move freely. This results in low quality of life and, combined with a relatively high slaughter age, leads to increased animal welfare impact.**
- If the cattle can spend 100 days in an open field, whilst other circumstances remain the same, the animal welfare loss goes down steeply to €15 (E£500). This means that the space per animal has high influence on the results.
- In Europe, animal welfare regulations are in place. On average, cattle in Europe spend 137 days on pasture and have more space per animal, which contributes to better quality of life. European cattle are also generally larger, meaning fewer animals are required to produce the same quantity of beef, resulting in lower overall suffering.
- For example, in France, considering cattle spend 170 days on pasture, animal welfare loss is estimated at €3.80 (E£130) per kilogram of beef.
- At the SEKEM farm in Egypt, cattle have access to 30 square meters of open field per animal year-round, and they are fed organic feed produced on the farm. This high standard of life quality results in a relatively low animal welfare impact of €0.001 (E£ 0.04) per kilogram of beef. While halal slaughter is the predominant method in Egypt, a detailed assessment of its animal welfare implications was beyond the scope of this study.
- In recent years the Egyptian government has worked to boost domestic beef production by expanding the national herd size and implementing policies, for example restricting the slaughter of cattle under 400 kg.** These measures have contributed to lower overall animal welfare costs.

Figure 6. Animal welfare loss (eur/kg)



The figure shows results for five scenarios: (1) conventional farming in Egypt in feedlot, (2) conventional farming assuming animals can spend 100 days in open field (3) conventional farming Europe, (4) conventional farming in France and (5) organic farming at the SEKEM farm. Data comes from previous studies by Impact Institute, desk research about animal standards in Egypt and SEKEM farm data.

*Source: Voiceless Animal Cruelty Index (2017); ** USDA (2018). ** See **Appendix** for more information about the animal welfare methodology.
**By law all animals in Egypt are halal slaughtered, which is not included in this assessment. For example, animal distress can vary with local practices such as stunning before slaughter. It is not expected to significantly affect animal welfare overall.

Conclusion

04

CONCLUSION | KEY INSIGHTS

This baseline assessment reveals the significant environmental costs of beef production and underscores the need to close the data gap to determine the true cost of (organic) meat in Egypt.

- This project highlights the significant environmental and animal welfare costs associated with beef production, revealing the hidden environmental costs—land use, biodiversity loss, climate change, and air pollution—that are often ignored. Using global data, we found that the true price gap of beef is much higher than its market price, with a middle range (where the middle 50% of the datapoints falls - 1st to 3rd quartile) between €17 (E£560) and €50 (E£1,600). We were not able to estimate the environmental costs of Egyptian beef due lack of readily available secondary data. Within the global middle range of environmental costs, minimal grazing farms are on the high end.
- Generally, organic farms do not use pesticides and non-organic fertilisers and have a lower impact on biodiversity compared to conventional farming systems. However, because of bigger land use (m2 per cow), and less productive farms and cropland, there is a clear trade off for organic production. There is little data on the difference between organic and conventional beef production outside of Europe. Organic beef's environmental cost per hectare is lower than conventional systems but higher when comparing per kg beef. Further research on biodiversity impacts is needed to understand the trade-offs between organic and conventional beef production more comprehensively, especially considering the local Egyptian context.
- At the SEKEM farm improved manure management practices are used, and all energy used on farm is renewable. Additionally, the impact on biodiversity is limited because of biodynamic and holistic farming. Furthermore, land that was reclaimed from the desert for beef production is expected to have a much lower land use and biodiversity impact. An exploration of this impact reduces the overall environmental costs of beef significantly (down by approximately 50%). However, a careful assessment of the overall environmental impact should be made including among other impacts increased pressure on water scarcity for irrigation demands and heightened air pollution because of compost use.
- Animal welfare costs vary depending on practices such as days spent on open fields, slaughter age and length of the slaughter process. Animal welfare loss was valued at close to 0 when using data from the SEKEM farm. Access to open fields increases the life quality of the cattle and decreases the animal welfare impact. Regulations and organic certification can help ensure better living conditions for animals. While halal slaughter is the predominant method in Egypt according to Islamic law, a comprehensive assessment of its animal welfare implications was not included within the scope of this assessment.

CONCLUSION | KEY ASSUMPTIONS & LIMITATIONS

A summary of data use, assumptions and limitations are listed below.

Study Focus	
Data	• **Database:** The calculations rely mostly on secondary data collected from the database from Poore and Nemecek (2018).* The functional unit is 1 kg of beef with an additional assessment per hectare for organic production. Beef from dairy farms was excluded. • **Impacts in scope** of this analysis are land occupation (including biodiversity), contribution to climate change and air pollution. Particulate matter formation is an important contributor to air pollution impact of cattle farming related to a range of activities related to livestock, such as feed production, manure management and production. To assess this impact, a ratio was derived from terrestrial acidification and particulate matter formation of the Agribalyse database (see **Appendix).** Furthermore, animal welfare loss was assessed based on the method adopted by Impact Institute.** • **Value chain scope:** the value chain includes input, production, transport, slaughter, processing and retail stages of the production of beef.
Key Limitations	• **Lack of data**: one of the main limitations of this assessment is the lack data for Egypt. Furthermore, for organic farms only European data was available. • **Impacts out of scope:** This report focuses on selected environmental impacts. However, other important impacts—particularly social like employee health and well-being and living incomes for farmers—were not included in this assessment. • **Particulate matter formation:** data was not available for particulate matter formation. Because it is an important impact to take into account for manure management, it has been derived from other air pollution impacts (i.e. terrestrial acidification). • **Animal welfare**: days on open field for days on pasture was interpreted as days on pasture in the animal welfare model. Assumption that the animal welfare model mostly cares about space and time spent in open space. • **Uncertainty**: the true price of beef is highly dependent on the geographical location for land use and biodiversity impact, as well as on the production system: whether it is organic or extensive use of the land, or conventional and intensive use of the land. Because of this, no *one* true price of beef can be reported. • **Exchange rate:** exchange rate volatility of the Egyptian pound affects the reliability of interpreting numbers and figures in this report.

*Poore and Nemecek (2023). **Impact Institute (2023).

CONCLUSION | FUTURE EGYPT-FOCUSED TRUE PRICE ASSESSMENTS

To enhance the reliability of our environmental and animal welfare cost estimations, we recommend prioritizing the following actions.

- **Improve data availability and geographic relevance:** Future studies should focus on collecting localized data specific to Egypt's agricultural practices, environmental conditions, and social contexts. This includes obtaining data on the ecosystem services of desert-reclaimed land. This would allow to accurately calculate the true price of beef and other products produced on reclaimed land from the desert and organic farming systems.
- **Refine methodological alignment:** Enhancing the alignment of global datasets, such as Poore and Nemecek (2018), with the True Price methodology is essential. This includes incorporating Egypt-specific monetisation factors and more tailoring to regional practices, such as minimal grazing systems and the impact of desert land use as more data becomes available.
- **Expand scope of material impacts**: Where data is available, future assessments should incorporate additional material impacts, such as underpayment to farmers and localised particulate matter formation. In addition, policymakers can support the development of more accurate, regionally relevant data on social and environmental indicators of beef production, enabling better decision-making and supporting more sustainable agricultural practices in Egypt.

Appendix

APPENDIX OVERVIEW

The Appendix contains the following items:

BACKGROUND OF SEKEM

A

APPENDIX | SEKEM INITIATIVE

SEKEM: Pioneering Sustainable Agriculture and Holistic Development in Egypt.

- SEKEM, established in 1977 by Dr. Ibrahim Abouleish, is a pioneering initiative in Egypt that integrates sustainable agriculture with social and cultural development. **The SEKEM farm uses biodynamic agricultural methods to revitalize the Egyptian desert.** The SEKEM code of conduct states commitment to protect and advocate for human rights in all their activities and spheres of influence.
- **The SEKEM farm is Demeter certified for biodynamic agriculture.** The Biodynamic Federation Demeter was founded 100 years ago with the aim to represent high quality standards of regenerative and holistic farming and food production. Their principles ensure soil fertility, healthy plants, food quality, biodiversity and animal welfare. The Demeter is working on more than 230.000 ha in 65 countries.
- **The SEKEM farm has an Economy of Love Certification**, which certifies the entire value chain on holistic criteria of culture, society, environment and economy.
- **Animal welfare** of the cattle is high priority at the SEKEM farm. The SEKEM cattle produces meat and milk. The cattle live unbound in an open space covered by a shading roof, animal feed comes from their own farm and they do not use hormones and preventative antibiotics.
- Furthermore, environmental impact has high priority. **Manure is used as part of a mixture with green residue**: a mixture of compost, molasses and water aerated for 16 hours that accelerates activity of microorganisms in compost. No pesticides and non-organic fertilizers are used.
- To further decrease the environmental impact, **energy sources at the farm are sunlight, wind and hydro-power**.
- **With the Greening The Desert Project SEKEM reclaimed 315 ha from the desert into fertile land**, with the aim to reclaim 1000 ha. By doing this, biodiversity is increased, and land is made fertile and cultivated with the potential to feed thousands of people.

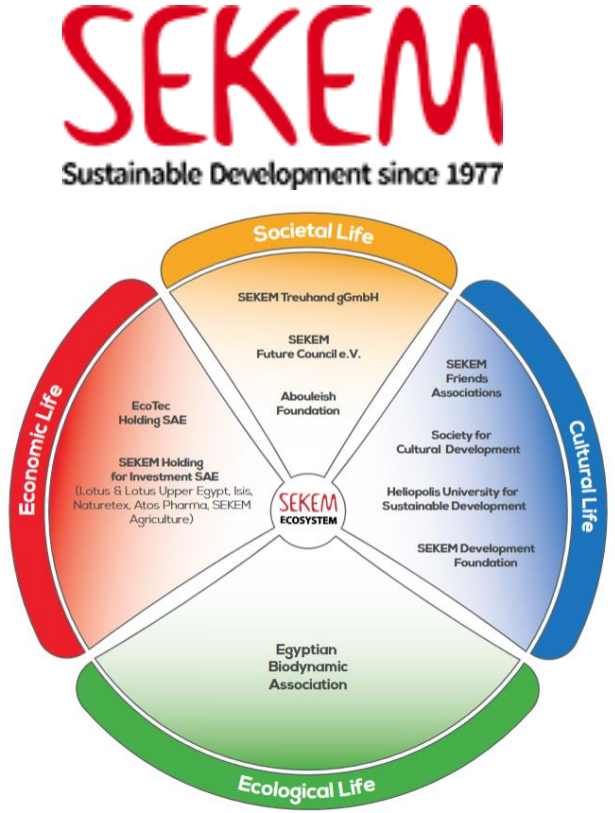


Figure A1. SEKEM Initiative- Institutional Ecosystem. Source: [SEKEM Annual report 2023.]

Sources & References

B

APPENDIX | KEY SOURCES

Main methods and databases used.

Environmental impacts

Mainly, the environmental impact data comes from the database from the paper of Poore and Nemecek (2018). Other sources used were the True Price Method and True Price Database, as well as Life Cycle Assessment (LCA) databases Agribalyse and EcoInvent, mainly for comparison purposes.

- **Poore and Nemecek, (2018):** The paper from Poore and Nemecek presents the results of environmental impacts of approximately 38.000 farms producing 40 different agricultural goods, among which beef. Retrieved from: https://www.science.org/doi/10.1126/science.aaq0216.\

Other supplementary databases are:

- **Agribalyse, (2021).** Agribalyse is a French database on the environmental impact of agricultural and food products to improve practices. The data was based on Life Cycle Assessment (LCA) method. Retrieved from: https://doc.agribalyse.fr/documentation-en/agribalyse-data/data-access .
- **EcoInvent database**: The EcoInvent LCI (Life Cycle Inventory) database is considered to be the most comprehensive and reliable LCI database in Europe and includes a comprehensive accounting of emissions emitted and resources consumed in the entire life cycle of many products and processes.

Data sources of the **True Price method** were used for the determining the health and biodiversity effects and converting to the monetary value of impacts.

- https://trueprice.org/true-price-resources/

Animal welfare loss

Animal welfare loss was calculated using the methodology developed by Impact Institute (2023) for the Eurogroup for Animals, which is based on an academic method developed for integrating animal welfare into LCA (Scherer et al., 2017). The input data of the model are mainly based on primary data collected by RDNA for organic beef, and on a selection of secondary data sources for all scenarios of conventional beef production.

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- **Scherer et al., (2017).** Framework for integrating animal welfare into life cycle sustainability assessment. Retrieved from: https://link.springer.com/article/10.1007/s11367-017-1420-x

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Methodology

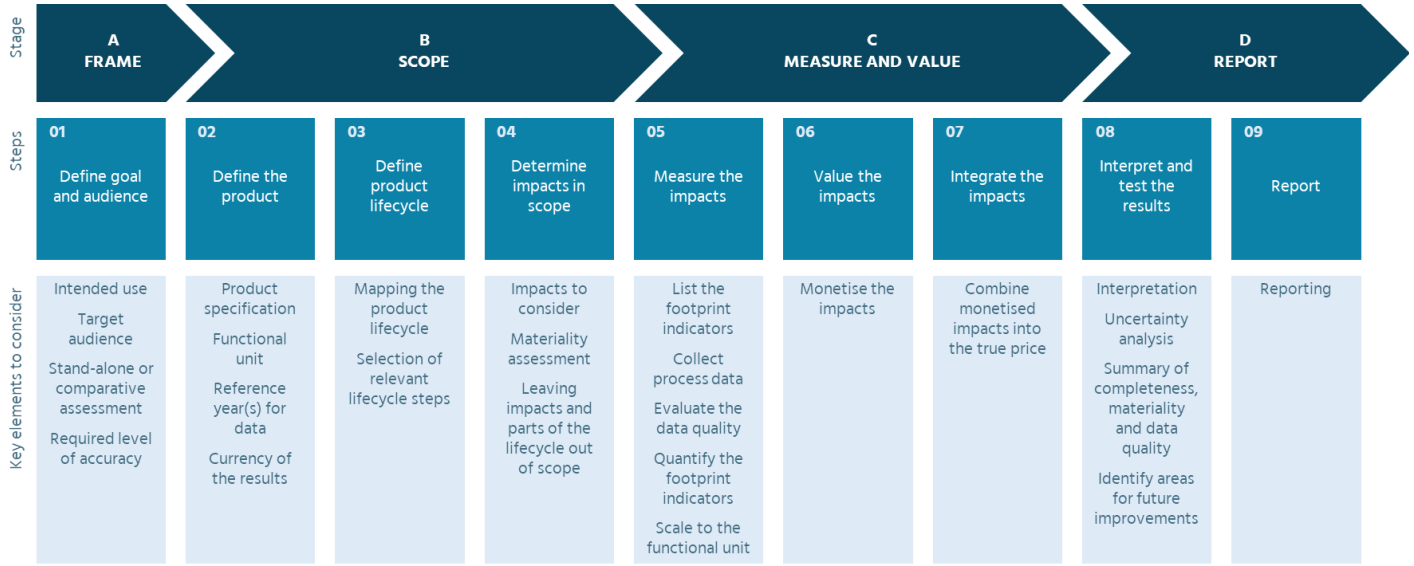
C

APPENDIX | TRUE PRICE ASSESSMENT METHOD

This true price project is based on the True Price Assessment Method,* which follows a clear and structured process.

- Performing a true price assessment follows a specific approach according to the True Price Assessment Method for Agri-food Products. The four stages of the assessment are described below.
- **Framing:** defining the goal and audience.
- **Scoping:** prescribes the requirements and recommendations for defining the scope of the assessment, including; product specification, value chain steps, and material impacts.
- **Measuring and valuing:** the social and environmental impacts in scope are measured and valued.
- **Reporting:** findings, methodologies, assumptions, and limitations are documented. The results of this true price scan are compiled into this report.

Figure C1. Stages, steps & key element of the True Price Assessment Method



*The True Price Assessment Method for Agri-food Products (2023) was developed by True Price and Wageningen Economic Research within the Public Pmate Partnership True and Fair Price for Sustainable Products (PPS Echte en Eerlijke Prijs voor Duurzame Producten).

APPENDIX | DETAILED METHOD - ENVIRONMENTAL IMPACTS

This section elaborates on detailed method decisions made during the assessment.

General

- An assessment of Poore & Nemeck (2018) was made for each individual farm how intensive cropland and pasture impact was in terms of biodiversity loss. For both cropland and pasture, an individual impact weighing factor was applied, based on how impactful the system is to biodiversity. The final land use and biodiversity impact was therefore dependent on both the actual land used and a combined weighing factor based on impact on biodiversity.
- A few rules were applied when assigning the biodiversity factors: generally, organic farms have lower impact. Farms above 50 m2 per kg of beef were assumed to have low stock density. When explicitly mentioned that pasture was natural or extensive, the impact was assumed to be minimal (unless pasture was degraded).
- The impact of land use change was excluded from the dataset as it is out of the value chain scope.
- Air pollution impact is based on acidification and particulate matter formation within the value chain scope. Particulate matter formation has been derived from the ratio between terrestrial acidification, based on an average ratio between these two impacts for beef in our internal database.

Exploration of the Egyptian case

- Cattle can be fed through grazing (pasture) or feed. Because of limited pasture in Egypt, we have more interest in feed-raised cattle. Therefore, only farms with less than 30% of pasture were included to explore the true price of beef in Egypt. This is relevant for two key aspects: the countries (and studies) selected in the sample and the land occupation impact factor.

Animal welfare

- To quantify the impact of low animal welfare, animal life years lost were calculated using Scherer et al.'s framework for integrating animal welfare into life cycle sustainability assessment.*
- Welfare loss per animal type was determined by considering (a) life quality, (b) lifespan until slaughter, (c) slaughter duration (including transport), and (d) the number of animals affected per kg of output, enabling comparison across animal products. For (a) life quality, a single variable was used as a proxy for each animal type's general well-being.

*Scherer, Tomasik, Rueda, & Pfister, (2018).

APPENDIX | COUNTRIES AND NUMBER OF STUDIES OF GLOBAL AVERAGE

Table C1. Countries and number of studies included in the global average environmental cost of beef results – data from Poore and Nemecek (2018)

Country	Number of studies	Number of data points
France	5	22
Ireland	3	3
Sweden	1	1
Switzerland	1	2
Denmark	1	2
Australia	5	15
Brazil	10	22
Canada	6	12
Chile	1	2
Indonesia	1	8
United Kingdom	2	6
United States of America	7	10
Uruguay	1	5
Germany	1	1
Mexico	1	2
Netherlands	1	1
Romania	1	1

APPENDIX | MONETISED AND NON-MONETISED RESULTS

Global average - environmental cost of beef production: range reflects the range where the middle 50% of the datapoints falls (1st to 3rd quartile).

Table C2. True price gap of conventional beef by impact (2023 Euros/ 1 kg beef).

Impact	Middle range lower boundary (1st quartile)	Middle range upper boundary (3rd quartile)
Land use	€ 5,24	€ 30,13
Contribution to climate change	€ 7,81	€ 13,70
Air pollution	€ 3,83	€ 5,33
Sum	**€ 16,88**	**€ 49,17**

Table C3. Non-monetised impact data (unit/kg beef).

Impact (unit)	Subindicator	Unit	Middle range lower boundary (1st quartile)	Middle range upper boundary (3rd quartile)
Land use		Ha	0,007	0,028
Contribution to climate change (Co2eq)		Kg of CO2-equivalent	46,41	81,47
Air pollution	Acidification	Kg SO2-equivalent	0,23	0,33
	Particulate matter formation	Kg PM2.5-equivalent	0,04	0,05

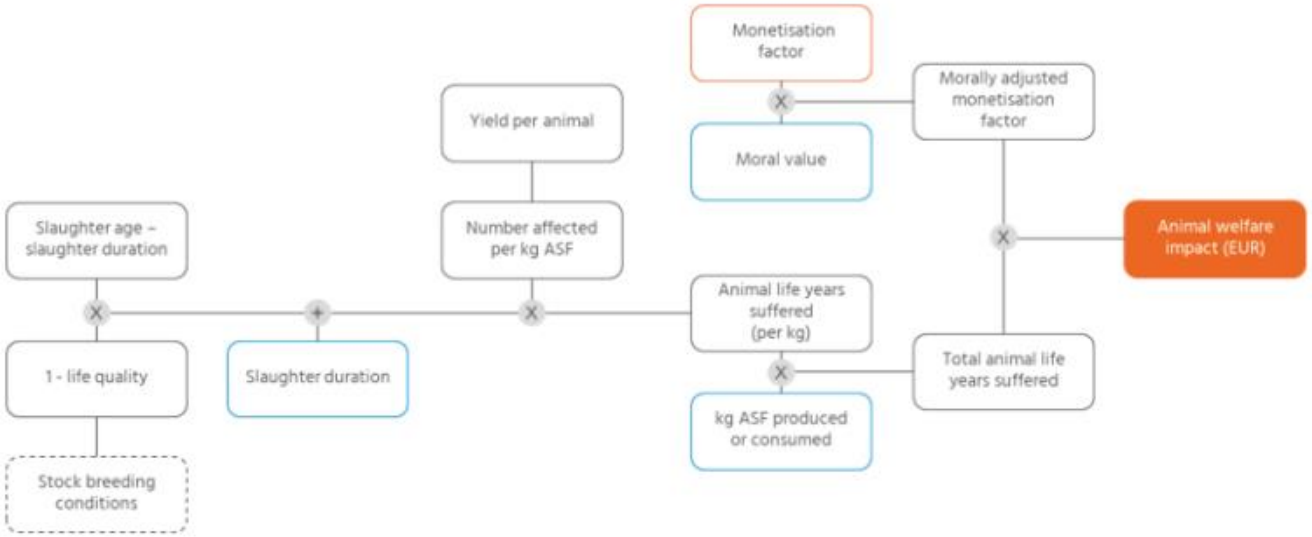
*This land use and biodiversity footprint is not adjusted for the number of species lost in a particular ecosystem (bio-ha)

APPENDIX | DETAILED METHOD - ANIMAL WELFARE LOSS

Animal welfare is about the mental and physical well-being of non-human animals.

- Low animal welfare cost is quantified by looking at a scientific framework on animal wellbeing for life cycle assessments (LCAs). It is measured looking at parameters like time spent in open field or pasture, live weight, slaughter age and slaughter duration.*
- Animal welfare is about the mental and physical wellbeing of animals. Animal welfare loss is based on a calculation of the life years suffered per animal, and is expressed in Disability Adjusted Life Years (DALY).
- To quantify animal welfare, rearing practices are considered and multiplied with the morally adjusted monetary value of DALY (Scherer, Tomasik, Rueda, & Pfiser, 2018).
- To express the impact of animal welfare in a monetary value, the animal life years suffered are multiplied with a morally adjusted monetisation factor of a (human) DALY (Monetisation Factors for True Pricing).

Figure C2. Visualisation of the formulas for the impact of low animal welfare. *Source: Impact Institute (2018)



*Monetary valuation using a method developed by Impact Institute (2023) in a study for the Eurogroup for Animals.

Data quality assessment

D

APPENDIX | COMPLETENESS, MATERIALITY & DATA QUALITY

The completeness of value chain scope, data quality and how most material impacts in the value chain are addressed are three crucial determinants of the level of accuracy of a true price assessment.

An assessment of the determinants of the level of accuracy of a true price assessment helps identify the most important areas to improve in future studies. For example, to identify impacts with high materiality and low data quality (e.g. land use for beef).

General approach: In this true price scan we based the assessment on the general approach regarding scope, data quality and how material impacts are addressed. Because of a lack of data for the target geography of Egypt, we used the database of Poore and Nemecek (2018) to calculate a global average of the true price of beef. This database contains more data from different beef production systems, and includes air pollution, which is a material impact in livestock management. The model was built manually, which was necessary to align the data with the True Price methodology and to assess the biodiversity impact per datapoint.

Exceptions: The following exceptions can make the assessment more or less accurate:

- Because of an individual assessment of each datapoint, each impact has been weighted to individual circumstances. Although certain rules were applied, it could be biased by human judgment.
- Particulate matter formation was derived from terrestrial acidification. Therefore, the numbers could alter from the actual numbers.
- Overall, the exploration of the impact of beef cannot be interpreted as the actual true price of beef in Egypt. This is because (1) the assessment of minimal grazing studies is based on a few case studies only; (2) in Egypt, some land used for beef production is reclaimed from the desert. Because of this, land use and biodiversity impact would be lower, and other environmental impacts would increase, such as water scarcity and air pollution. Therefore, the actual impact of beef production in Egypt could deviate from the current findings; (3) when assessing the true price of beef in Egypt, Egypt monetisation factors should be applied.

APPENDIX | COMPLETENESS, MATERIALITY & DATA QUALITY

Category	Impact	Completeness	Value chain step	Materiality*	Data quality	Data explanation
Environmental	**Air pollution**		Farm to retail	+	●●○○○	Poore and Nemecek (2018) data used. Some 'Air pollutoion' indicators included in the True Price Method were not available. There was no data for the target country Egypt.
	Contribution to climate change		Farm to retail, incl. inputs	+	●●○○○	Poore and Nemecek (2018) data used. All included farms had data for every step of the value chain. There was no data for the target country Egypt.
	Land use and biodiversity		Farm to retail (mainly farm)	++	●●○○○	Poore and Nemecek (2018) data used. All included farms had data for every type of land. There was no data for the target country Egypt.
Social	**Animal welfare**		Farm to Slaughter	+	●●●●○	Primary data provided by RDNA was available for organic farming (SEKEM Farm). Other secondary sources have been used for conventional farming, and as an assessment for animal welfare in Europe.

- The table presented here shows the completeness of value chain scope, data quality and how most material impacts in the value chain are addressed for this exploratory true price gap assessment of beef production. These elements are crucial determinants of the level of accuracy of a true price assessment.
- For completeness, all environmental impacts are rated as 'high.' Animal welfare as 'very high.' Other value chain steps currently out of scope, like consumption and disposal/waste reduce completeness.
- Generally, there was no data for a lot of countries, including the target country Egypt. Additionally, just a few organic system farms were included, of which only in Europe. For this reason, the quality of the available data for environmental impact was rated 2/5.
- For Air pollution impact, particulate matter formation was not available and therefore was derived from terrestrial acidification
- For animal welfare, data was received from the client and quality was rated as high. However, there was no global average or European average of animal welfare available, because it was too variable.
- Importantly, other relevant impacts considered in the True Price Method, such as underpayment to farmers and land use change, are outside the scope of this analysis. However, land use change, for instance, is likely to be less significant in Egypt due to the farms' location on reclaimed desert land.

* Refers to the contribution of the impact in the results (true price gap).
++high; + high-medium; +/- medium; - low materiality

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