Internalization of Externalities of Animal-Derived Products in Hungary

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1. Externalities & Methodology for Calculation

An externality is a cost or benefit that is caused by one party but financially incurred or received by another. Externalities can be negative or positive. A negative externality is the indirect imposition of a cost by one party onto another. A positive externality, on the other hand, is when one party receives an indirect benefit as a result of actions taken by another. Externalities can stem from either the production or consumption of a good or service. The costs and benefits can be both private—to an individual or an organization—or social, meaning it can affect society as a whole.[1] However, these external impacts, most of the time, are not taken into consideration while designing policies. The calculation of external costs is a vital first step to make the hidden costs visible to consumers and producers to drive the market in a sustainable favored. The second step is the incorporation of these costs into the prices.

To calculate the environmental externalities of animal-based food production, the impact pathway is followed instead of the alternative top-down approach. The impact pathway methodology starts from calculating the environmental burden that is created by an activity, followed by multiplying these environmental impacts by established monetization factors to obtain the environmental cost of the activity[2]. In this report, the external costs from the unpaid bill of consuming the following animal products are calculated: beef (both from beef cattle and dairy cattle), chicken, pork, milk, and eggs.

a. Life Cycle Assessment

Life Cycle Assessment for this report is performed through SimaPro, using the Agrifootprint database present in the software. The environmental performance of the production of animal products is explained by the Feed Conversion Rate, which indicates the efficiency of

[1] https://www.investopedia.com/terms/e/externality.asp
[2] Friedrich, R., Bickel, P. (2001). The Impact Pathway Methodology. In: Friedrich, R., Bickel, P. (eds) Environmental External Costs of Transport. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-04329-5_2

conversion of feed inputs to animal products. The parameters include yield (kg milk/cow; piglets/sow; kg pig/kg feed; kg broilers/feed, number of eggs/kg feed)[3].

The Recipe Midpoint method is used for the calculation of the environmental impacts, which includes 17 different impact categories that the economic activity contributes to. For the life cycle assessment of animal-based products, the system boundaries are established as cradle to gate: the whole production chain up to the moment that the meat is sold to retail. The final product is the fresh product that leaves the farm/slaughterhouse, and the steps such as packaging and disposal are not included. The system boundaries and included processes can be seen in Figure 1.

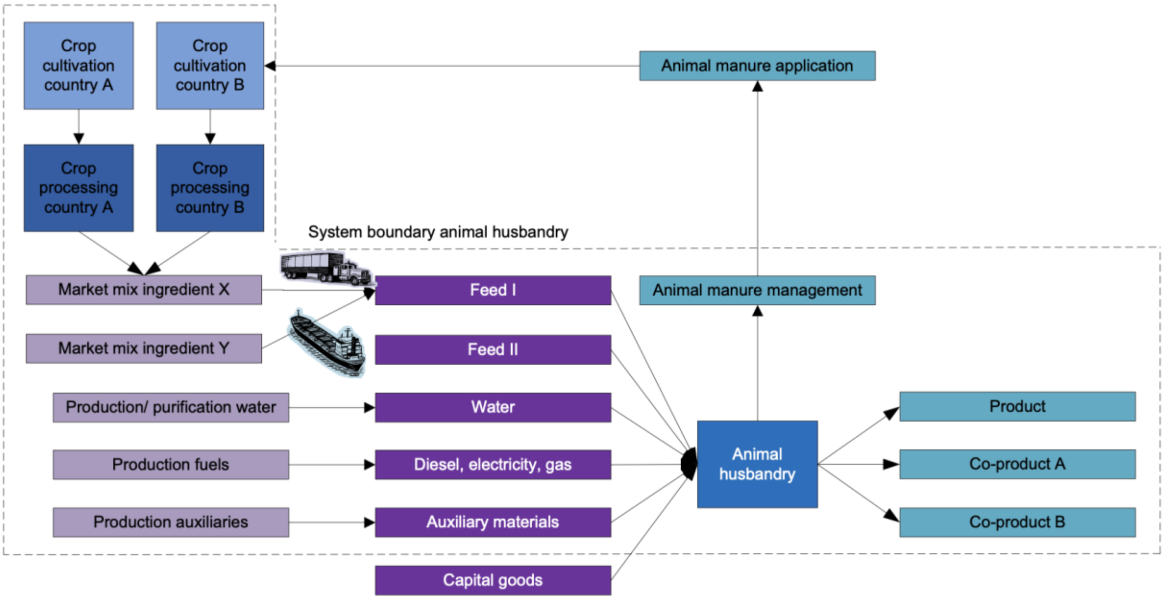

Figure 1. System Boundary for Animal Husbandry[4]

The impacts are calculated for 1 kg of each animal-derived product. As the allocation method, economic allocation is used, which indicates that the environmental impact is attributed to the products and by-products proportional to their market share.

b. Environmental Prices

The environmental prices that are included in the LCA package in SimaPro are used to weigh the results of various environmental effects into a single score. These environmental prices are established by CE Delft, and the social cost of environmental emissions and other actions is expressed in euros per kilogram of pollutant or comparable units, such as noise, using environmental prices. They indicate how much people are willing to pay to prevent undesirable effects. These environmental prices are expressed as €/kg emission, in 2015 prices. The

[3] Agri-footprint, Agri-footprint 6 Methodology Report – Part 2: Description of Data (Version 5), (PRé Sustainability, March 2023). https://simapro.com/wp-content/uploads/2023/03/FINAL-Agri-footprint-6-Methodology-Report-Part-2-Description-of-Data-Version-5.pdf

[4] Agri-footprint, Agri-footprint 6 Methodology Report – Part 2: Description of Data (Version 5), (PRé Sustainability, March 2023). https://simapro.com/wp-content/uploads/2023/03/FINAL-Agri-footprint-6-Methodology-Report-Part-2-Description-of-Data-Version-5.pdf

environmental prices/external costs related to different impact categories can be seen in Table 1[5].

Table 1. Environmental Prices of ReciPe Impact Categories

Theme	Unit	External Cost
Climate change	€/kg CO_2-eq.	€ 0.0566
Ozone depletion	€/kg CFC-eq.	€ 30.4
Human toxicity	€/kg 1,4 DB-eq.	€ 0.0991
Photochemical oxidant formation	€/kg NMVOC-eq.	€ 1.15
Particulate matter formation	€/kg PM10-eq.	€ 39.2
Ionizing radiation	€/kg kBq U235-eq.	€ 0.0461
Acidification	€/kg SO_2-eq.	€ 4.97
Freshwater eutrophication	€/kg P-eq.	€ 1.86
Marine eutrophication	€/kg N	€ 3.11
Terrestrial ecotoxicity	€/kg 1,4 DB-eq.	€ 8.69
Freshwater ecotoxicity	€/kg 1,4 DB-eq.	€ 0.0361
Marine ecotoxicity	€/kg 1,4 DB-eq.	€ 0.00739
Land use	€/m^2·year	€ 0.0845

2. Regionalization of External Costs for Hungary

As mentioned, the Agri footprint data available in SimaPro is used for the calculations. The dataset primarily includes processes modeled for activities in Ireland or the Netherlands. However, to better reflect regional impacts influenced by specific policies, agricultural practices, and efficiencies, some data have been updated using Hungarian sources.

a. Emissions from Livestock

Methane is a strong greenhouse gas and comes after carbon dioxide as the second-largest atmospheric contributor to climate warming. Around 60% of today's methane emissions are the result of human activities, where livestock emissions, from manure and enteric fermentation releases, are responsible for approximately 32% of human-caused methane emissions[6].

One of the main regionalized datasets involves the emissions resulting from cattle farming in Hungary. The following data are used to update the emission values in the Agri footprint dataset. The primary source is the National Inventory Document published by the Institute of

[5] CE Delft, Environmental Prices Handbook: EU28 Version (Delft: CE Delft, April 2021), https://cedelft.eu/wp-content/uploads/sites/2/2021/04/CE_Delft_7N54_Environmental_Prices_Handbook_EU28_version_Def_VS2020.pdf
[6] NASA, Methane | Vital Signs of the Planet, Climate Change (accessed June 11, 2025), "Methane is a powerful heat-trapping gas… an estimated 60 % of today's methane emissions are the result of human activities,". https://climate.nasa.gov/vital-signs/methane/?intent=121

Agricultural Economics[7]. The most recent available data, from the year 2022, is used in the calculations. The emissions shown in the table represent annual emissions per animal.

Table 2. Emissions resulting from dairy and non-dairy cattle

	Emission Source	Emission Source	
	Enteric Fermentation	Manure Management	
	CH_4	CH_4	N_2O
Dairy Cattle	134 kg CH4 per year per animal	8.00 kg per animal	0.27 kg per animal
Non-Dairy Cattle	73 kg CH4 per year per animal	7.20 kg per animal	0.34 kg per animal

As the methane emissions for other livestock are negligible compared to emissions associated with cattle farming, the present data for the Netherlands Economic Region is used for the other products.

The emissions related to milk production are calculated using the annual milk production per animal and the emissions resulting from the dairy cattle. According to the Hungarian data, on average, 8405 liters of milk are obtained from each dairy cattle annually, compared to the original Netherlands data, which is based on 8652 kg of raw milk produced by every cow in a year.

b. Feed Composition & Fertilizer Application

Another important dataset that is regionalized is the feed composition for animals and the fertilizer application rate, both synthetic and manure application rates.

Animal feed significantly contributes to greenhouse gas emissions from the livestock sector, representing 45% of total emissions, occupying 70% of the worldwide agricultural area, and utilizing 30–40% of human-edible feed crops. Therefore, the composition of the feed has a significant impact on the environmental performance[8]. Feed composition in Hungary is updated based on the Ministry of Agriculture report and can be seen in Table 3[9].

[7] Hungary, Hungary's 2024 National Inventory Submission under the UNFCCC (Bonn: United Nations Framework Convention on Climate Change, December 2024), https://unfccc.int/sites/default/files/resource/HU_NID_2024dec.pdf

[8] *Alessandro Gatto, Marijke Kuiper, Hans van Meijl, and Corina van Middelaar, "Unveiling the Economic and Environmental Impact of Policies to Promote Animal Feed for a Circular Food System," Resources, Conservation & Recycling, (2024). https://doi.org/10.1016/j.resconrec.2023.107317

[9] *Feed Planet Magazine, "Overview of the Hungarian Feed Sector," Feed Planet Magazine. https://feedplanetmagazine.com/blog/overview-of-the-hungarian-feed-sector-1434

Table 3. Feed Composition for Cattle, Poultry, and Pigs in Hungary

Feed Composition (%)	Cattle	Poultry	Pig
Cereals	39,4	62	68,6
Protein Crops	14,2	18,3	10,6
Oil Seeds	20,5	-	5,3
Feed Supplements	5	1,8	3,1
Processing By-products	15,9	5,6	-
Fats and Oils	-	-	1

The synthetic nitrogen fertilization is used to improve crop yields; however, its use is unsustainable. The use of synthetic nitrogen fertilizers accounted for 8.3% of farm-gate emissions in 2019, according to FAO[10]. Although the EU has several regulations regarding fertilizer use, each Member State might have different national agricultural policies, therefore, application rates. The data used for the regionalization of the fertilizer and manure application rates are obtained from the Hungarian Statistical Office for the year 2022, which can be seen in the Table. The main emission resulting from this application is dinitrogen monoxide.

Table 4. Fertilizer and Manure Application Rates and Associated N2O Emissions in Hungary

	Application Rate (kg/hectare)	Total Application in 2022 (kg)	Total N2O Emissions Resulting (Gg)[11]
Synthetic Fertilizer[12]	324	3236346	5,12
Animal manure applied to the soil[13]	15900	233,5	1,61

In addition to these, water use and electricity mix data are also regionalized using the present Agrifootprint data for Hungary.

[10] Menegat, S., Ledo, A. & Tirado, R. Greenhouse gas emissions from global production and use of nitrogen synthetic fertilisers in agriculture. *Sci Rep* **12**, 14490 (2022). https://doi.org/10.1038/s41598-022-18773-w
[11] Hungary, Hungary's 2024 National Inventory Submission under the UNFCCC (Bonn: United Nations Framework Convention on Climate Change, December 2024), https://unfccc.int/sites/default/files/resource/HU_NID_2024dec.pdf
[12] https://www.ksh.hu/docs/eng/xstadat/xstadat_annual/i_omn028b.html
[13] https://www.ksh.hu/stadat_files/mez/en/mez0040.html

3. Analysis & Major Drivers of External Costs

a. External Cost of Animal Products

The calculated single price for products can be seen in Figure 2, also showing the costs resulting from different environmental categories.

The beef obtained from beef cattle has a significantly higher cost compared to other products. This major cost difference arises from the contribution to particulate matter formation, climate change, and terrestrial acidification. Particulate matter impact results primarily from ammonia from manure handling and application, and artificial fertilizer application for feed, while the climate change impact results from the methane emissions and the higher amount of feeding requirement of cattle compared to other animals. The beef from dairy cattle has a lower cost, as the environmental impact is allocated between beef and milk, and the fact that a higher amount of milk is obtained from a cow over life lifetime compared to beef.
The calculated external costs with 2015 prices are adjusted to the current price level of 2025 based on the harmonized consumer index, as suggested by the CE Delft Handbook[14]. For inflation, the consumer price index (CPI) is used.[15]

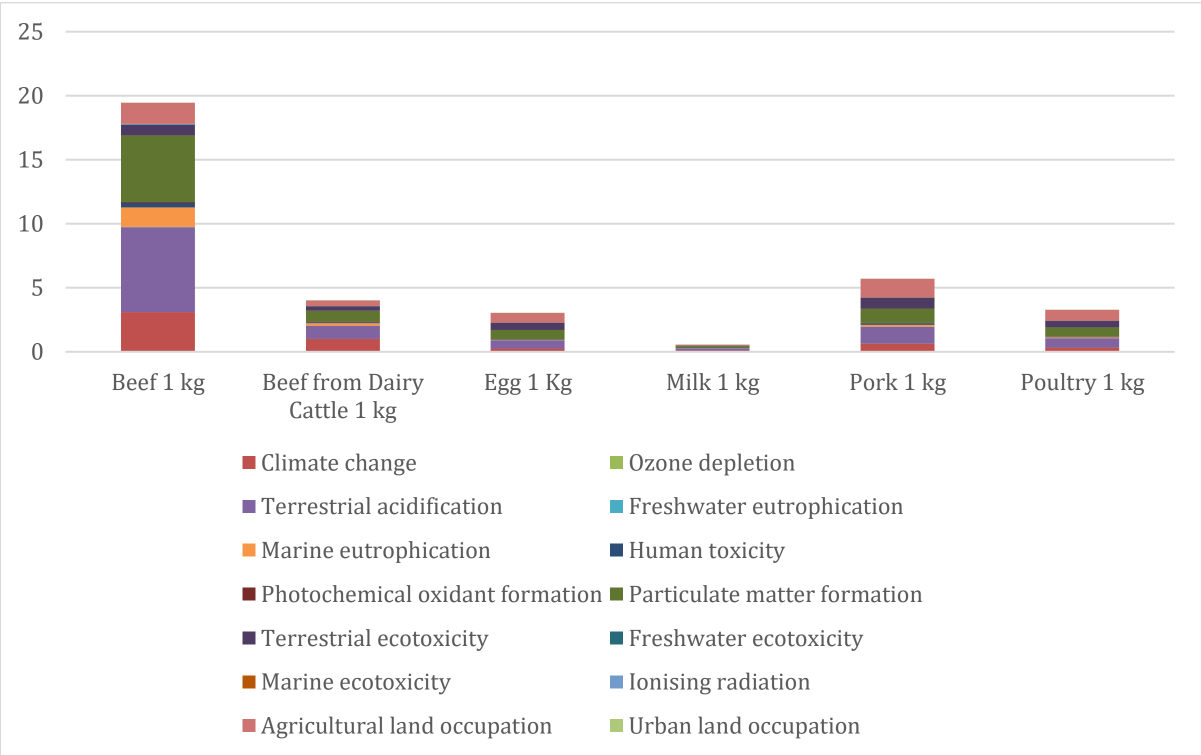

Figure 2. External Costs of Animal-Derived Products Calculated with Environmental Price Method

[14] *Environmental Prices Handbook 2024: EU27 Version – Methodical Justification of Key Indicators Used for the Valuation of Emissions and the Environmental Impact (The Hague: CE Delft, 2024).
[15] https://www.theglobaleconomy.com/Hungary/cpi/

The environmental price of the products can be seen in Table 5.

Table 5. Calculated Environmental Prices for Animal-Derived Products

Product	Price (€/kg)
Beef from beef cattle	19,47
Beef from dairy cattle	4,01
Egg	3,04
Milk	0,54
Pork	5,71
Chicken	3,28

Table 6 presents the prices with the impact categories.

Table 6. Contribution of Impact Categories to Final Environmental Price

Impact category	Beef from Beef Cattle	Beef from Dairy Cattle	Egg	Milk	Pork	Chicken
Total	19,47	4,31	3,04	0,54	5,71	3,28
Climate change	3,11	0,99	0,26	0,12	0,63	0,34
Ozone depletion	0,00	0,00	0,00	0,00	0,00	0,00
Terrestrial acidification	6,63	1,04	0,65	0,17	1,34	0,71
Freshwater eutrophication	0,02	0,00	0,00	0,00	0,00	0,00
Marine eutrophication	1,53	0,19	0,05	0,03	0,15	0,07
Human toxicity	0,34	0,07	0,03	0,00	0,10	0,07
Photochemical oxidant formation	0,07	0,03	0,02	0,00	0,03	0,02
Particulate matter formation	5,20	0,85	0,68	0,12	1,12	0,70
Terrestrial ecotoxicity	0,83	0,34	0,56	0,05	0,87	0,49
Freshwater ecotoxicity	0,02	0,00	0,00	0,00	0,00	0,00
Marine ecotoxicity	0,00	0,00	0,00	0,00	0,00	0,00
Ionizing radiation	0,07	0,02	0,00	0,00	0,02	0,02
Agricultural land occupation	1,65	0,43	0,77	0,05	1,46	0,85
Urban land occupation	0,00	0,00	0,00	0,00	0,00	0,00

4. Total Cost of Consumption of Animal-Derived Products

In Table 7, the per capita environmental cost of consumption is shown for each animal-derived product.

Although beef registers the highest environmental cost, pork results in the highest total environmental cost due to its high consumption in Hungary. The environmental cost of pork is followed by chicken and milk consumption.

Table 7. The per capita annual environmental cost of consumption of animal-derived products in Hungary for the year 2022

Products	Annual Consumption (per capita)[16]	Annual Environmental Cost (€ per capita)	Annual Environmental Cost (HUF per capita)
Milk (liters)	56,7	25,67	10366
Egg (pieces)	167	25,21	10177
Beef (kg)	1,1	17,29	6981
Pork (kg)	19,2	88,52	35739
Chicken (kg)	25,2	66,74	26947

The values in HUF are based on the official exchange rate of 19.06.2025.

5. Internalization of External Costs

In Table 8, the average market prices for May 2025, obtained from the Hungarian Central Statistical Office, and the calculated external costs of the animal-derived products are shown. The following product prices from the Hungarian Central Statistical Office are used :

- Milk: 11101 Pasteurised ESL milk, 2.8% fat content, litre
- Egg: 11001 Eggs, 10 pieces
- Pork: 10003 Pork leg (thigh), without bone
- Beef: 10103 Beef, without bone
- Chicken: 10401 Chicken, organs removed, kg

16 https://www.ksh.hu/stadat_files/jov/en/jov0051.html

Table 8. Market Price vs External Cost of Animal-Derived Products

Product	Market Price 2025 €/kg	External Cost 2015 €/kg	External Cost 2025 €/kg	Total cost €/kg
Milk	1,02	0,32	0,54	1,57
Beef (from beef cattle)	12,27	11,45	19,47	31,73
Egg	3,61	1,79	3,04	6,66
Pork	4,79	3,36	5,71	10,50
Chicken	3,15	1,93	3,28	6,43

Product	Market Price 2025[17] HUF/kg	External Cost 2015 HUF/kg	External Cost 2025 HUF/kg	Total cost HUF/kg
Milk	413	128	216	629
Beef (from beef cattle)	4940	4611	7776	12716
Egg	1455	720	1214	2669
Pork	1930	1353	2281	4211
Chicken	1270	777	1204	2474

a. Current VAT Rates in Hungary

Animal-derived products are eligible for the 5% VAT rate in Hungary, which is the first reduced rate[18]. The list of products that are eligible for the reduced VAT rate can be seen below.

VAT Rate	Products
5%	Livestock, such as pigs, cattle, sheep, and goats, and their meat during certain production stages. Pork, Poultry, eggs, and raw milk

[17] https://www.ksh.hu/stadat_files/ara/hu/ara0044.html
[18] https://www.globalvatcompliance.com/vat-rates-in-hungary/

b. Comparison of the Prices with Internalized Costs and a Possible Higher VAT Level

It is easy to avoid further damage caused by subsidised prices: the subsidies must be removed. The VAT on meat and dairy products should be raised to the general VAT level (27%), and an environmental tax should be levied to include the environmental costs in the prices. In the table below, the resulting price changes are presented. (It does not include the removal of direct subsidies on production because such a measure would put Hungarian producers at a disadvantage in comparison to producers abroad, and thus imported products would replace Hungarian ones, which is not desirable at all.)

Table 9. The retail price of certain meat and dairy products currently and after the internalization of external costs and VAT increase

Product	Market Price (5% VAT) (€/kg)	Market Price without VAT (€/kg)	External Cost (€/kg)	Market Price without VAT + External Cost (€/kg)	27% VAT (€/kg)	Total Cost with 27% VAT (€/kg)
Milk	1,02	0,97	0,54	1,51	0,41	1,92
Beef	12,27	11,66	19,47	31,13	8,40	39,53
Egg	3,61	3,43	3,04	6,47	1,75	8,22
Pork	4,79	4,55	5,71	10,26	2,77	13,03
Chicken	3,15	2,99	3,28	6,27	1,69	7,97

Product	Market price (HUF/kg)	Market Price without VAT (HUF/kg)	External cost (HUF/kg)	Market Price without VAT + External Cost (HUF/kg)	27% VAT (HUF/kg)	Total Cost with 27% VAT (HUF/kg)
Milk	413	392	216	608	164	773
Beef	4940	4693	7776	12469	3367	15836
Egg	1455	1382	1214	2596	701	3297
Pork	1930	1834	2281	4115	1111	5225
Chicken	1270	1204	1310	2517	679	3196

However, introducing such significant price increases can be politically challenging as an initial measure. Therefore, a more feasible first step to reduce the demand for animal-derived products could be to apply the highest VAT rate.

Furthermore, price tags that show the true cost of these products alongside their market prices could be displayed at their selling point, on the example of a retail company in Germany. [19] This approach can help inform consumers and encourage more conscious purchasing decisions.

Politicians fear removing subsidies on meat and dairy products due to social backlash. However, as practice in various countries proves, proper compensation would not only prevent social backlash but also reduce social inequalities. This was also demonstrated by the meat price reform in Hungary[20]. In 1976, the very generous meat subsidy was abolished, and as a result, meat prices skyrocketed. Parallelly, everyone, including infants, received 60 forints per month, which was not a small amount at the time, representing 2 per cent of the gross average monthly wage and a much higher proportion for the poor. So, the poorest benefited the most, as they consumed relatively little meat, and even then only the cheapest varieties.

[19] Vegconomist. (2023, September 5). PENNY charges "true cost" of nine products, leading to huge rise in meat and dairy prices. Vegconomist. https://vegconomist.com/sustainability-environment/penny-true-cost-animal-products/

[20] Lessons learnt from the meat price reform in Hungary in 1976. https://www.levego.hu/sites/default/files/Meat_price_reform_Hungary.pdf