PRODUCT CATEGORY RULES (PCR)
PUBLICATION DATE 2025-11-06

EPD
INTERNATIONAL EPD SYSTEM

FOOD AND BEVERAGE PRODUCTS

PCR 2025:03
VERSION 1.0.1

VALID UNTIL 2030-07-14

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1 INTRODUCTION

1.1 GENERAL

This document constitutes Product Category Rules (PCR) developed in the framework of the International EPD System: a programme for Environmental Product Declarations (EPD)[1] according to ISO 14025:2006, ISO 14040:2006, ISO 14044:2006, and product-specific standards, such as EN 15804 and ISO 21930 for construction products. EPDs are voluntary documents for a company or an industry association to present transparent, consistent, and verifiable information about the environmental performance of their products (goods or services).

The General Programme Instructions (GPI), publicly available on www.environdec.com, includes the rules for the overall administration and operation of the programme and the basic rules for developing EPDs registered in the programme. A PCR complements the GPI and the normative standards by providing specific rules, and guidelines for developing an EPD for one or more specific product categories (see Figure 1), thereby enabling the generation of consistent EPDs within a product category. A PCR should not repeat the rules and guidelines of the GPI, but include additions, specifications and deviations to the rules set in the GPI. As such, a PCR shall be used together with the GPI.

This PCR is a main PCR that may be complemented with one or several complementary PCR (c-PCR). If there is an applicable and valid c-PCR, it shall be used in case it has been valid for at least 90 days when the EPD is verified[2]. If it has been valid for less than 90 days, it is optional to use the c-PCR. The valid c-PCRs can be found on www.environdec.com.

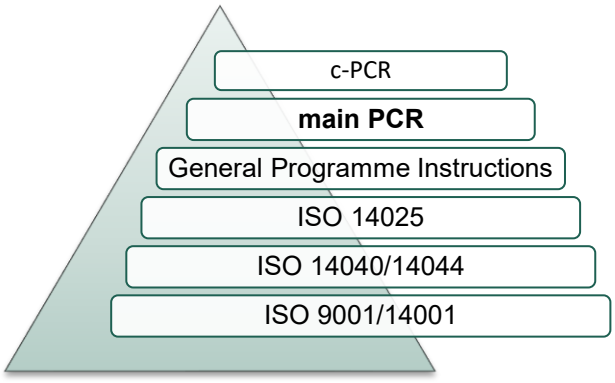

Figure 1. The hierarchy between PCRs, standards, and other documents.

The present PCR uses the following terminology:

- The term “shall” is used to indicate what is obligatory, i.e., a requirement.
- The term “should” is used to indicate a recommendation. Any deviation from a recommendation shall be justified in the EPD development process.
- The terms “may” or “can” are used to indicate an option that is permissible.

For definitions of other terms used in the document, see the GPI and normative standards.

Any references to this PCR shall include the PCR registration number, name, and version number.

The programme operator maintains the copyright of the PCR to ensure that it is possible to publish, update, and make it available to all organisations to develop and register EPDs. Stakeholders participating in PCR development should be acknowledged in the final document and on the website.

1.2 DEVELOPMENT OF C-PCR

A complementary PCR (c-PCR) may be developed for a more specific category of food and beverage products, for example dairy products or preserved food. Such a c-PCR may be developed within the framework of the International EPD System using the regular PCR development procedure. A c-PCR should not repeat the rules and guidelines of the main PCR (this document), but include additions, specifications and deviations to the rules set in the main PCR. As such, a c-PCR shall be used together with the main PCR. Read more in the GPI.

[1] Termed type III environmental declarations in ISO 14025.

[2] This does not apply when the EPD is re-verified during its validity, unless the validity period is extended.

A c-PCR should contain:

- general information, for example scope of the c-PCR, programme-related information, and information about its development, and
- further specifications and additional requirements on LCA modelling and EPD content in relation to the main PCR (this document), for example regarding type(s) of EPD allowed, system boundaries, declared or functional unit, environmental performance indicators or additional information.

For the development of c-PCRs, the c-PCR template available on www.environdec.com shall be used.

All c-PCRs currently available or under development are listed on www.environdec.com.

2 GENERAL INFORMATION

2.1 ADMINISTRATIVE INFORMATION

Name:	Food and beverage products
Registration number and version:	2025:03, version 1.0.1
Programme:	EPD INTERNATIONAL EPD SYSTEM
Programme operator:	EPD International AB, Box 210 60, SE-100 31 Stockholm, Sweden. Website: www.environdec.com E-mail: support@environdec.com
PCR Moderator:	Si Gao, Head of the IVL Swedish Environmental Research Institute China Division, si.gao@ivl.se
PCR Committee:	Juanjuan Yao & Xuchen Zhao, IVL Swedish Environmental Research Institute Keshi Wu & Xiaoyi Gao, All China Environment Federation Bárbara Civit, Universidad Tecnológica Nacional Yuguang Zhou, China Agricultural University Mingyi Liu, Chinese Association for Standardization Ricardo Méndez, Sara Lago & Eduardo Entrena, Contactica Cristian Andler, Greenticket MAPPING LCA Yanjing Zhu, Pinqiao Ren & Zhe Peng, Siwaliya Environmental Technologies (Beijing) Elena Neri, INDACO2 Srl Sonia Pignatelli, Life Cycle Engineering Spa Maame Ekua Manful, Technological University Dublin Dr. Dubravka Skunca (individual expert)
Publication date:	2025-11-06 See Section 9 for a version history of the PCR.
Valid until:	2030-07-14 The validity may change. See www.environdec.com for the latest version of the PCR and the latest information on its validity and transition periods between versions.
Development and updates:	The PCR has been developed following ISO 14027, including public consultation and review. The rules for the development and updating processes are described in Section 9 of the GPI. The PCR is valid for a pre-determined time period to ensure that it is updated at regular intervals. When the PCR is about to expire, the PCR Moderator shall initiate a discussion with the Secretariat on

	if and how to proceed with updating the PCR and renewing its validity. A PCR may be updated before it expires, based on changes in normative standards or provided significant and well-justified proposals for changes or amendments are presented. When there has been an update of the PCR, the new version should be used to develop EPDs. For small updates (change of third-digit version number), the previous version is normally immediately removed from the PCR library on www.environdec.com and there is no transition period. For medium updates (change of second-digit version number), the previous version of the PCR is valid in parallel during a transition period of at least 90 days, but not exceeding its previously set validity period. For large updates (change of first-digit version number), the previous version is valid in parallel during a transition period of at least 180 days, but not exceeding its previously set validity period. Stakeholder feedback on PCRs is very much encouraged. Any comments on this PCR may be sent directly to the PCR Moderator and/or the Secretariat during its development or during its period of validity.
Standards and documents conformance:	General Programme Instructions of the International EPD System, version 5.0.1, based on ISO 14025 and ISO 14040/14044.[3]
PCR language(s):	At the time of publication, this PCR was available in English. If the PCR is available in several languages, these are available on www.environdec.com. In case of translated versions, the English version takes precedence in case of any discrepancies.

2.2 SCOPE OF PCR

2.2.1 PRODUCT CATEGORY DEFINITION AND DESCRIPTION

This document provides product category rules (PCR) for the assessment of the environmental performance of food and beverage products, defined to include any edible or drinkable product, and upstream raw materials and intermediate products thereof, and the declaration of this performance by an EPD.

An available definition of food (and beverage), according to ISO 22000:2018, is: a substance (ingredient), whether processed, semi-processed or raw, which is intended for consumption, and includes drink, chewing gum and any substance which has been used in the manufacture, preparation or treatment of "food" but does not include cosmetics or tobacco or substances (ingredients) used only as drugs.

There is no exhaustive list of products and product categories covered by the above definition. All products that are covered by a harmonised standard for edible or drinkable products according to the Codex Alimentarius[4] shall, however, be considered as food (or beverage) products.

The International EPD System uses the UN CPC system for classification for PCRs. The UN CPC codes listed in Table 1 are a non-exhaustive list of those included in the scope of this PCR and they correspond to a subset of Section 2 of the UN CPC classification.[5]

[3] Some rules influencing EPD development are independent of the GPI version referred to in the PCR. For example, the latest rules on EPD verification procedures in the GPI shall be followed within 90 days of its publication. See Section 5.1 in the GPI for a description of the four categories of rules and when they shall be followed.

[4] https://www.fao.org/fao-who-codexalimentarius/en/

[5] https://unstats.un.org/unsd/classifications/unsdclassifications/cpcv21.pdf

Table 1. Non-exhaustive list of UN CPC codes included in the scope of this PCR, if the application of the product is nutrition.

UN CPC code	UN CPC name
21	Meat, fish, fruits, vegetables, oils and fats
211	Meat and meat products (except 2119)
212	Prepared and preserved fish, crustaceans, molluscs and other aquatic invertebrates (except 2129)
213	Prepared and preserved vegetables, pulses and potatoes
214	Prepared and preserved fruits and nuts
215	Animal fats
216	Vegetable oils
217	Margarine and similar preparations
22	Dairy products
221	Processed liquid milk, cream and whey
222	Other dairy products
223	Eggs, in shell, preserved or cooked
23	Grain mill products, starches and starch products; other food product
231	Grain mill products
232	Starches and starch products; sugars and sugar syrups n.e.c.
233	Preparations used in animal feeding, lucerne (alfalfa) meal and pellets
234	Bakery products
235	Sugar and molasses
236	Cocoa, chocolate and sugar confectionery
237	Macaroni, noodles, couscous and similar farinaceous product
239	Food products n.e.c (coffee, tea, etc)
24	Beverages
241	Ethyl alcohol; spirits, liqueurs and other spirituous beverages
242	Wines
243	Malt liquors and malt
244	Soft drinks; bottled mineral waters

2.2.2 GEOGRAPHICAL SCOPE

This PCR may be used globally.

2.2.3 EPD VALIDITY

An EPD becomes valid as of its version date (see Section 8.4.5 of the GPI). When an EPD is originally published, the validity period is normally five years starting from the version date or until the EPD has been de-registered from the International EPD System. Shorter validity periods are also accepted, for example if decided by the EPD owner.

For rules on when an EPD shall be updated and re-verified during its validity, see Section 6.8.1 of the GPI. For validity periods in case of updates of EPDs, see Section 6.8 of the GPI.

The version date and the period of validity shall be stated in the EPD. Publication of a new version of the PCR or the GPI does not affect the validity of already published EPDs.

3 REVIEW AND BACKGROUND INFORMATION

This main PCR was developed in accordance with the PCR development process described in the GPI of the International EPD System, including open consultation and review.

3.1 OPEN CONSULTATION

3.1.1 VERSION 1.0.0

This PCR was available for open consultation from 2024-10-02 until 2024-11-26, during which any stakeholder was able to provide comments by contacting the PCR Moderator and/or the Secretariat.

Stakeholders were invited via e-mail or other means to take part in the open consultation and were encouraged to forward the invitation to other relevant stakeholders. The following stakeholders provided comments during the open consultation and agreed to be listed as contributors in the PCR and on www.environdec.com:

- Ruini Luca, Barilla G e R Fratelli SpA;
- Javier Martin Echazarreta, National Institute of Industrial Tecchnology (INTI);
- Niels Jungbluth, ESU-services Ltd;
- Zhou Hui, Institute of Agricultural Economics and Development of Chinese Academy of Agricultural sciences (IAED-CAAS);
- Zhang Yuyang-China Power Complete Equipment CO., LTD (CPCEC);
- Kong Ling'e, Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences (IARRP-CAAS).

3.2 PCR REVIEW

3.2.1 VERSION 1.0.0

PCR review panel:	The Technical Committee of the International EPD System. A full list of members is available on www.environdec.com. The review panel may be contacted via support@environdec.com. Members of the Technical Committee were requested to state any potential conflict of interest with the PCR Committee, and if there were conflicts of interest they were excused from the review.
Chair of the PCR review:	Claudia A. Peña
Review dates:	2025-03-19 until 2025-05-11

3.3 EXISTING PCRS FOR THE PRODUCT CATEGORY

As part of the development of this PCR, existing PCRs and other internationally standardised methods that could potentially act as PCRs were considered to avoid unnecessary overlaps in scope and to ensure harmonisation with established methods of relevance for the product category. The existence of such documents was checked among the following EPD programmes and international standardisation bodies:

- International EPD System, www.environdec.com
- The EPD programmes listed under ECO Platform, https://www.eco-platform.org/the-eco-epd-programs.html
- UL Solutions, https://www.ul.com/resources/product-category-rules-pcrs
- EU's Product Environmental Footprint (PEF) framework, https://green-business.ec.europa.eu/environmental-footprint-methods_en
- EPD Italy, https://www.epditaly.it/en/

Table 2 lists the identified PCRs and other standardised methods.

Table 2. Existing PCRs and other internationally standardised methods that were considered to avoid overlap in scope and to ensure harmonisation with established methods:

Name of PCR/standard	Programme/ standardisation body	Registration number	Scope
Arable and vegetable crops	International EPD System	PCR 2020:07	CPC 011 Cereals, CPC 012, Vegetables, CPC 014 Oilseeds and oleaginous fruits, CPC 017 Pulses (dried leguminous vegetables), CPC 018 Sugar crops, CPC 0191 Forage products, fibres, living plants, cut flowers and flower buds, unmanufactured tobacco, and natural rubber
Bakery products	International EPD System	PCR 2012:06	CPC 234 Bakery products
Birds' eggs in shell, fresh	International EPD System	PCR 2011:15	CPC 023 Eggs of hens or other birds in shell, fresh
Bottled waters, not sweetened or flavoured	International EPD System	PCR 2010:11	CPC 24410 Bottled waters, not sweetened or flavoured
Dairy products	International EPD System	PCR 2021:08	CPC 022 Raw milk, CPC 221 Processed liquid milk, cream and whey, CPC 222 Other Dairy products
Espresso coffee	International EPD System	PCR 2018:03	Espresso coffee, a sub-set of CPC 23912
Fish and fish products	International EPD System	PCR 2021:05	CPC 042 Fish live, fresh or chilled for human consumption; CPC 2121 Fish, frozen (excluding fish fillets and fish meat); CPC 2122 Fish fillets and meat; fish livers and roes; CPC 2123 Fish, dried, whether or not salted, or in brine; smoked incl. fillets; edible fishmeal
Fish, otherwise prepared or preserved; caviar and caviar substitutes	International EPD System	PCR 2019:09	CPC 2124 Fish, otherwise prepared or preserved; caviar and caviar substitutes
Fruits and nuts	International EPD System	PCR 2019:01	CPC 013 Fruits and nuts
Grain mill products	International EPD System	PCR 2013:04	CPC 231 Grain mill products
Meat of mammals	International EPD System	PCR 2012:11	CPC 2111 Meat of mammal: fresh or chilled; CPC 2113 Meat of mammal, frozen. As mammals meat is intended, but not limited to, the meat of: cattle, buffalo, pigs, rabbits, hares, sheep, goat, camels, horses and other equines.
Meat of poultry (fresh, frozen or chilled)	International EPD System	PCR 2010:13	All kind of poultry meat (fresh, chilled or frozen) are included in this product group, as defined by UN CPC 2112 and 2114, but not limited to: chicken, duck, emu, goose, ostrich, turkey, guinea fowl, pheasant.
Uncooked pasta, not stuffed or otherwise prepared	International EPD System	PCR 2010:01	CPC 2371 Uncooked paste, not stuffed or otherwise prepared
Moka coffee	International EPD System	PCR 2019:08	CPC 23912 Moka coffee

Pasta, cooked, stuffed or otherwise prepared; couscous	International EPD System	PCR 2011:07	CPC 2372 Pasta, cooked, stuffed or otherwise prepared; couscous
Preparations used in animal feeding for food-producing animals	International EPD System	PCR 2016:03	CPC 233 Preparations used in animal feeding; lucerne (alfalfa) meal and pellets; CPC 0419 Other live fish, not for human consumption, including seeds and feeds for aquaculture; CPC 39120 Bran and other residues from the working of cereals or legumes; vegetable materials and vegetable waste, vegetable residues and co-products, whether or not in the form of pellets, of a kind used in animal feeding n.e.c. Pet food is not included in the scope of this PCR.
Prepared and preserved vegetable and fruit products, including juice	International EPD System	PCR 2019:10	CPC 213 Prepared and preserved vegetables, pulses and potatoes; CPC 214 Prepared and preserved fruits and nuts
Preserves and preparations of meat (including meat offal or blood)	International EPD System	PCR 2016:05	CPC 2118 Preserves and preparations of meat, meat offal or blood
Raw sugar, refined sugar, and molasses	International EPD System	PCR 2013:13	CPC 2351, 2352 and 2354 (Raw sugar, refined sugar, and molasses)
Sauces, mixed condiments and mustard	International EPD System	PCR 2010:19	CPC 23995 Sauces, mixed condiments, mustard flour and meal prepared mustard
Soft drinks	International EPD System	PCR 2022:07	CPC 24490 Other non-alcoholic caloric beverages
Tea	International EPD System	PCR 2019:02	CPC 23391 Green tea (not fermented), black tea (fermented) and partly fermented tea, in immediate packagings of a content not exceeding 3 kg, subset of CPC 23999 Other food products n.e.c.
Prepared and preserved vegetable and fruit products, including juice	International EPD System	PCR 2019:10	CPC 2132 Vegetable juices, 2139 Other prepared and preserved vegetables, pulses and potatoes
Wine	International EPD System	PCR 2020:06	CPC 2421 Wine of fresh grapes, whether or not flavoured; grape must
Virgin olive oils and its fractions	International EPD System	PCR 2010:07	CPC 21537 Virgin olive oil and its fractions
Meat of poultry fresh	International EPD System	PCR 2010:13	UN CPC 2112 Meat of poultry, fresh or chilled (and its Subclasses) and Class 2114 Meat of poultry, frozen (and its Subclasses)
Edible products of animal originn.e.c	International EPD System	PCR 2016:02	CPC 0293 Edible products of animal originn.e.c
Raw sugar, refined sugar and Molasses	International EPD System	PCR-2013:13	CPC2351: raw cane or beet sugar; 2352: refined sugar 2354:Molasses
Bovine and ovine milk	EPD Italy	PCR EPDItaly 042, under development	Bovine and olive milk

Product Environmental Footprint Category Rules Guidance	European Commission	Version 6.3	PEFCR Guidance document
PEFCR Beer	European Commission	-	Beer
PEFCR Pasta	European Commission	-	Pasta
PEFCR Marine fish	European Commission	-	Marine fish
PEFCR feed for food-producing animals	European Commission		food-producing animals
PEFCR for packed water	European Commission	Version 1.1	Packed water
PEFCR for dairy products	European Commission		Dairy products

3.4 REASONING FOR DEVELOPMENT OF PCR

This PCR was developed to enable publication of EPDs for the product category of food and beverage based on ISO 14025 and ISO 14040/14044. The PCR enables different practitioners to generate consistent results when assessing the environmental impact of products of the same product category, and thereby it supports comparability of products within a product category. This main PCR will replace the stand-alone PCRs of the International EPD System listed in Table 2 – upon their expiration – and may over time be complemented by c-PCRs with similar scopes as the stand-alone PCRs. For information about c-PCRs, see Sections 1.1 and 1.2.

3.5 UNDERLYING STUDIES USED FOR PCR DEVELOPMENT

The methodological choices made during the development of this PCR (declared/functional unit, system boundary, allocation methods, impact categories, data quality rules, etc.) were primarily based on the following underlying studies:

All previously published PCRs within the International EPD System on food and beverage products (see Table 2 in Section3.3).

IPCC. (2019). 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4. https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html

International Dairy Federation (IDF). (2015). A common carbon footprint approach for the dairy sector: The IDF guide to standard life cycle assessment methodology (Bulletin of the International Dairy Federation No. 479/2015). https://www.fil-idf.org/wp-content/uploads/2016/09/Bulletin479- 2015_A-common-carbon-footprint-approach-for-the-dairy-sector.CAT.pdf[6]

Nemecek, T., Antón, A., Basset-Mens, C. et al. (2022). Operationalising emission and toxicity modelling of pesticides in LCA: The OLCA-Pest project contribution. International Journal of Life Cycle Assessment, 27, 527–542. https://doi.org/10.1007/s11367-022-02048-7

European Commission (EC). (2021). Recommendation on the use of Environmental Footprint methods: Annexes 1 to 2. https://environment.ec.europa.eu/publications/recommendation-use-environmental-footprint-methods_en

The European Livestock and Meat Trades Union (UECBV)- Technical Secretariat for the Red Meat Pilot. (2020). Footprint Category Rules Red Meat (version 1.1).

Zampori, L. and Pant, R.(2019). Suggestions for updating the Product Environmental Footprint (PEF) method, EUR 29682 EN, Publications Office of the European Union, Luxembourg. doi:10.2760/424613 (JRC115959)

European Environment Agency (EEA). (2002). EMEP/CORINAIR Emission Inventory Guidebook (3rd edition). https://www.eea.europa.eu/en/analysis/publications/emepcorinair3

[6] The document IDF, Bulletin 479/2015 has been used as reference for the definition of the biophysical allocation rules as well as the baseline methodologic approach produced by the Cattle Model Working Group (CMWG) aimed at supporting the work of the already discontinued Pilot for PEFCR for Red Meat development.

Frischknecht, R., Steiner, R., & Jungbluth, N. (2009). The Ecological Scarcity Method – EcoFactors (2006b): A method for impact assessment in LCA. Federal Office for the Environment FOEN: Zürich und Bern.

Van Amstel, A. (2006). IPCC 2006 Guidelines for National Greenhouse Gas Inventories. In 2006 IPCC guidelines for national greenhouse gas inventories (Vol. 1–5). Intergovernmental Panel on Climate Change (IPCC). https://www.ipcc.ch/report/2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/

Milà i Canals, L., Romanyà, J., & Cowell, S. J. (2007). Method for assessing impacts on life support functions (LSF) related to the use of 'fertile land' in Life Cycle Assessment (LCA). Journal of Cleaner Production, 15(15), 1426–1440. https://doi.org/10.1016/j.jclepro.2006.05.005.

Nemecek, T., Kagi, T. (2007). Life Cycle Inventories of Agricultural Production Systems (Ecoinvent report No.15). Agroscope Reckenholz Taenikon Research Station ART, Swiss Centre for life cycle inventories.

Prasuhn, V. (2006). Erfassung der PO4-Austräge für die Ökobilanzierung - SALCA-Phosphor. Agroscope FAL Reckenholz, Zürich, 22 p., Available at www.agroscope.admin.ch.

Ruini, L., Marchelli, L., Marino, M., & Filareto, A. (2012). Barilla EPD process system to increase reliability, comparability and communicability of LCA studies. In M. S. Corson & H. M. G. van der Werf (Eds.), Proceedings of the 8th International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2012) (pp. 427–432). INRA.

FAO. (2014a). Greenhouse gas emissions and fossil energy demand from poultry supply chains. http://www.fao.org/3/amj752e.pdf.

Luigi Lavazza S.p.A. (2014). Carbon footprint of one cup of espresso coffee prepared with the A Modo Mio system. Underlying LCA report, December 10th 2014 (critical review performed by Certiquality).

EN 60661:2014-05. Methods for measuring the performance of electric household coffee makers. CENELEC.

Maas-van Berkel, B., van den Boogaard, B., & Heijnen, C. (2004). Preservation of Fish and Meat (3rd Edition). Wageningen, the Netherlands. ISBN: 90-72746-01-9

Davies, R. W. D., Cripps, S. J., Nickson, A., & Porter, G. (2009). Defining and estimating global marine fisheries bycatch. Marine Policy, 33(4), 661–672. https://doi.org/10.1016/j.marpol.2009.01.003

Ford, J., Pelletier, N., Ziegler, F., Scholz, A., Tyedmers, P., Sonesson, U., Kruse, S., & Silverman, H. (2012). Proposed Local Ecological Impact Categories and Indicators for Life Cycle Assessment of Aquaculture A Salmon Aquaculture Case Study. Journal of Industrial Ecology, 16(2), 254–265. https://doi.org/10.1111/j.1530-9290.2011.00410.x

Philis, G., Ziegler, F., Gansel, L. C., Jansen, M. D., Gracey, E. O., & Stene, A. (2019). Comparing life cycle assessment (LCA) of salmonid aquaculture production systems: status and perspectives. Sustainability, *11*(9), 2517. https://doi.org/10.3390/su11092517

Sherry, J., & Koester, J. (2020). Life Cycle Assessment of Aquaculture Stewardship Council Certified Atlantic Salmon (Salmo salar), *Sustainability,* 12(5), 6079. https://doi.org/10.3390/su12156079

Parker, R. (2012). Review of life cycle assessment research on products derived from fisheries and aquaculture: a report for Seafish as part of the collective action to address greenhouse gas emissions in seafood, Sea Fish Industry Authority.

Newton, R. W., & Little, D. C. (2018). Mapping the impacts of farmed Scottish salmon from a life cycle perspective. International Journal of Life Cycle Assessment. 23, 1018–1029.

Justel-Rubio, A., & Restrepo, V. (2017). Computing a global bycatch Rate of non-target species in tropical tuna purse seine fisheries. ISSF Technical Report 2017-01. International Seafood Sustainability Foundation, Washington, D.C., USA. https://www.iss-foundation.org/about-issf/what-we-publish/issf-documents/issf-2017-01-computing-a-global-rate-of-non-target-species-catch-bycatch-in-tropical-tuna-purse-seine-fisheries/

Song, X., Liu, Y., Pettersen, J. B., Brandão, M., Ma, X., & Røberg, S., et al. (2019). Life cycle assessment of recirculating aquaculture systems: a case of atlantic salmon farming in china. Journal of Industrial Ecology. 23(5): 1077-1086. https://doi.org/10.1111/jiec.12845

FAO. (2016). Greenhouse gas emissions and fossil energy use from poultry supply chains: Guidelines for assessment. Livestock Environmental Assessment and Performance Partnership. FAO, Rome, Italy.

Kalhor, T., Rajabipour, A., Akram, A., & Sharifi, M. (2016). Environmental impact assessment of chicken meat production using life cycle assessment. Information Processing in Agriculture, 3(4), 262–271. https://doi.org/10.1016/j.inpa.2016.10.002

Leinonen, I. (2013). Comparing the environmental impacts of alternative protein crops in poultry diets: The consequences of uncertainty, Agricultural Systems, 121, 33–42. https://doi.org/10.1016/j.agsy.2013.06.008

Murawska, D. (2013). Age-related changes in the percentage content of edible and nonedible components in turkeys, Poultry Science, 92(1), 255–264. http://dx.doi.org/ 10.3382/ps.2012-02611

ISO 14067:2018; Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification

CESISP, 2014. The Water Footprint, Ecological Footprint and Carbon Footprint of vegetal products - Conserve Italia soc. coop. agr.

CESISP, 2018. Life Cycle Assessment of fruit and vegetable products - EPD PROCESS - Conserve Italia soc. coop. agr.

Del Borghi, A., Gallo, M., Strazza, C., & Del Borghi, M. (2014). An evaluation of environmental sustainability in the food industry through life cycle assessment: The case study of tomato products supply chain. *Journal of Cleaner Production, 78*, 121–130. https://doi.org/10.1016/j.jclepro.2014.04.083

Del Borghi, A., Strazza, C., Magrassi, F., Taramasso, A. C., & Gallo, M. (2018). Life cycle assessment for eco-design of product-package systems in the food industry: The case of legumes. *Sustainable Production and Consumption, 13*, 24–36. https://doi.org/10.1016/j.spc.2017.11.001

Del Borghi, A., Tacchino, V., Moreschi, L., Matarazzo, A., Gallo, M., & Arellano Vazquez, D. (2022). Environmental assessment of vegetable crops towards the water-energy-food nexus: A combination of precision agriculture and life cycle assessment. Ecological Indicators, 140, Article 109015. https://doi.org/10.1016/j.ecolind.2022.109015

FAO. (2007). Meat processing technology for small to medium scale producers, RAP publication 2007/20, for the definition of the product category. https://openknowledge.fao.org/server/api/core/bitstreams/4cfabbd3-16aa-47f8-ac6f-b54a48cb8abd/content

JRC, & European Commission. (2015). Baseline Approaches for the Cross-Cutting Issues of the Cattle Related Product Environmental Footprint Pilots in the Context of the Pilot Phase.

Klenk, I., Landquist, B., & Ruiz de Imana, O. (2012). The Product Carbon Footprint of EU Beet Sugar, Comité Européen des Fabricants de Sucre from Sugar Industry Journal, 137 (3), 169 - 177. DOI: https://doi.org/10.36961/si12784

Tassielli, G., Namdari, M., Rafiee, S., Aghbashlo, M., Hosseinpour, S., notarnicola, b., & Renzulli, P. (2015). International conference on Life Cycle Assessment as reference methodology for assessing supply chains and supporting global sustainability challenges Stresa Life cycle assessment of sugar production in Hamadan sugar mill.

Comité Européen des Fabricants de Sucre (CEFS). (2014). A life cycle assessment of beet sugar in the European Union: Summary.

Renouf, M., & Wegener, M. (2007). Environmental life cycle assessment (LCA) of sugarcane production and processing in Australia. Proceedings of the Australian Society of Sugar Cane Technologists, 29.

Seabra, J., Macedo, I., Chum, H., Faroni, C. E., & Sarto, C. (2011). Life cycle assessment of Brazilian sugarcane products: GHG emissions and energy use. Biofuels, Bioproducts and Biorefining, 5, 519-532. https://doi.org/10.1002/bbb.289

Chauhan, M. K., Varun, Chaudhary, S., Kumar, S., & Samar. (2011). Life cycle assessment of sugar industry: A review. *Renewable and Sustainable Energy Reviews*, *15*(7), 3445-3453. https://doi.org/https://doi.org/10.1016/j.rser.2011.04.033

Studio completo con metodologia LCA per la valutazione dell'impatto ambientale di 3 tipologie di fornitura della bevanda analcolica Pepsicola ai fini della Dichiarazione ambientale di prodotto (Environmental Product Declaration – EPD®)2021 (dati 2019).

Doublet, G., & Jungbluth, N. (2010). Life cycle assessment of drinking Darjeeling tea (Report Version 1.0). ESU-services Ltd. https://www.esu-services.ch

Azapagic, A., Bore, J., Cheserek, B., Kamunya, S., & Elbehri, A. (2015). A life cycle assessment of Kenyan tea. In Kenya's tea sector under climate change: An impact assessment and formulation of a climate-smart strategy (pp. 63–80).

Cichorowski, G., Joa, B., Hottenroth, H., & Schmidt, M. (2015). Scenario analysis of life cycle greenhouse gas emissions of Darjeeling tea. The International Journal of Life Cycle Assessment, 20. https://doi.org/10.1007/s11367-014-0840-0

Tran, T., Branca, G., Arslan, A., & Van Mai, T. (2016). Value chain analysis of climate-smart Shan tea production in the northern mountainous region of Vietnam. *Italian Review of Agricultural Economics (REA), 71*(1), 155–169. https://doi.org/10.13128/REA-18636

Munasinghe, M., Deraniyagala, Y., Dassanayake, N., & Karunarathna, H. (2017). Economic, social and environmental impacts and overall sustainability of the tea sector in Sri Lanka. *Sustainable Production and Consumption, 12*, 155–169. https://doi.org/10.1016/j.spc.2017.07.003

Tea & Herbal Infusions Europe. (2018). Compendium of Guidelines for Tea, Issue 5. https://thie-online.eu/files/thie/docs/THIE%20Compendium%20tea.pdf

Tea & Herbal Infusions Europe. (2018). Compendium of Guidelines for Herbal and Fruit Infusions. https://www.teeverband.de/files/bilder/Publikationen/Recht/2018-07-17_Compendium_of_Guidelines_for_Herbal_Infusions_-_ISSUE_6.pdf

Murray, D., Liao, J., Stankovic, L., & Stankovic, V. (2015). How to make efficient use of kettles: Understanding usage patterns. In Proceedings of the 8th International Conference on Energy Efficiency in Domestic Appliances and Lighting (EEDAL 2015), Lucerne, Switzerland. https://strathprints.strath.ac.uk/55059/1/Murray_etal_EEDAL2015_How_make_efficient_use_kettles_understanding_usage_patterns.pdf

Murray, D. M., Liao, J., Stankovic, L., & Stankovic, V. (2016). Understanding usage patterns of electric kettle and energy saving potential. *Applied Energy*, *171*, 231-242. https://doi.org/https://doi.org/10.1016/j.apenergy.2016.03.038

Neri and Pulselli. (2017). LCA report of Prosecco di Valdobbiadene DOCG Ius Naturae and Grande Cuvée del Fondatore for Bortolomiol SpA. INDACO2.

Neri and Pulsell. (2017). LCA report of wine production of different wines produced by Case Corini. INDACO2.

Neri and Pulselli. (2017).LCA report of wine and oil for Fattoria la Maliosa. INDACO2.

Neri and Pulselli. (2015). Carbon Footprint of the "Vernaccia di San Gimignano" for the "Consorzio del vino Vernaccia di San Gimignano" . INDACO2.

Casolani, N., D'Eusanio, M., Liberatore, L., Raggi, A., & Petti, L. (2022). Life Cycle Assessment in the wine sector: A review on inventory phase. *Journal of Cleaner Production*, *379*, 134404. https://doi.org/https://doi.org/10.1016/j.jclepro.2022.134404

Ferrara, C., & De Feo, G. (2018). Life Cycle Assessment Application to the Wine Sector: A Critical Review. Sustainability, 10(2), 395. https://doi.org/10.3390/su10020395

Iannone, R., Miranda, S., Riemma, S., & De Marco, I. (2014). Life cycle assessment of red and white wines production in Southern Italy. Chemical Engineering Transactions, 39, 595–600. https://doi.org/10.3303/CET1439100

Ambiente Italia S.r.l. (2018). Life-cycle assessment (LCA) of the Monini Extra Virgin Olive Oil.

Russo, C., Tuomisto, H., George, M., Pattara, C., & Polo Palomino, J. A. (2015). *PEF screening report in the context of the EU Product Environmental Footprint Category Rules (PEFCR) Olive Oil Pilot*. https://doi.org/10.13140/RG.2.1.1052.9361

Joumri, L., Labjar, N., Dalimi, M., Harti, S., Dhiba, D., Messaoudi, N., Bonnefille, S., & Hajjaji, S. (2023). Life cycle assessment (LCA) in the olive oil value chain: A descriptive review. *Environmental Development, 45*, 100800. https://doi.org/10.1016/j.envdev.2022.100800

Rapa, M., & Ciano, S. (2022). A review on life cycle assessment of the olive oil production. *Sustainability, 14*(2), 654. https://doi.org/10.3390/su14020654

Lo Giudice, V., Faraone, I., Bruno, M. R., et al. (2021). Olive trees by-products as sources of bioactive and other industrially useful compounds: A systematic review. *Molecules, 26*(16), 5081. https://doi.org/10.3390/molecules26165081

Supporting Technical Paper of Double Pyramid. (2016, October 11). Version 7. Retrieved from www.barillacfn.com

EPD International, Environmental Product Declarations published in EPD international by Barilla G. e R. Fratelli

EPD International Environmental Product Declarations published in EPD international by Italia Zuccheri

EPD International, Environmental Product Declarations published in the EPD International by Granarolo S.p.A.

EPD international, Environmental Product Declarations published in the EPD International by COOP Italia

EPD international, Environmental Product Declarations published in the EPD International by INALCA S.P.A.

EPD International Environmental Product Declarations published in EPD international by Assomela-Italian association of Producer Organizations

4 LCA METHOD

This section provides rules for the LCA method used to develop an EPD for the product category as defined in Section 2.2.1. The basic rules of the LCA method are set in Annex A of the GPI, and this section only includes additions, specifications and deviations to the rules set in the GPI. Guidance and examples of applying the LCA method are also available on www.environdec.com/methodology.

4.1 MODELLING APPROACH

See Section A.1 of the GPI.

4.2 DECLARED UNIT/FUNCTIONAL UNIT

EPDs based on this main PCR without using a complementary PCR (c-PCR) shall use a declared unit.

For food products, including products that are raw materials or intermediate products, the declared unit shall be defined as 1 kg of product and its packaging (the weight of the packaging is not included in this 1 kg) as presented to the consumer or, for upstream products, the customer.

For beverage products, including products that are raw materials or intermediate products, the declared unit shall be defined as 1 litre of product and its packaging (the volume of the packaging is not included in this 1 litre) as presented to the consumer or, for upstream products, the customer.

This main PCR uses a declared unit instead of a functional unit as a single functional unit cannot capture all the relevant functional variations of products covered by the PCR. Functional aspects shall, however, be taken into consideration when comparing EPDs based on this PCR. Further, EPDs based on this PCR together with a c-PCR may use a functional unit – instead of a declared unit – according to the specifications in the c-PCR. For information about c-PCRs, see Sections 1.1 and 1.2.

The reference flow in the LCA shall be defined at the shelf of the retailer or at the marketplace (e.g., 250 g, a pouch of 170 g, etc.) for end products, or at the delivery to the business customer for upstream products.

The following information defines the product unit and shall be reported in the production information section of the EPD (see Section 6.4.4), if applicable:

- Ingredients.
- Nutritional facts (serving size, calories, macronutrients (such as carbohydrates, proteins, and fats), micronutrients (such as vitamins and minerals), and other important components like dietary fiber and sugar.
- Description of the sales unit (type of packaging, weight).
- Storage method and shelf-life of the product (e.g., freezer: 18 months, room temperature: 24 days).

The declared unit shall be stated in the EPD. The environmental performance results shall be given per declared unit. A description of the function of the product shall be included in the EPD, if relevant, including specifications regarding the product performance during its use (see above bullet points).

4.2.1 TECHNICAL SPECIFICATION AND LIFESPAN

Not applicable for this product category.

4.3 SYSTEM BOUNDARY

EPDs based on this main PCR shall be “cradle to grave”. If a c-PCR is used in addition to this main PCR, the system boundary is set by the c-PCR.

All environmentally relevant processes from “cradle to grave” should be included, so that at minimum 95% of the total energy use, mass of product content, and environmental impact is accounted for (see Section 4.5).

In case of raw materials and intermediate products like flour or other products for which further processing will be carried out, and these are unknown, the system boundary shall be "cradle to grave".

For the c-PCR development, specific scenarios for the use stage of a specific food can be outlined.

4.3.1 LIFE-CYCLE STAGES AND INFORMATION MODULES

Due to different data quality rules and the presentation of results, the product life cycle shall be divided into the following life-cycle stages and information modules. Specific c-PCR may provide more details on some relevant modules for the product category.

- Product stage, modules A1-A3:
  - A1: Raw material extraction and processing (e.g., seeding and agricultural operations), production of intermediate materials and components (e.g., including transformation processes such as milling, fermentation or pressing), processing of secondary material input, production of distribution and consumer packaging.[7]
  - A2: Transports to the manufacturer of the product (when applicable) and waste processing of product losses.
  - A3: Manufacturing of the product[8] and waste processing of product losses.
- Distribution and storage stage, modules A4-A5:
  - A4: Transport of the product to the distribution centre, user or retail, and waste processing of product losses.
  - A5: Storage of product (e.g., retail operations) and waste processing of intermediate packaging and product losses.
- Consumption stage, modules B1-B7:
  - B1: Consumption of the product (e.g., including direct emissions, such as dry ice used for cooling.)
  - B2: Maintenance of the product: does not apply
  - B3: Repair of the product: does not apply
  - B4: Replacement: does not apply
  - B5: Refurbishment: does not apply
  - B6: Energy use in consumption (e.g., cooking or refrigerating).
  - B7: Water use in consumption (e.g., diluting).
- End-of-life stage for consumer packaging and product not consumed, modules C1-C4:
  - C1: De-construction/demolition/deinstallation: does not apply
  - C2: Transport to waste processing and/or disposal.
  - C3: Waste processing for recovery and/or recycling.
  - C4: Disposal
- In addition, consequences of recovered material/energy beyond the product cycle may be reported in module D.
- In the EPD, the environmental performance of each of the life-cycle stages and module D shall be reported separately, and in aggregated form for the life-cycle stages (modules A-C). Modules that do not apply for this product category (according to the above bullet points) shall be excluded.
- Section A.3.1 of the GPI outlines rules for how to assign generation of electricity and production of fuels, steam and other energy carriers used, and losses arising, in each information module.
- Sections 4.3.1.1-4.3.1.4, further describe the processes to include or exclude for each life-cycle stage.

[7] For raw materials and intermediate products that are sold not to consumers but business customers, some or all agricultural operations may be in A1, so what is an A3 process in one product system may be an A1 process in another.

[8] In case of not being primary production, like fruits or vegetables, these are the processes under operational control of the EPD owner.

4.3.1.1 Modules A1-A3: Product stage

- Module A1:
  - Agriculture processes. This includes, e.g., air, water and soil emissions and emissions from energy used in agriculture as well as emissions of nitrous gases. The cradle for agriculture is soil preparation and cultivation.
  - Production of materials used in agriculture (fertilisers, pesticides, seeds, seedling, cuttings, plants, livestock and fodder for the cultivation).
  - Operations for the transformation of land use, such as grazing on the grassland, if applicable.
  - Any activities that take place on farms, if applicable.
  - Animal breeding (including feed production, enteric fermentation and manure management).
  - Fishing
  - Aquaculture, including feed production.
  - Production of auxiliary products used such as detergents for cleaning/washing, refrigerant for cooling, etc.
  - Production of raw material (and e.g., natural water (CPC 180) at the well or spring from the cradle).
  - Production of semi-products used in the core process, if applicable.
  - Production of materials for greenhouses, mulching, trays, and substrates (peat, vermiculite, etc) for vegetable product and ingredients as spices and additives for meat and dairy product.[9]
  - Generation of electricity and production of fuels, steam and other energy carriers used in upstream processes.
  - Manufacturing of primary and secondary packaging, if applicable.
- Module A2:
  - Transports from field to the semi production plants, if applicable
  - External transportation of materials and components to the manufacturing of the product under study (e.g. ingredients, packaging and auxiliary materials).
  - Other transportation within the processes.
- Module A3:
  - Manufacturing of the final product.
  - Product refrigeration or freezing, if applicable.
  - Packaging of the final product (e.g., stretch blow moulding of pre-forms, bottle flushing, filling, corking).

Processes not listed here may also be included. All elementary flows at resource extraction shall be included, except for the flows that fall under the general cut-off rule in Section 4.5.

The mix of electricity used in A1-A3 processes shall be documented in the EPD, where relevant.

4.3.1.2 Modules A4-A5: Distribution and retail stage

- Module A4:
  - The transport of the product to the customer shall be described in the EPD, where relevant, from manufacturing to an average retailer/distribution platform/user, and be accounted for in this priority:
    - Actual transportation modes and distances to a specific customer or market, representing the geographical scope of the EPD;
    - A weighted average of transportation modes and distances, based on transportation to several customers or markets, representing the geographical scope of the EPD.
  - Refrigeration along the distribution chain, if applicable.

[9] For modelling of the production of other ingredients, spices, and additives used in the product, the applicable c-PCR (if any) available on www.environdec.com shall be considered.

- Waste processing of product losses, and the corresponding production of these losses, occurring in transport processes in module A4. Actual food loss and waste rate shall be applied if available, but if not, default loss rates during distribution (due to broken product, not returning to the manufacturer) shall be assumed to be 5%.

- Module A5:
  - Storage of product (e.g., retail operations)
  - If the product needs a cold storage for preserving its shelf life, the environmental impacts related to this process shall be estimated. Since the impacts could vary significantly, the following expression should be adopted to calculate the values in a comparable way[10].
  - Electric energy used for the cold storage should be calculated by the following formula:
  - *Equation 1.*

$$E_p = E_s \times \frac{100}{u} \times V_p \times t$$

Where:

- Ep is is the electric energy consumption (kWh)
- Es is the specific energy consumption of the cooling room (kWh per m3 per day)
- u is the degree of utilisation of the storage room (%)
- Vp is the volume of the considered product (functional unit = 1 kg).
- t is the time of the storage (days).
- Values could be set as follow:
- Es = 0,59 kWh per m3 per day in the product is stored in a cold place (5°C);
- Es = 0,63 kWh per m3 per day in the product is stored in a frozen place (-20°C);
- u = 50%
- Vp = 0,001 m3 (if more specific data are available, the hypotheses shall be included in the EPD).
- t = shelf life of the product (days).
- The time of cold or frozen storage used for the study shall be declared in the EPD.
- Different Es, u, Vp default values can be used but they shall be presented in the EPD.

- Waste processing of intermediate packaging and product losses occurring in storage processes (e.g., in retail) in module A5. Also, the corresponding production of the product losses in A5 shall be assigned to A5.

Processes not listed here may also be included. All elementary flows at resource extraction shall be included, except for the flows that fall under the general cut-off rule in Section 4.5.

Scenarios for the end-of-life stage shall be technically and economically practicable and compliant with current regulations in the relevant geographical region based on the geographical scope of the EPD. Key assumptions regarding the end-of-life stage scenario shall be documented in the LCA report. For example, the transportation packaging.

4.3.1.3 Modules B1-B7: Use stage

- B1: Customer or consumer use of the product (e.g., including direct emissions, such as: dry ice for cooling)
- B6: Energy use in consumption (e.g., cooking or refrigerating).
- B7: Water use in consumption (e.g., diluting).
  - Data for the use stage are usually based on scenarios, but specific data should be used when available and relevant.
  - Data on the emissions from the use stage should be based on documented tests, verified studies in conjunction with average or typical product use, or recommendations concerning suitable product use. Whenever applicable, test methods shall be internationally recognised.
- Domestic food losses: if no specific data is available (e.g., country based), default mean product loss rates at consumer can be assumed as 5%). The product loss at home may refer to country-specific data, and if not available,

[10] www.lcafood.dk

it may be assumed to be 50% disposed of by i.e., incineration and landfill, 25% composting and 25% by anaerobic digestion.

- Domestic product conservation: for the estimation of energy consumption of the product conservation in the domestic refrigerator of the final user the following assumptions should be used:
  - Annual energy consumption of the refrigerator (A class3): 300 kWh
  - Average mass of products stored in refrigerator: 10 kg
  - Estimated consumption of energy per kg of product = 300 kWh * (365 days)-1 * (10 kg) -1 = 0.082 kWh/day/kg
  - Average permanence of the product in the refrigerator: half of the declared shelf life.

If alternative assumptions are used, these shall be described and justified in the EPD.

- Cooking: Food often needs cooking before eating. The following data should be used to estimate the energy use in cooking:[11]:
  - Cooking in the pan on stove: 5.5 kW per hour of operation;
  - Boiling in the pot on stove: 3 kW per hour of operation;
  - Cooking in the oven (with 15 minutes of pre-heating): 2.2 kW per hour of operation;
  - Cooking in microwave oven: 1.4 kW per hour of operation

Alternatively, energy use can be estimated using other assumptions, such as indications/suggestions that are provided to consumers. If this is done, the assumptions (including cooking time and energy use per hour) shall be justified and presented in the EPD.

Processes not listed here may also be included. All elementary flows at resource extraction shall be included, except for flows that fall under the general cut-off rule in Section 4.5.

4.3.1.4 Modules C1-C4: End-of-life stage for packaging and product not consumed

- C2: Transport of any consumer packaging or wasted part of the product to waste processing.
- C3: Waste processing for reuse, recovery and/or recycling any packaging or wasted part of the product.
- C4: Disposal (e.g., incineration, composting, retting) of any packaging or wasted part of the product.

The product loss at home can refer to country-specific data, and if not available, it can be assumed to be 50% disposed of by i.e., incineration and landfill, 25% composting and 25% by anaerobic digestion.

Scenarios for the end-of-life stage shall be technically and economically practicable and compliant with current regulations in the relevant geographical region based on the geographical scope of the EPD. Key assumptions regarding the end-of-life stage scenario shall be documented in the LCA report. For example, consumer packaging and residue/waste from food cooking etc.

Processes not listed here may also be included. All elementary flows at resource extraction shall be included, except for the flows that fall under the general cut-off rule in Section 4.5.

4.3.1.5 Excluded processes

See Section A.3.1.1 of the GPI.

4.3.1.6 Infrastructure and capital goods

See Section A.3.1.2 of the GPI.

4.3.2 OTHER BOUNDARY SETTING RULES

See Section A.3.2 of the GPI for rules on setting boundaries to nature as well as geographical and temporal boundaries. See Section A.4 of the GPI and Section 4.6 below for rules on setting boundaries to other product systems.

[11] Supporting Technical Paper of Double Pyramid 11/10/2016 • Version: 7; www.barillacfn.com

4.4 PROCESS FLOW DIAGRAM

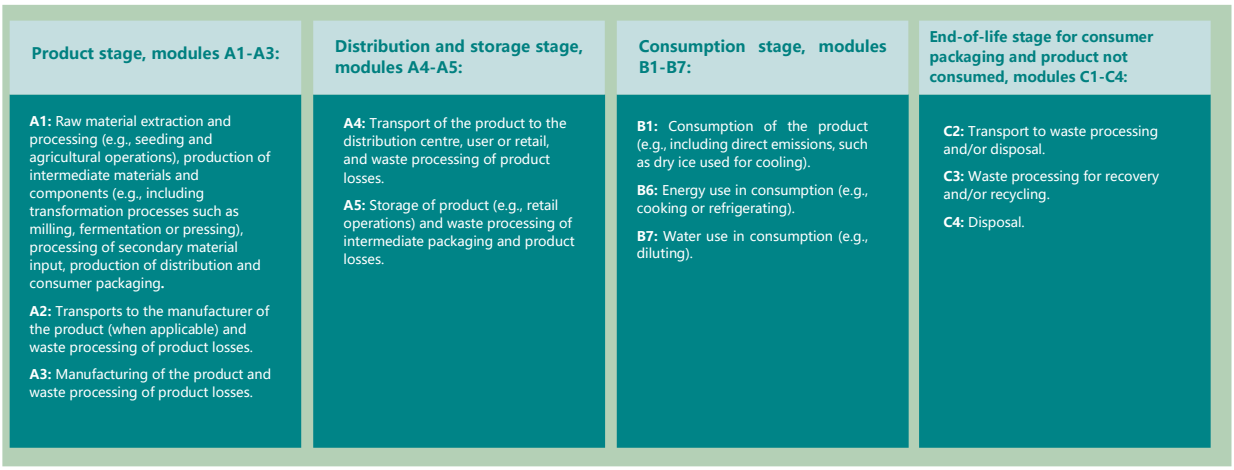

Figure 2. Process flow diagram illustrating the processes that shall be included in the product system, except consumption stage that may be excluded for raw materials and intermediate products, divided into the life-cycle stages. The illustration of processes to include may not be exhaustive, see Section 4.3.1.

4.5 CUT-OFF RULES

See Section A.3.3 of the GPI.

4.6 ALLOCATION RULES

See Section A.4 of the GPI.

4.6.1 ALLOCATION OF CO-PRODUCTS

See Section A.4.1 of the GPI.

As a reminder, co-products are defined as "any of two or more marketable materials, products or fuels from the same unit process, but which is not the object of assessment[12].

Additionally, this PCR provides specific allocation rules for key processes in different product systems as follows:

- Grains, cereals, and vegetables production (Section 4.6.1.1)
- Fruits and nuts (Section 4.6.1.2)
- Dairy products (Section 4.6.1.3)
- Meat of mammals (Section 4.6.1.4)
- Fresh eggs in shell (Section 4.6.1.5)
- Meat of poultry (Section 4.6.1.6)
- Fish product, including caviar and caviar substitutes (Section 4.6.1.7)
- Virgin olive oils (Section 4.6.1.8)
- Food processing and other food products (Section 4.6.1.9)
- Feed production (Section 4.6.1.10)
- Coffee (Section 4.6.1.11)
- Tea (Section 4.6.1.12)

[12] In industry vocabulary, the terms co-product, non-core products or sub-products are sometimes used to refer to co-products.

- Other beverage products (Section 4.6.1.13)

4.6.1.1 Grains, cereals, and vegetables production

If straw or a product comparable to straw is harvested and sold as a co-product, allocation between the main product and straw shall be done based on actual prices of the main product and straw on the market the products are intended for. The price of the main product and straw shall be specified and justified in the EPD. If prices are unknown, average prices values should be used from statista[13], or the allocation factors shown in Table 3[14], may be used.

Table 3. Allocation factors for grain, cereal and vegetable production in case actual prices for the intended market are unknown.

Process	Main product and co-products	Allocation factors
Wheat production	Grains and straw	Extensive crop production system: 92.5% to grains and 7.5% to straw. Integrated production: 92.5% to grains and 7.5% to straw. Organic Crop Production system: 93.1% to grains and 6.9% to straw.
Rye production	Grains, straw	Extensive crop production system: 90.3% to grains and 9.7% to straw. Integrated production: 90.3% to grains and 9.7% to straw. Organic crop production system: 91.9% to grains and 8.1% to straw.
Barley production	Grains, straw	Extensive crop production system: 89.9% to grains and 10.1% to straw. Integrated production: 89.9% to grains and 10.1% to straw. Organic crop production system: 91.3% to grains and 8.7% to straw.

4.6.1.2 Fruits and nuts

If allocation cannot be avoided through sub-division, the allocation method shown in Table 4 shall be used for fruits and nuts plantation and production.

Table 4. Allocation method for plantation and production of fruits and nuts.

Process	Main product and co-products	Allocation method
Polyculture plantation	Cultivation of more than one type of fruits or nuts in the same field/farm	Allocation based on mass
Production process	Processing of more than one type of fruits or nuts in the same plant/company	Allocation based on mass

4.6.1.3 Dairy products

For the dairy farm system where the main focus is on production of milk, the meat generated from surplus calves and cull dairy cows is an important co-product. It is therefore necessary to determine total emissions and to allocate them between milk and meat.

The biophysical allocation method proposed by the International Dairy Federation (2015) shall be used. The allocation factor (AF) for milk shall be calculated as follows, accounting for the beef-to-milk ratio (BMR):

[13] https://www.statista.com/statistics/1111334/impact-of-coronavirus-on-monthly-cereals-price-index-worldwide/

[14] Nemecek, T. and Kagi, T. (2007). Life Cycle Inventories of Agricultural Production Systems (Ecoinvent report No.15). Agroscope Reckenholz Taenikon Research Station ART, Swiss Centre for life cycle inventories.

Equation 2. Allocation factor for milk: $AF_{milk} = 1 - 6.04\ x\ BMR$

where,

$$\mathrm{BMR} = \frac{\mathrm{M_{meat}}}{\mathrm{M_{milk}}}$$

$\mathrm{M_{meat}}$ = the mass of live weight of all animals sold including bull calves and culled mature animals per year
$\mathrm{M_{milk}}$ = the mass of fat and protein corrected milk (FPCM) sold per year (corrected to 4% fat and 3.3% protein)

The fat and protein corrected milk (FPCM) which has a unit of kg per year is calculated as follows:

$$\mathrm{FCPM} = \text{annual milk production} \times [0.1226 \times \text{fat\%} + 0.0776 \times \text{protein\%} + 0.2534]$$

Table 5 lists the mandatory allocation method also for other key processes related to dairy products.

Table 5. Allocation methods for processes related to dairy products.

Process	Main products and co-products	Allocation method
Dairy farming	Milk, meat	Biophysical allocation method according to the Equation
Dairy plant	Dairy products (e.g., milk, cream, yoghurt, butter, cheese)	Allocation based on the dry weight (i.e., dry matter content) of the products, as proposed by the International Dairy Federation (2015).

4.6.1.4 Meat of mammals

Below is a definition of terms used in this section:

- Mammal: non-reproducing mammal destined to meat production (ex. calf in cow meat farming).
- Reproductive mammal: mammal of female gender that has reproduced and that at end of career (when no longer destined to reproduction and/or milk production) is destined to meat production (e.g., reproductive cow in cow meat farming).
- Economic value: wholesale price of the product (or co-product) to which allocation is applied.
- Biophysical allocation: allocation method aligned with ISO14044 that reflects the underlying use of feed energy by (dairy) animals and the physiological feed requirements of the animal to produce milk and meat (International Dairy Federation, 2015).

There are two types of key processes in the production of meat from mammals that requires co-products allocation:

- Production of meat from reproductive mammals (e.g., meat from dairy cows at the end of career, etc.).
- Slaughterhouse activities.

Allocation methods for each type of key process are provided below.

Co-product allocation for production of meat from reproductive mammals

Meat chain co-products may vary in relation to the type of mammal considered; and may come in the form of food products or miscellaneous goods; Table 6 shows an indicative and non-comprehensive example:

Table 6.Typology of mammals and their co-products (non-comprehensive list).

Mammal typology	Co-products
Cow	Meat
	Milk
	Leather
Sheep	Meat
	Milk
	Wool
Pig	Meat
Goat	Meat
	Milk

A. Meat from dairy farm systems (e.g., meat from culled dairy cows at the end of career)

For dairy farm system where the focus is milk production, meat generated from surplus calves and culled dairy cows are important co-products.

When the object of the analysis is meat from culled dairy cow, the environmental burdens to consider are the following (see also

Figure 3):

- A share of the environmental burdens of the reproductive mammal's life cycle before entering in the reproductive phase; in this case, the environmental burden shall be allocated on the biophysical basis to all products (i.e., the reproductive mammal's meat at the end of career, milk, surplus calves) generated during the entire life cycle of the reproductive mammal.
- Environmental burdens of the reproductive mammal's lifecycle starting from the last breeding phase up to its slaughter house.

When the object of the analysis is meat from veal calves, the environmental burdens to consider are the following (see also

Figure 3):

- Environmental burdens of the reproductive mammal's life cycle before entering in the reproduction phase; in this case, the environmental burden shall be allocated on the biophysical basis to all products (i.e., the reproductive mammal's meat at the end of career, milk, surplus calves) generated during the entire life cycle of the reproductive mammal.
- Environmental burdens of the mammal (e.g., surplus calf) life cycle.

For products from dairy farm systems, the environmental burden shall be allocated between milk and meat in line with the Equation shown in Section 4.6.1.3. After having calculated the allocation factor for milk, the allocation factor for meat is calculated as follows:

Equation 3. Allocation factor for meat from dairy farm: $AF_{meat} = 1 - AF_{milk}$

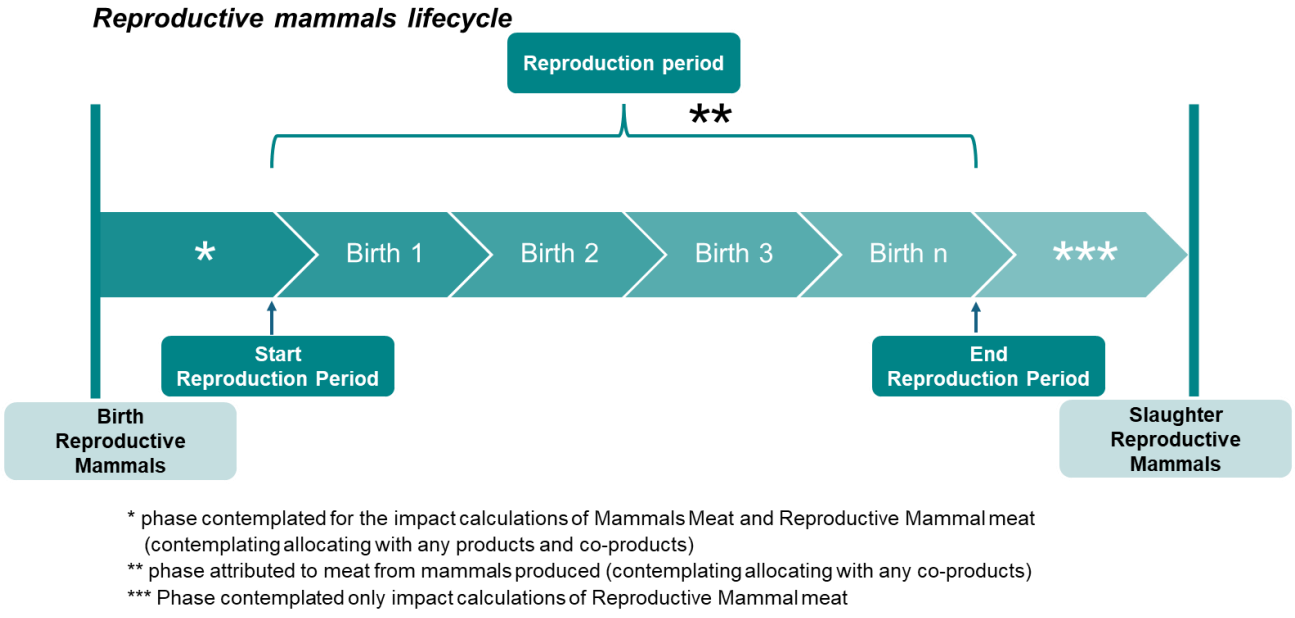

Figure 3. The life cycle of a reproductive mammal.

B. Meat from mammals in systems dedicated solely to meat production (e.g., cattle meat)

In this case, the mammal is the object of meat transformation processing and the environmental burdens to considered are as follows (see also

Figure 3):

- Environmental burdens of the reproductive mammal's lifecycle before entering in the reproduction phase; in this case, the environmental burdens shall be allocated on the biophysical basis to the meat products generated during the entire life cycle of the reproductive mammal products (i.e., generated mammals' meat and reproductive mammal's meat).
- Environmental burdens of the reproductive mammal life cycle phase dedicated to the reproduction and nurturing of mammals, considering the total amount of produced meat (from the generated mammals and the reproductive mammal itself) following the biophysical allocation approach.

See Appendix I for a calculation example for co-products allocation of reproductive mammals.

Co-product allocation for slaughterhouse activities

The possible co-products of slaughterhouse activities are quite different in meat production systems (e.g., meat, leather, fat, etc.) and may vary from one species to another. Mass allocation is problematic as the outputs (in terms of mass) are not linearly related to the mass of inputs. Therefore, the allocation method to apply under this PCR is economic allocation[15].

The environmental burden for each meat product and co-product that exit the slaughterhouse shall be evaluated using their average economic value, considering the economic values over the last three years, with annual verification of updates; these values shall be reported in the LCA report, along with a description of sources and main hypotheses done for the calculation. Data on slaughterhouse activities shall be specific for the animal species under study. Key assumptions shall be documented.

The following are the main products and co-products exiting the slaughterhouse plant that shall be allocated with co-product allocation (economic allocation according to the above paragraph):

- Fresh meat and products suitable for human consumption
- Hides and skins, sold to leather industry
- Products sold for rendering (e.g., fat)

[15] Economic allocation is also suggested by the CMWG Guidelines, Appendix 8 Meat Processing.

In addition, the following items exit the slaughterhouse for incineration, energy recovery or compost shall be allocated as waste (see Section 4.6.2):

- Specified risk material (e.g., skull, spinal cord, etc., sent to incineration)
- Products not suitable for human consumption (sent to recovery/energy plants)
- Products to compost (co-products, sent to recovery)

4.6.1.5 Fresh eggs in shell

Following the LEAP guidelines (FAO 2016)[16], allocation method based on economic value shall be used for eggs production where spent birds for slaughter and manure are produced as co-products. Note that manure is considered as a co-product if it is a valuable output from the farm, e.g., it can be sold as fertiliser or as fuel in a nearby power plant. For each product, an average economic value over the last three years shall be used, with annual verification of updates. The prices and the description of the sources of price shall be provided for the EPD verification along with any assumptions made.

For manure that is considered as residual or waste, see allocation rules in Section 4.6.2.

Table 7. Allocation method for fresh eggs in shell.

Process	Main product and co-products	Allocation method
Egg production	Eggs, spent birds for slaughter and manure	Economic allocation based on average prices of the products over three years period.

4.6.1.6 Meat of poultry

Mass-based allocation shall be used for poultry meat processing[17].

In commercial processing of poultry, edible products have different functions and markets compared to the co-products not edible by humans. If any rendering treatment happens within the slaughterhouse, it shall be considered.

It is recommended to use primary, product-specific data to calculate the mass allocation factors. If this is not feasible, the default values in Table 8 may be used.

[16] https://www.fao.org/partnerships/leap/resources/publications/en

[17] This was chosen instead of economic allocation, as economic values of products and co-products of poultry meat processing plants may change significantly as a function of time or due to circumstantial market events (e.g., avian influenza).

Table 8. Default allocation factors for poultry meat processing (edible and inedible).

Main products and co-products	Allocation factors
Meat	61.2%
Skin with fat	9.9%
Feet	2.8%
Head	1.6%
Liver	1.0%
Heart	0.5%
Gizzard	0.7%
Bones	10.7%
Gastrointestinal tract (abdominal fat, lungs, trachea, kidneys)	3.2%
Feathers	2.9%
Blood	3.5%
Loss (body weight loss during post slaughter processing and dissection)	2.2%

4.6.1.7 Fish products, including caviar and caviar substitutes

If allocation cannot be avoided through sub-division, the environmental burden of preparation of fish products shall follow the allocation method in Table 9.

Table 9. Allocation method for preparation of fish products, including caviar and caviar substitutes.

Process	Main product and co-products	Allocation method
Preparation, all steps of preparation between live fish and consumption	Main product: Live fish; Fish, fish fillets and fish meat (including minced): fresh, chilled, or frozen; or Fish, fish fillet and fish meat, smoked or salted: fresh, chilled or frozen or caviar or caviar substitute Co-products: liver and other co-products not intended for human consumption, e.g., head and gutted used like ingredients for pet food or feed for other food producing animals	Economic allocation based on market prices of the different fractions. If data on prices are not available, environmental burdens shall be fully allocated to the main product.

4.6.1.8 Virgin olive oils

If allocation cannot be avoided through sub-division, the allocation method shown in Table 10 shall be used for virgin olive oil production.

Table 10. Allocation method for virgin olive oils.

Process	Main product and co-products	Allocation method
Cultivation of olive trees	Olives, and wood produced by pruning, tree renovation or end of trees life	Allocation based on economic value
Production of olive and olive oil	Olive and different grades or qualities of virgin olive oil (such as organic/non-organic, or virgin olive oil/extra virgin oil/estrissimo virgin oil)	Allocation based on product volume or mass

Production of olive oil	Olive oil, pomace, Olive pits or stones	Allocation based on economic value

4.6.1.9 Other food production processes

Table 11 shows allocation methods for food production processes not covered in above subsections.

Table 11. Allocation method for food processing and other food products.

Process	Main product and co-products	Allocation method
Grain mill production	Grain mill products, co-product(s)	Allocation based on mass
Sauce production	Sauce product, co-product(s)	Allocation based on mass
Refined sugar production	Refined sugar, pulp, molasses, bagasses, and other co-products	Allocation based on the percentage of sucrose content in the products
Bakery production	Bakery products, co-products	Allocation based on mass
Pasta production	Pasta products, co-products	Allocation based on mass
Food processing for prepared and preserved vegetable and fruit	Food product, co-products	Allocation based on mass

4.6.1.10 Feed production

Animal feeding are relevant processes for food such as dairy, eggs and meat products. Feed products are normally co-products from grains and vegetable crops, or co-products from food processing process. Allocation of feed product is therefore presented separately in this section. See Table 12 for the allocation method that shall be applied.

Table 12. Allocation method for feed production.

Process	Main product and co-products	Allocation method
Feed as co-products from a crop	Crop itself and its co-products	If primary data are collected for feed ingredients, economic allocation shall be done according to the procedure described in Section 4.6.1.1.
Feed mill operations, i.e., compound feed production	For example, flour and middlings	If average feed mill data is available, mass allocation shall be used (average consumption per kg of feed produced).
Processing of feed ingredients	For example, oil and oilseed cake	If primary data are collected for feed ingredients, economic allocation shall be done according to LEAP feed guidelines (FAO 2016).

4.6.1.11 Coffee

In coffee production, the cultivation of green coffee[18] can produce several co-products. In this section, allocation for inputs and outputs including emissions are provided.

For polyculture plantation where coffee and other cash crops are involved, the following allocation hierarchy shall be followed:

[18] Green coffee refers to the raw beans of the coffee plant.

1. Divide the process into sub-processes by obtaining the primary data on, e.g., fertilisers used for coffee and for the other cash crop. In the case of manure, "production" is allocated 100% to the animal with transport, storage and on farm handling all to be allocated to the coffee production.
2. If it is not possible to collect data on the quantities of fertilisers for all crops in the studied product system, farmers should be encouraged to at least estimate the fertiliser use data on coffee. They will know how many coffee trees they have and should also be aware of roughly how much fertiliser they use for each tree, as these fertilisers are applied manually in a ring around the tree stem.
3. If the above are not feasible, the default value tables for nitrogen uptake shown in Appendix II and the example in Appendix III shall be used. However, if practitioners have other literature sources which are of higher quality or have more representative data for the individual coffee involved than the default value tables provided, these data sources should be used.
4. Use economic allocation.

Where the cash crop is not included in the table or there is more than one cash crop, 100% shall be allocated to the coffee.

4.6.1.12 Tea

Tea is generally grown in monoculture plantations, sometimes with other plants around the perimeter of the fields to reduce erosion. There are no valuable co-products created in monoculture tea plantations or processing. Ingredients used to flavoured tea, or for herbal and fruit infusions, may be grown in either monoculture or polyculture. In the case of monoculture plantations, the problem of allocation does not occur and consequently all consumption and emissions of the plantation are related to a single product. For polycultures, the allocation method in Table 13 shall be used.

Table 13. Allocation method for tea.

Process	Main product and co-products	Allocation method
Polyculture tea plantations	Tea leaves, herbs and fruit grown for use in tea and HFI[19] or other products	1. Crops specific data for all inputs and outputs shall be used to avoid allocation. 2. If crop specific data is not available, published uptake values for fertiliser, irrigation, pesticides, and herbicides shall be used for each crop type. Example of published values are those from USDA's crop nutrient tool[20]. 3. If published values are not available for relevant to the geographical location of the plantations, allocation based on economic values averaged over the previous three-year period shall be used.
Process of HFI ingredients – when no subdivision or physical allocation is possible	Processed herbs and fruit ready for tea or HFI, co-products	Allocation based on economic value of the products in the intended market, averaged over three years.

4.6.1.13 Other beverage products

If allocation cannot be avoided through sub-division, the environmental burden of production processes for other beverage products shall follow the allocation methods in Table 14.

Table 14. Allocation method for beverage product other than coffee and tea.

Process	Main product and co-products	Allocation method
Food processing for juice, plant-based milk	Juice/plant-based milk	Allocation based on mass

[19] Herbal and fruit infusions

[20] United States Department of Agriculture (2018)

Wine, grape production	Must, pomace and stems	Allocation based on mass.
Wine making	Wine and lees	Allocation based on mass.
Wine production, when the weight of co-products is unknown.	Wine, pomace, stems and lees	Apply typical allocation factors of 80% for wine, 15% for pomace, 4% for stems and 1% for lees
Soft drink	Soft drink, co-products	Allocation based on volume

4.6.2 ALLOCATION OF WASTE

See Section A.4.2 of the GPI.

As a reminder, waste is a "substance or object which the holder discards or intends or is required to discard" (definition from EN 15804). A further clarification is that waste, if eventually used for a specific purpose, requires processing to cease being waste and thus leave the product system.

In addition, when manure from farming system is considered as waste, it results in a clean separation of the system where all post-farm emissions from use of the manure are assigned to that use, while all on-farm management is assigned to the animal product(s) from the farm (birds, eggs, etc.). Thus, when manure is disposed to a landfill or to incineration without energy recovery, or sent to another waste treatment facility, all the emissions associated with on-farm manure management are assigned to product from the farm at the farm gate. Emissions associated with the final disposal of litter are considered within the system boundary too and shall be accounted for and assigned to the animal product(s).

Note that according to the LEAP guidance (FAO 2016) [21], manure should, as the default approach, be considered as residual at the farmgate. However, in this PCR, the allocation method will depend on whether manure is a co-product or waste.

4.7 DATA AND DATA QUALITY RULES

See Section A.5 of the GPI.

See Section 4.8 for further rules related to data and data quality per life-cycle stage and module D.

4.7.1 DATA CATEGORIES

See Section A.5.1 of the GPI.

4.7.2 DATA QUALITY REQUIREMENTS FOR PRIMARY DATA

See Section A.5.2 of the GPI.

4.7.3 DATA QUALITY REQUIREMENTS FOR REPRESENTATIVE SECONDARY DATA

See Section A.5.3 of the GPI.

4.7.4 DATA QUALITY ASSESSMENT AND DECLARATION

See Section A.5.4 of the GPI.

4.7.5 EXAMPLES OF DATABASES FOR SECONDARY DATA

This PCR does not list any examples of databases to be used for secondary data.

[21] LEAP Guidelines | Livestock Environmental Assessment and Performance (LEAP) Partnership | Food and Agriculture Organization of the United Nations https://www.fao.org/partnerships/leap/resources/publications/fao-leap-guidelines/en

4.8 OTHER LCA RULES

See Section A.6 of the GPI.

For specific LCA rules per life-cycle stage, see Section 4.9.

4.8.1 MASS BALANCE

See Section A.6.1 of the GPI.

4.8.2 ELECTRICITY MODELLING

See Section A.6.2 of the GPI.

The following requirement for contractual instruments in the GPI may not be possible to comply with in all markets for contractual instruments: "the contractual instrument shall … be valid for at least the upcoming six months from the publication of the EPD." Therefore, it is replaced with the following: "is produced as close as possible to the period to which the contractual instrument is applied and comprises a corresponding timespan."

4.8.3 BIOGAS MODELLING

See Section A.6.3 of the GPI.

4.9 SPECIFIC RULES PER LIFE-CYCLE STAGE AND MODULE D

See Section A.7 of the GPI.

Additionally, for accounting of emissions from use of fertilisers and pesticides, site-specific or region-specific data shall be used. If there are no site or region-specific data available, emissions due to fertilisers and pesticides use shall be calculated according to the rules presented in Section 4.9.1 to 4.9.6. The emissions and references for their emission factors are summarised in Table 5.

Table 15. Farm emissions from fertilisers, land use, land transformation and pesticides, sections in which the emission factors can be found, and the sources of the emission factors

	Emission	Section	Reference
Emissions to air	NH_3, NOx emission	4.9.1	IPCC (2019)[22]
	N_2O (direct and indirect emissions)	4.9.2	Zampori and Pant (2019)[23]
	CH_4 (direct emissions)	4.9.3	IPCC (2019)[24]
Emissions to water	Nitrates	4.9.4	IPCC (2019)[22]
	Phosphorus	4.9.5	Zampori and Pant (2019)[23]
Emissions to soil	Pesticides	4.9.6	

4.9.1 NH_3 AND NO_X EMISSIONS

If no site or region-specific data are available, ammonia volatilized shall be estimated using the emission factors from IPCC (2019), see Table 16.

[22] IPCC (2019) Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories; N_2O emissions from managed soils, and CO_2 emissions from lime and urea application table A7-3 (updated).

[23] Zampori L, Pant R, 2019. Suggestions for updating the Product Environmental Footprint (PEF) method. Luxembourg, Publications Office of the European Union. JRC115959 / EUR 29682 EN. DOI: 10.2760/424613. https://ec.europa.eu/jrc/en/publication/suggestions-updating-product-environmental-footprint-pef-method.

[24] IPCC (2019) Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 5.5.

Table 16. Total NH_3 emissions from cultures due to fertiliser volatilization: values are kg NH_3-N volatilized per kg of N in fertilisers applied, Total NOx emissions from cultures due to fertiliser volatilization: values are kg NOx-N volatilized per kg of N in fertilisers applied.

Fertilisers type	Emission factor for NH_3	Emission factor for NOx	Total N volatilised [$Frac_{GASF}$]
Ammonium nitrate (AN)	0.030	0.029	0.059
Anhydrous ammonia (AA)	0.029	0.001	0.03
Diammonium phosphate (DAP)	0.091	0.007	0.098
Monoammonium phosphate (MAP)	0.053	0.007	0.06
Ammonium sulphate (AS)	0.095	0.007	0.102
Calcium ammonium nitrate (CAN)	0.016	0.016	0.032
Sodium nitrate	0.002	0.001	0.003
Urea	0.142	0.011	0.153
Animal manure[25]	0.210	0.005	0.215

For fertilisers not covered in Table 16, the mix in Table 17 shall be used unless primary data is available.[26]

Table 17. Default assumption for the mix of different fertilisers products not covered in Table 16Table .

Fertiliser product	Fertiliser mix
Nitrogen solutions	Urea (50%), AN (25%), CAN (25%)
Other N straight	AN (50%), CAN (50%)
Other NP (N)	AN (50%), CAN (50%)
AP	MAP (50%), DAP (50%)
N K compound (N)	Sodium Nitrate
N P K compound (N)	AN (50%), CAN (50%)
Where AN = Ammonium nitrate, CAN = calcium ammonium nitrate AS = ammonium sulphate, AP = ammonium phosphate, MAP = monoammonium phosphate and DAP = diammonium phosphate.	

4.9.2 DIRECT AND INDIRECT EMISSIONS OF N_2O

If site or region-specific primary data are not available, direct and indirect N_2O emissions shall be estimated using the Tier 2 methodology provided by IPCC (2019) according to the following equations and the emission factors in Table 18:

$$N_2O_{Total} = (N_2O_{Direct} - N + N_2O_{(ATD)} - N + N_2O_{(L)} - N) \times 44/28$$

$$N_2O_{Direct} - N = F_{SN} \times EF_1$$

$$N_2O_{(ATD)} - N = (F_{SN} \times Frac_{GASF}) \times EF_4$$

$$N_2O_{(L)} - N = (F_{SN} \times Frac_{LEACH-(H)}) \times EF_{5rig}$$

F_{SN} = annual amount of synthetic fertiliser N applied to soils, kg N yr-1

EF_1 = emission factor for N_2O emissions from N inputs, kg N_2O – N (kg N input)$^{-1}$ [27]

$Frac_{GASF}$ = fraction of synthetic fertiliser N that volatilises as NH_3 and NOx, kg N volatilised (kg of N applied)$^{-1}$

[25] IPCC (2019) Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories 11.3 (updated).

[26] IPCC (2019) Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories A7-2 (updated).

[27] Table 11.1 in Chapter 11 of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

EF_4 = emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces, [kg N – N_2O (kg NH_3 – N + NOx – N volatilised)-1][28]

$Frac_{LEACH-(H)}$ = fraction of all N added to/mineralised in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff, kg N (kg of N additions)$^{-1}$ [29]

EF_5 = emission factor for N_2O emissions from N leaching and runoff, kg N_2O – N (kg N leached and runoff)$^{-1}$

Table 18. Default data for indirect emissions of N_2O in case primary data is not used.

Factor	Emission factor For N_2O
EF_1 for N additions from synthetic fertilisers, organic amendments and crop residues, and N mineralised from mineral soil as a result of loss of soil carbon [kg N2O – N (kg N)$^{-1}$]	0.010
EF_4 [N volatilisation and re-deposition], kg N2O – N (kg NH3 – N + NOx – N volatilised)$^{-1}$	0.010
EF_5 [leaching/runoff], kg N2O – N (kg N leaching/runoff)$^{-1}$	0.011
$Frac_{GASF}$ [Volatilisation from synthetic fertiliser], (kg NH3 – N + NOx – N) (kg N applied)$^{-1}$	See Table 16 and Table 17
$Frac_{LEACH-(H)}$ [N losses by leaching/runoff in wet climates], kg N (kg N additions or deposition by grazing animals)$^{-1}$	0.24

4.9.3 DIRECT EMISSIONS OF CH_4 FROM PADDY WATER

If no primary data on direct emissions from paddy water are available, the emission shall be estimated using the IPCC (2019)[30].

4.9.4 EMISSION OF NITRATES

If no site- or region-specific data are available, emissions from nitrates leaching and runoff shall be estimated using the emission factor from IPCC (2019): the total NO_3 emissions due to leaching and runoff is 0.24 kg NO_3-N per kg of N in fertilisers applied.

4.9.5 EMISSION OF PHOSPHORUS

If no site- or region-specific data are available, phosphorus emissions shall be estimated using the emission factor reported in Table B.16 of Zampori and Pant (2019): 0.05 kg of P emitted to water per each kg of P based fertilisers applied. Alternatively, more detailed modelling based on the SALCA-P method (Prasuhn 2006) may be used if sufficiently robust and justified agronomic data are available. If the SALCA-P method is used, the detailed method shall be fully documented in the LCA report.

Alternative method for phosphorus emissions

Three different kinds of phosphorus emission to water are distinguished:

- leaching of soluble phosphate to ground water (inventoried as “phosphate, to ground water”), see Equation ,
- run-off of soluble phosphate to surface water (inventoried as “phosphate, to river”), see Equation , and
- erosion of soil particles containing phosphorus (inventoried as “phosphorus, to river”).

Phosphorus leaching to the ground water shall be estimated as an average leaching, corrected by phosphorus fertilization:

Equation 4. Calculation of phosphorus leached to ground water: $Pgw = Pgwl * Fg$

[28] Table 11.3 in Chapter 11 of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

[29] Table 11.3 in Chapter 11 of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

[30] IPCC (2019) Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 5.5.

where:

Pgw = quantity of phosphorus leached to ground water (kg/ha)

Pgwl = average quantity of P leached to ground water for a land use category (0.07 kg P/ha assumed equivalent to the factor for arable land)

Fgw = correction factor for fertilization with slurry.

$$Fgw = 1 + 0.2/80 * P_2O_{5sl}$$

P_2O_5sl = quantity of P_2O_5 applied

Run-off to surface waters shall be calculated in a similar way to leaching to ground water:

Equation 5. Calculation of phousphorus lost though run-off: $Pro = Prol * Fro$

where:

Pro = quantity of phosphorus lost through run-off to rivers (kg/ha)

Prol = average quantity of P lost through run-off to rivers for a land use category (0.175 kg P/ha assumed equivalent to the factor for arable land)

Fro = correction factor for fertilization with phosphorus.

The correction factor for fertilization with phosphorus (Fro) is calculated as:

$$Fro = 1 + 0.2/80 * P_2O_{5min} + 0.7/80 * P_2O_{5sl} + 0.4/80 * P_2O_{5man}$$

where:

P_2O_{5min} = quantity of P_2O_5 applied with mineral fertilisers (kg/ha)

P_2O_{5sl} = quantity of P_2O_5 applied with slurry (kg/ha)

P_2O_{5man} = quantity of P_2O_5 applied with solid manure (kg/ha)

Phosphorus emissions through erosion to surface waters, if there is no more accurate information available, may be estimated using the default value 0.53 kg P/ha, derived from an elaboration made using the SALCA-P model (considering 1.5 $t*ha^{-1}*yr^{-1}$ of eroded soil)[31].

4.9.6 ACTIVE SUBSTANCE OF PESTICIDES

To calculate the impact of pesticides production, the content in active substance of the specific products shall be considered.

As default approach, if no site- or region-specific data are available, the pesticides applied on the field, with primary data on the active ingredient in the pesticide available, shall be modelled as 90% emitted to the agricultural soil compartment, 9% emitted to air and 1% emitted to water[32]. However, if no primary data on the active ingredient in the pesticide is available, it is not possible to know its volatile components. In this case, since the emissions to air cannot be modelled, it shall be assumed that all pesticides applied are 100% emitted to agricultural soil[33].

Emissions assumptions shall be declared in the EPD and justified in the LCA report, including documentations of emissions factors, data sources and calculation methods.

[31] SALCA's Own Emission and Impact Assessment Models. available at: https://www.agroscope.admin.ch/agroscope/en/home/topics/environment-resources/life-cycle-assessment/salca-method/emission-impact-assessment-models.html

[32] In Paragraph *4.4.1.4 Pesticides, Directorate-General for Environment. (2021). Annexes 1 to 2*, available at: https://environment.ec.europa.eu/publications/recommendation-use-environmental-footprint-methods_en

[33] The approach as in the most used LCA databases (e.g., Ecoinvent, World Food LCA database), also reviewed and reported in scientific papers (Nemecek, T., Antón, A., Basset-Mens, C. et al. Operationalising emission and toxicity modelling of pesticides in LCA: the OLCA-Pest project contribution. Int J Life Cycle Assess 27, 527–542 (2022). https://doi.org/10.1007/s11367-022-02048-7 and scientific reports (OLCA-Pest project, https://backend.orbit.dtu.dk/ws/portalfiles/portal/337036593/OLCA-Pest_FinalReport_Public.pdf).

4.10 ENVIRONMENTAL PERFORMANCE INDICATORS

See Section A.8 of the GPI.

Biogenic carbon sequestration should be considered not only in the product but also in the production process and shall be balanced out with virtual emission in module C. Please see the Appendix IV for Guidance on the Calculations of Biogenic Carbon for perennial species (e.g., orchards, grassland, or pasture production). The Appendix IV shall not be used for annual crops.

The following additional resource use indicator in accordance with the impact assessment methods and characterization factors of EN 15804 shall be reported in the EPD:

- Net use of fresh water (m^3)

This indicator is considered relevant as in many cases, higher agricultural yields are associated with increased water consumption. Furthermore, due to the high uncertainty in water deprivation modelling, reporting the net use of fresh water can help to better interpret the results and characteristics of the production system under study.

The EPD should include additional environmental performance indicators as listed below (using the impact assessment methods and characterization factors of EF 3.1 package). The reporting of additional environmental indicators is recommended due to the significant increase in the use of herbicides, fungicides, and insecticides in agricultural production over the past fifty years. These indicators, when considered together, provide a more comprehensive understanding of the environmental impacts associated with different production systems (e.g., conventional vs. organic).

- Eco-toxicity - freshwater (ETP-fw)
- Human toxicity, cancer effect (HTP-c)
- Human toxicity, non-cancer effects (HTP-nc)
- Land use related impacts: Soil quality Index (SQI)

4.11 SPECIFIC RULES PER EPD TYPE

4.11.1 MULTIPLE PRODUCTS FROM THE SAME COMPANY

See Section A.9.1 of the GPI.

4.11.2 SECTOR EPD

See Section A.9.2 of the GPI.

4.11.3 EPD OWNED BY A TRADER

See Section A.9.3 of the GPI.

4.11.4 EPD OF PRODUCT NOT YET ON THE MARKET

See Section A.9.4 of the GPI.

4.11.5 EPD OF PRODUCT RECENTLY ON THE MARKET

See Section A.9.5 of the GPI.

5 CONTENT OF LCA REPORT

Data for verification shall be presented in the form of an LCA report – a systematic and comprehensive summary of the project documentation that supports the verification of an EPD. The LCA report is not part of the public communication.

See Section 8.3.1 of the GPI for rules on the content of the LCA report.

Note that there may be rules on the content of the LCA report elsewhere in the GPI or in this PCR.

6 CONTENT AND FORMAT OF EPD

See Section 7 of the GPI.

6.1 EPD LANGUAGES

See Section 7.1 of the GPI.

6.2 UNITS AND QUANTITIES

See Section 7.2 of the GPI.

6.3 USE OF IMAGES IN EPD

See Section 7.3 of the GPI.

6.4 SECTIONS OF THE EPD

See Section 7.4 of the GPI.

6.4.1 COVER PAGE

See Section 7.4.1 of the GPI.

6.4.2 GENERAL INFORMATION

See Section 7.4.2 of the GPI.

6.4.3 INFORMATION ABOUT EPD OWNER

See Section 7.4.3 of the GPI.

6.4.4 PRODUCT INFORMATION

See Section 4.2 of this PCR and Section 7.4.4 of the GPI.

6.4.5 CONTENT DECLARATION

See Section 7.4.5 of the GPI. Note that information about recycled materials in the product is not applicable for this product category.

6.4.6 LCA INFORMATION

See Section 7.4.6 of the GPI.

6.4.7 ENVIRONMENTAL PERFORMANCE

See Section 7.4.7 of the GPI.

The EPD shall declare the environmental performance indicators listed or referred to in Section 4.10 and should declare additional environmental performance indicators listed in Section 4.10, per declared unit and per life-cycle stage.

Specific c-PCR may set further requirements for the product category.

6.4.8 ADDITIONAL ENVIRONMENTAL INFORMATION

See Section 7.4.8 of the GPI.

6.4.9 ADDITIONAL SOCIAL AND ECONOMIC INFORMATION

See Section 7.4.9 of the GPI.

6.4.10 INFORMATION RELATED TO SECTOR EPDS

See Section 7.4.10 of the GPI.

6.4.11 VERSION HISTORY

See Section 7.4.11 of the GPI.

6.4.12 ABBREVIATIONS

See Section 7.4.12 of the GPI.

6.4.13 REFERENCES

See Section 7.4.13 of the GPI.

7 LIST OF ABBREVIATIONS

CPC	Central product classification
EPD	Environmental product declaration
GPI	General Programme Instructions
ISO	International Organization for Standardization
LCA	Life cycle assessment
PCR	Product category rules
UN	United Nations
CMWG	Cattle Model Working Group
AFOLU	Agriculture, Forestry and Other Land Use
AB	Above-ground biomass
BB	Below-ground biomass
DW	Deadwood
LI	Litter
SO	Soils
GWP	Global Warming Potential
LULUC	Land Use and Land-Use Change
HWP	Harvested Wood Products
ETP-fw	Eco-toxicity - freshwater
HTP-c	Human toxicity, cancer effect
HTP-nc	Human toxicity, non-cancer effects
SQI	Land use related impacts: Soil quality Index

8 REFERENCES

Ambiente Italia S.r.l. (2018). Life-cycle assessment (LCA) of the Monini Extra Virgin Olive Oil.

Azapagic, A., Bore, J., Cheserek, B., Kamunya, S., & Elbehri, A. (2015). A life cycle assessment of Kenyan tea. In Kenya's tea sector under climate change: An impact assessment and formulation of a climate-smart strategy (pp. 63–80).

Casolani, N., D'Eusanio, M., Liberatore, L., Raggi, A., & Petti, L. (2022). Life Cycle Assessment in the wine sector: A review on inventory phase. Journal of Cleaner Production, 379, 134404. https://doi.org/https://doi.org/10.1016/j.jclepro.2022.134404

CEN (2021) EN 15804:2012+A2:2019/AC:2021, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.

CESISP, 2014. The Water Footprint, Ecological Footprint and Carbon Footprint of vegetal products - Conserve Italia soc. coop. agr.

CESISP, 2018. Life Cycle Assessment of fruit and vegetable products - EPD PROCESS - Conserve Italia soc. coop. agr.

Chauhan, M. K., Varun, Chaudhary, S., Kumar, S., & Samar. (2011). Life cycle assessment of sugar industry: A review. Renewable and Sustainable Energy Reviews, 15(7), 3445-3453. https://doi.org/https://doi.org/10.1016/j.rser.2011.04.033

Cichorowski, G., Joa, B., Hottenroth, H., & Schmidt, M. (2015). Scenario analysis of life cycle greenhouse gas emissions of Darjeeling tea. The International Journal of Life Cycle Assessment, 20. https://doi.org/10.1007/s11367-014-0840-0

Comité Européen des Fabricants de Sucre (CEFS). (2014). A life cycle assessment of beet sugar in the European Union: Summary.

Davies, R. W. D., Cripps, S. J., Nickson, A., & Porter, G. (2009). Defining and estimating global marine fisheries bycatch. Marine Policy, 33(4), 661–672. https://doi.org/10.1016/j.marpol.2009.01.003

Del Borghi, A., Gallo, M., Strazza, C., & Del Borghi, M. (2014). An evaluation of environmental sustainability in the food industry through life cycle assessment: The case study of tomato products supply chain. Journal of Cleaner Production, 78, 121–130. https://doi.org/10.1016/j.jclepro.2014.04.083

Del Borghi, A., Strazza, C., Magrassi, F., Taramasso, A. C., & Gallo, M. (2018). Life cycle assessment for eco-design of product-package systems in the food industry: The case of legumes. Sustainable Production and Consumption, 13, 24–36. https://doi.org/10.1016/j.spc.2017.11.001

Del Borghi, A., Tacchino, V., Moreschi, L., Matarazzo, A., Gallo, M., & Arellano Vazquez, D. (2022). Environmental assessment of vegetable crops towards the water-energy-food nexus: A combination of precision agriculture and life cycle assessment. Ecological Indicators, 140, Article 109015. https://doi.org/10.1016/j.ecolind.2022.109015

Doublet, G., & Jungbluth, N. (2010). Life cycle assessment of drinking Darjeeling tea (Report Version 1.0). ESU-services Ltd. https://www.esu-services.ch

EN 60661:2014-05. Methods for measuring the performance of electric household coffee makers. CENELEC.

EPD International (2025) General Programme Instructions for the International EPD System. Version 5.0.1, dated 2025-02-27. Available on www.environdec.com.

EPD International Environmental Product Declarations published in EPD international by Assomela-Italian association of Producer Organizations

EPD International Environmental Product Declarations published in EPD international by Italia Zuccheri

EPD International, Environmental Product Declarations published in EPD International by Barilla G. e R. Fratelli

EPD international, Environmental Product Declarations published in EPD International by COOP Italia

EPD international, Environmental Product Declarations published in EPD International by INALCA S.P.A.

EPD International, Environmental Product Declarations published in the EPD International by Granarolo S.p.A.

European Commission (EC). (2021). Recommendation on the use of Environmental Footprint methods: Annexes 1 to 2. https://environment.ec.europa.eu/publications/recommendation-use-environmental-footprint-methods_en

European Environment Agency (EEA). (2002). EMEP/CORINAIR Emissio Inventory Guidebook (3rd edition). https://www.eea.europa.eu/en/analysis/publications/emepcorinair3

FAO (2016) Environmental performance of animal feeds supply chains: Guidelines for assessment. Livestock Environmental Assessment and Performance Partnership.

FAO. (2007). Meat processing technology for small to medium scale producers, RAP publication 2007/20, for the definition of the product category. https://openknowledge.fao.org/server/api/core/bitstreams/4cfabbd3-16aa-47f8-ac6f-b54a48cb8abd/content

FAO. (2014a). Greenhouse gas emissions and fossil energy demand from poultry supply chains. http://www.fao.org/3/amj752e.pdf.

FAO. (2016). Greenhouse gas emissions and fossil energy use from poultry supply chains: Guidelines for assessment. Livestock Environmental Assessment and Performance Partnership. FAO, Rome, Italy.

Ferrara, C., & De Feo, G. (2018). Life Cycle Assessment Application to the Wine Sector: A Critical Review. Sustainability, 10(2), 395. https://doi.org/10.3390/su10020395

Flisch, R., Sinaj, S., Charles, R. & Richner, W. (2009). GRUDAF 2009 - Grundlagen für die Düngung im Acker und Futterbau. Agrarforschung 16 (2), 1-97.

Ford, J., Pelletier, N., Ziegler, F., Scholz, A., Tyedmers, P., Sonesson, U., Kruse, S., & Silverman, H. (2012). Proposed Local Ecological Impact Categories and Indicators for Life Cycle Assessment of Aquaculture A Salmon Aquaculture Case Study. Journal of Industrial Ecology, 16(2), 254–265. https://doi.org/10.1111/j.1530-9290.2011.00410.x

Frischknecht, R., Steiner, R., & Jungbluth, N. (2009). The Ecological Scarcity Method – EcoFactors (2006b): A method for impact assessment in LCA. Federal Office for the Environment FOEN: Zürich und Bern.

Iannone, R., Miranda, S., Riemma, S., & De Marco, I. (2014). Life cycle assessment of red and white wines production in Southern Italy. Chemical Engineering Transactions, 39, 595–600. https://doi.org/10.3303/CET1439100

International Dairy Federation (IDF). (2015) A common carbon footprint approach for dairy. The IDF guide to standard lifecycle and assessment methodology for the dairy sector.

International Dairy Federation (IDF). (2015). A common carbon footprint approach for the dairy sector: The IDF guide to standard life cycle assessment methodology (Bulletin of the International Dairy Federation No. 479/2015).

IPCC (2019) Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html

ISO (2006a) ISO 14025:2006, Environmental labels and declarations – Type III environmental declarations – Principles and procedures.

ISO (2006b) ISO 14040:2006, Environmental management – Life cycle assessment – Principles and framework.

ISO (2006c) ISO 14044: 2006, Environmental management – Life cycle assessment – Requirements and guidelines.

ISO (2015a) ISO 14001:2015, Environmental management systems – Requirements with guidance for use.

ISO (2015b) ISO 9001:2015, Quality management systems – Requirements.

ISO (2017) ISO 21930:2017, Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.

ISO (2018b) ISO/TS 14067:2018, Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification and communication.

ISO 14067:2018; Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification

Joumri, L., Labjar, N., Dalimi, M., Harti, S., Dhiba, D., Messaoudi, N., Bonnefille, S., & Hajjaji, S. (2023). Life cycle assessment (LCA) in the olive oil value chain: A descriptive review. Environmental Development, 45, 100800. https://doi.org/10.1016/j.envdev.2022.100800

JRC, & European Commission. (2015). Baseline Approaches for the Cross-Cutting Issues of the Cattle Related Product Environmental Footprint Pilots in the Context of the Pilot Phase.

Justel-Rubio, A., & Restrepo, V. (2017). Computing a global bycatch Rate of non-target species in tropical tuna purse seine fisheries. ISSF Technical Report 2017-01. International Seafood Sustainability Foundation, Washington, D.C., USA. https://www.iss-foundation.org/about-issf/what-we-publish/issf-documents/issf-2017-01-computing-a-global-rate-of-non-target-species-catch-bycatch-in-tropical-tuna-purse-seine-fisheries/

Kalhor, T., Rajabipour, A., Akram, A., & Sharifi, M. (2016). Environmental impact assessment of chicken meat production using life cycle assessment. Information Processing in Agriculture, 3(4), 262–271. https://doi.org/10.1016/j.inpa.2016.10.002

Klenk, I., Landquist, B., & Ruiz de Imana, O. (2012). The Product Carbon Footprint of EU Beet Sugar, Comité Européen des Fabricants de Sucre from Sugar Industry Journal, 137 (3), 169 - 177. DOI: https://doi.org/10.36961/si12784

LEAP Guidelines (FAO,2016) https://www.fao.org/partnerships/leap/resources/publications/fao-leap-guidelines/en

Leinonen, I. (2013). Comparing the environmental impacts of alternative protein crops in poultry diets: The consequences of uncertainty, Agricultural Systems, 121, 33–42. https://doi.org/10.1016/j.agsy.2013.06.008

Lo Giudice, V., Faraone, I., Bruno, M. R., et al. (2021). Olive trees by-products as sources of bioactive and other industrially useful compounds: A systematic review. Molecules, 26(16), 5081. https://doi.org/10.3390/molecules26165081

Luigi Lavazza S.p.A. (2014). Carbon footprint of one cup of espresso coffee prepared with the A Modo Mio system. Underlying LCA report, December 10th 2014 (critical review performed by Certiquality).

Maas-van Berkel, B., van den Boogaard, B., & Heijnen, C. (2004). Preservation of Fish and Meat (3rd Edition). Wageningen, the Netherlands. ISBN: 90-72746-01-9

Milà i Canals, L., Romanyà, J., & Cowell, S. J. (2007). Method for assessing impacts on life support functions (LSF) related to the use of 'fertile land' in Life Cycle Assessment (LCA). Journal of Cleaner Production, 15(15), 1426–1440. https://doi.org/10.1016/j.jclepro.2006.05.005.

Munasinghe, M., Deraniyagala, Y., Dassanayake, N., & Karunarathna, H. (2017). Economic, social and environmental impacts and overall sustainability of the tea sector in Sri Lanka. Sustainable Production and Consumption, 12, 155–169. https://doi.org/10.1016/j.spc.2017.07.003

Murawska, D. (2013). Age-related changes in the percentage content of edible and nonedible components in turkeys, Poultry Science, 92(1), 255–264. http://dx.doi.org/ 10.3382/ps.2012-02611

Murray, D. M., Liao, J., Stankovic, L., & Stankovic, V. (2016). Understanding usage patterns of electric kettle and energy saving potential. Applied Energy, 171, 231-242. https://doi.org/https://doi.org/10.1016/j.apenergy.2016.03.038

Murray, D., Liao, J., Stankovic, L., & Stankovic, V. (2015). How to make efficient use of kettles: Understanding usage patterns. In Proceedings of the 8th International Conference on Energy Efficiency in Domestic Appliances and Lighting (EEDAL 2015), Lucerne, Switzerland. https://strathprints.strath.ac.uk/55059/1/Murray_etal_EEDAL2015_How_make_efficient_use_kettles_understanding_usage_patterns.pdf

Nemecek, T., Antón, A., Basset-Mens, C. et al. (2022). Operationalising emission and toxicity modelling of pesticides in LCA: The OLCA-Pest project contribution. International Journal of Life Cycle Assessment, 27, 527–542. https://doi.org/10.1007/s11367-022-02048-7

Nemecek, T., Kagi, T. (2007). Life Cycle Inventories of Agricultural Production Systems (Ecoinvent report No.15). Agroscope Reckenholz Taenikon Research Station ART, Swiss Centre for life cycle inventories.

Neri and Pulsell. (2017). LCA report of wine production of different wines produced by Case Corini. INDACO2.

Neri and Pulselli. (2015). Carbon Footprint of the "Vernaccia di San Gimignano" for the "Consorzio del vino Vernaccia di San Gimignano". INDACO2.

Neri and Pulselli. (2017). LCA report of Prosecco di Valdobbiadene DOCG Ius Naturae and Grande Cuvée del Fondatore for Bortolomiol SpA. INDACO2.

Neri and Pulselli. (2017).LCA report of wine and oil for Fattoria la Maliosa. INDACO2.

Newton, R. W., & Little, D. C. (2018). Mapping the impacts of farmed Scottish salmon from a life cycle perspective. International Journal of Life Cycle Assessment. 23, 1018–1029.

Parker, R. (2012). Review of life cycle assessment research on products derived from fisheries and aquaculture: a report for Seafish as part of the collective action to address greenhouse gas emissions in seafood, Sea Fish Industry Authority.

Philis, G., Ziegler, F., Gansel, L. C., Jansen, M. D., Gracey, E. O., & Stene, A. (2019). Comparing life cycle assessment (LCA) of salmonid aquaculture production systems: status and perspectives. Sustainability, 11(9), 2517. https://doi.org/10.3390/su11092517

Prasuhn, V. (2006). Erfassung der PO4-Austräge für die Ökobilanzierung - SALCA-Phosphor. Agroscope FAL Reckenholz, Zürich, 22 p., Available at www.agroscope.admin.ch.

Previously published PCRs within the International EPD System on food and beverage products (see Table 2 in Section3.3).

Previously published PEFCRs by European Union on food and beverage products (see Table 2 in Section3.3).

Rapa, M., & Ciano, S. (2022). A review on life cycle assessment of the olive oil production. Sustainability, 14(2), 654. https://doi.org/10.3390/su14020654

Renouf, M., & Wegener, M. (2007). Environmental life cycle assessment (LCA) of sugarcane production and processing in Australia. Proceedings of the Australian Society of Sugar Cane Technologists, 29.

Ruini, L., Marchelli, L., Marino, M., & Filareto, A. (2012). Barilla EPD process system to increase reliability, comparability and communicability of LCA studies. In M. S. Corson & H. M. G. van der Werf (Eds.), Proceedings of the 8th International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2012) (pp. 427–432). INRA.

Russo, C., Tuomisto, H., George, M., Pattara, C., & Polo Palomino, J. A. (2015). PEF screening report in the context of the EU Product Environmental Footprint Category Rules (PEFCR) Olive Oil Pilot. https://doi.org/10.13140/RG.2.1.1052.9361

SALCA's Own Emission and Impact Assessment Models. available at: https://www.agroscope.admin.ch/agroscope/en/home/topics/environment-resources/life-cycle-assessment/salca-method/emission-impact-assessment-models.htm

Seabra, J., Macedo, I., Chum, H., Faroni, C. E., & Sarto, C. (2011). Life cycle assessment of Brazilian sugarcane products: GHG emissions and energy use. Biofuels, Bioproducts and Biorefining, 5, 519-532. https://doi.org/10.1002/bbb.289

Sherry, J., & Koester, J. (2020). Life Cycle Assessment of Aquaculture Stewardship Council Certified Atlantic Salmon (Salmo salar), Sustainability, 12(5), 6079. https://doi.org/10.3390/su12156079

Song, X., Liu, Y., Pettersen, J. B., Brandão, M., Ma, X., & Røberg, S., et al. (2019). Life cycle assessment of recirculating aquaculture systems: a case of atlantic salmon farming in china. Journal of Industrial Ecology. 23(5): 1077-1086. https://doi.org/10.1111/jiec.12845

Studio completo con metodologia LCA per la valutazione dell'impatto ambientale di 3 tipologie di fornitura della bevanda analcolica Pepsicola ai fini della Dichiarazione ambientale di prodotto (Environmental Product Declaration – EPD®)2021 (dati 2019).

Supporting Technical Paper of Double Pyramid. (2016, October 11). Version 7. Retrieved from www.barillacfn.com

Tassielli, G., Namdari, M., Rafiee, S., Aghbashlo, M., Hosseinpour, S., notarnicola, b., & Renzulli, P. (2015). International conference on Life Cycle Assessment as reference methodology for assessing supply chains and supporting global sustainability challenges Stresa Life cycle assessment of sugar production in Hamadan sugar mill.

Tea & Herbal Infusions Europe. (2018). Compendium of Guidelines for Herbal and Fruit Infusions. https://www.teeverband.de/files/bilder/Publikationen/Recht/2018-07-17_Compendium_of_Guidelines_for_Herbal_Infusions_-_ISSUE_6.pdf

Tea & Herbal Infusions Europe. (2018). Compendium of Guidelines for Tea, Issue 5. https://thie-online.eu/files/thie/docs/THIE%20Compendium%20tea.pdf

The European Livestock and Meat Trades Union (UECBV)- Technical Secretariat for the Red Meat Pilot. (2020). Footprint Category Rules Red Meat (version 1.1).

Tran, T., Branca, G., Arslan, A., & Van Mai, T. (2016). Value chain analysis of climate-smart Shan tea production in the northern mountainous region of Vietnam. Italian Review of Agricultural Economics (REA), 71(1), 155–169. https://doi.org/10.13128/REA-18636

United States Department of Agriculture. (2018). Crop Nutrient Tool. Retrieved from USDA Natural Resources Conservation Service - Nutrient Content of Crops. https://plants.usda.gov/npk/main

Van Amstel, A. (2006). IPCC 2006 Guidelines for National Greenhouse Gas Inventories. In 2006 IPCC guidelines for national greenhouse gas inventories (Vol. 1–5). Intergovernmental Panel on Climate Change (IPCC). https://www.ipcc.ch/report/2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/

Zampori, L., & Pant, R. (2019). Suggestions for updating the Product Environmental Footprint (PEF) method (JRC115959 / EUR 29682 EN). Publications Office of the European Union. https://doi.org/10.2760/424613 Previously published PCRs within the International EPD System on food and beverage products (see Table 2 in Section3.3).

9 VERSION HISTORY OF PCR

VERSION 1.0.0, 2025-07-14

Original version of the PCR.

VERSION 1.0.1, 2025-11-06

- Updated the PCR Committee list to include members' names.
- Added the UN CPC code 233 for Preparations used in animal feeding, lucerne (alfalfa) meal and pellets in Table 1 to clarify it is incuded in the scope of the PCR.
- Editorial change in footnote 7 (Section 4.3.1) where "..some or all agricultural operations may be in A3" was corrected to A1 instead of A3.

APPENDIX I: CALCULATION EXAMPLE FOR ALLOCATION OF MEAT FROM REPRODUCTIVE MAMMALS

As a support to the allocation rules described in Section 4.6.1.4, this section provides a calculation example using estimates intended to support the illustration of calculation method in

Figure 3. Note that numbers used in this section are purely indicative.

Before going into details of calculation, base hypotheses are made regarding the overall impacts associated with the life of the animal (data per head and for entire life), as well as the number of useful products in terms of bulk.

The two calculation examples respectively regard:

- the production of meat from the cull dairy cow (reproductive mammal)
- the production of veal meat from surplus calves (mammal)

Table 25. Calculation example - impact of a mammal (per head) for its entire life cycle.[34]

Impact for entire life cycle data per head)	Type of mammal		Acronym	kg CO_2 equivalents per head
	Cow (mammal)		ML	1 350
	Milk and reproduction cow (reproductive animal)	Impact since birth → start reproduction phase	RL1	2 000
		Impact of Reproduction Phase (5 parts)	RL2	15 000
		Impact End of Reproduction phase → Slaughter	RL3	1 000

Table 26. Calculation example – production quantity per head of mammal.

Production quantity (data per head)	Type of mammal	Product	Acronym	Mass value
	Milk cow that produces calves (reproductive mammals)	No. calves born	NB	3 calves during reproduction period (1 calf per cycle)
		Veal sold	RB	50 kg live weight (as new born calves)
		Meat from slaughter of end-of-life dairy cow	RMM	650 kg live weight
		Milk produced	RMK	25 000 litres/cow life cycle

The environmental impact shall be evaluated using the IDF methodology described above and calculating factors AF_{milk} and AF_{meat} reported in the table below.

Table 27. Calculation example - allocation factors for products from reproductive mammals.

Calculation of allocation factor $AF_{milk\,1}$ and $AF_{meat\,1}$ for the phase RL1 (impact since birth → start reproduction phase)	Calculation of allocation factor $AF_{milk\,2}$ and $AF_{meat\,2}$ for the phase RL2 (impact of reproduction phase)
$M_{milk} = 24\,997\ liters$	$M_{milk} = 24\,997\ liters$

[34] PCR 2012:11 Meat of mammals (4.0.1)

$M_{meat\ 1} = 650 + 50 \times 4 = 850\ kg$ (dairy cow + calves)	$M_{meat\ 2} = 50 \times 4 = 200\ kg$ (calves)
$AF_{milk\ 1} = 1 - 6.04 \times \frac{M_{meat}}{M_{milk}}$ = $1 - 6.04 \times \frac{850}{24{,}997}$= 80%	$AF_{milk\ 2} = 1 - 6.04 \times \frac{M_{meat\ 2}}{M_{milk\ 2}}$ = $1 - 6.04 \times \frac{200}{24{,}997}$= 95%
$AF_{meat\ 1} = 1 - 0{,}8$ = 20%	$AF_{meat\ 2} = 1 - 0{,}95$ = 5%

Culled dairy cow meat:

$RL1 * AF_{meat\ 1} + RL3$ = 2 000 x 0,2 + 1 000 = 1 400 kg CO_2 eq.

Total impact (1 400 kg CO_2 eq.) shall be divided by total weight of meat produced from the slaughtering of cull dairy cow (290 kg carcass weight): 4.8 kg CO_2 eq.

Surplus calf (veal) meat:

ML + RL1 x $AF_{meat\ 1}$ + $\frac{RL2 \times AF_{meat\ 2}}{NB}$ = 1 350 + 2 000 x 0,2 + (15 000 x 0,05) / 3 = 2 000 kg CO_2 eq.

Total impact (2 000 kg CO_2 eq.) shall be divided by weight of meat produced from one calf (150 kg carcass weight): 13,3 kg CO_2 eq.

APPENDIX II: ALLOCATION FACTORS FOR GREEN COFFEE

The default values of Table and Table are intended to be used when applying the third option in the allocation-method hierarchy of Section 4.6.1.11, for nitrogen uptake as allocation parameters for Arabica coffee and Robusta coffee, respectively, in intercropping systems.

Table 28. The default values for nitrogen uptake as allocation parameters for Arabica coffee in intercropping systems.

Intercropping system	Coffee (kg N / kg coffee cherry)	Other cash crop (kg N / kg crop)
Arabica Coffee - Avocado*	0.023±0.006	0.003
Arabica Coffee - Banana	0.023±0.006	0.006
Arabica Coffee - Bean (green)	0.023±0.006	0.008
Arabica Coffee - Citrus*	0.023±0.006	0.002
Arabica Coffee - Durian**	0.023±0.006	0.001
Arabica Coffee - Maize	0.023±0.006	0.024
Arabica Coffee - Mango	0.023±0.006	0.007
Arabica Coffee - Papaya*	0.023±0.006	0.002
Arabica Coffee - Pepper	0.023±0.006	0.018
Arabica Coffee - Plantain	0.023±0.006	0.006

Table 29. The default values for nitrogen uptake as allocation parameters for Robusta coffee in intercropping systems.

Intercropping system	Coffee (kg N / kg coffee cherry)	Other cash crop (kg N / kg crop)
Robusta Coffee - Avocado*	0.012±0.005	0.003
Robusta Coffee - Banana	0.012±0.005	0.006
Robusta Coffee - Bean (green)	0.012±0.005	0.008
Robusta Coffee - Citrus*	0.012±0.005	0.002
Robusta Coffee - Durian**	0.012±0.005	0.001
Robusta Coffee – Maize	0.012±0.005	0.024
Robusta Coffee – Mango	0.012±0.005	0.007
Robusta Coffee - Papaya*	0.012±0.005	0.002
Robusta Coffee – Pepper	0.012±0.005	0.018
Robusta Coffee – Plantain	0.012±0.005	0.006

APPENDIX III: ALLOCATION EXAMPLE FOR GREEN COFFEE

This is an example which uses the tables in Appendix II to calculate the allocation ratio in a coffee–banana intercropping system.

Primary data (also called specific data) from the survey on the farm contains the following information (Note: numbers below are purely fictional):

Farm A only knows that it purchases 1,000 kg of total nitrogen fertilisers per year for its Arabica coffee and banana intercropping system.

The average yield of coffee cherries is 800kg/acre (2,000 kg/ha); the average yield of banana is 500 kg/acre (1,250 kg/ha).

The EPD practitioners can use the above data and default values listed in the CFP-PCR to easily calculate the allocation ratios as follows:

The individual nitrogen requirement of coffee and banana per year can be calculated based on the amount of crops needed (default value see Table 6 in Appendix II) and the specific yield of the crops from the primary data:

$$Banana: \frac{0.006kg\ N}{kg\ Banana} x\ 500\frac{kg}{a} = 3kg\ N/a$$

The results show that coffee needs 18.4 kg of nitrogen fertiliser per year to harvest 800kg coffee cherries, and banana needs 3 kg to harvest 500 kg banana.

The second step is to calculate the percentage of allocation ratios assigned between coffee and banana.

Percentage of Arabic coffee: $\frac{18.4}{(18.4+3)} = 86\%$

Percentage of banana: $\frac{3}{(18.4+3)} = 14\%$

That means that of 1,000 kg of total nitrogen fertiliser applied on this farm, 860kg will be assigned to coffee (86%) and 140kg to banana (14%) per year.

Note: The calculated amount of fertiliser might not be equal to the actual amount applied on the farm. This might, for example, be based on the fact that the farmer applied additional organic compost or manure.

APPENDIX IV: CARBONN POOLS FOR PERENNIAL SPECIES

The appendix shall be used for perennial species (e.g., orchards, grassland, or pasture production) and shall not be used for annual crops. The term "grassland" refers to native grasses, and "pasture" may refer to include non-native grasses in the appendix; both considerations are the same.

1. Carbon Pools Considered

In accordance with equation from the IPCC Guidelines[35], the following carbon pools are included in the biogenic carbon balance:

- AB: Above-ground biomass
- BB: Below-ground biomass
- DW: Deadwood
- LI: Litter
- SO: Soils
- HWP: Harvested Wood Products

These pools represent dynamic reservoirs of carbon, subject to changes based on vegetation growth, land management, and land-use transitions. Their inclusion supports comprehensive accounting in alignment with the IPCC and GPI 5.0 guidance.

2. Global Warming Potential (GWP) – Biogenic

Biogenic GWP is one of the three sub-indicators for climate change in the EN 15804 and GPI 5.0 frameworks, alongside fossil GWP and GWP from land use and land-use change (GWP-LULUC). It refers to emissions and removals of CO_2 and CH_4 resulting from biomass oxidation or decomposition, and CO_2 removals during plant growth.

- Biogenic GWP emissions and removals shall be calculated separately from fossil GWP.
- CH_4 from biogenic sources shall use the characterization factors specified in the Impact Categories at www.environdec.com.
- Changes in carbon stocks associated with perennial systems (e.g., orchard fruits, olives, pastures, grasslands, short rotation coppices, tea, and grapes) due to land-use change shall be reported under GWP-LULUC, not GWP-biogenic.

The biogenic carbon content within the final product shall be reported independently of the GWP indicators. For instance, inedible components such as olive pits or nutshells reflect biogenic carbon that remains stored temporarily.

Following the mass balance of biogenic carbon:

- Transfers of biomass from a previous product system shall be recorded as –1 kg CO_2eq per kg of biogenic carbon.
- Transfers into a subsequent system shall be recorded as +1 kg CO_2eq per kg of biogenic carbon.

This ensures that the biogenic carbon removed during growth and emitted later results in a net-zero biogenic GWP across the life cycle, except where biogenic carbon is converted to CH_4, CO, or N_2O. To close the balance, biogenic removals shall be compensated by a virtual emission in Module C3, which must be explicitly reported in the EPD. The calculation approach can be found through link below: https://www.environdec.com/pcr/env-perf-indic/env-perf-indic-gpi5/indic-env-impact#climatechange.

3. Global Warming Potential (GWP) – Land Use and Land-Use Change (LULUC)

GWP-LULUC accounts for greenhouse gas emissions or removals due to changes in carbon stocks from:

- Land use for example GHG emissions and removals (e.g., management interventions such as pruning, fertilization, or biomass growth in orchard, grassland, or pasture systems); and leaving wood, branches and leaf on the tops of the soil. Here, it is important to consider the reference situation or land use baseline, so only differences in fruit orchard and grassland o pastureland management in comparison with a business-as-usual scenario should be accounted for.
- Land-use change (e.g., deforestation or conversion from cropland to fruit orchard or pastureland).

[35] Equation 2.3 in Chapter 2 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Land use and land-use change GWP shall be calculated and reported. Indirect land-use change, which refers to conversions of land because of changes in land use somewhere else, shall be excluded.

Only changes from a business-as-usual land-use baseline should be considered. Equation from the IPCC[36] may be used as a reference. Indirect land-use change (iLUC) is excluded. Emissions shall be estimated based on the following conditions:

- Land-use changes older than 20 – 25 years (e.g., as in the Olive Oil PCR) are excluded.
- When the previous land use is not known but the country is known, the GHG emissions arising from land-use change must be the estimate of average emissions from the land-use change for that activity in that country.
- When neither the country of origin nor the former land use is known, the GHG emissions arising from land-use change shall be the weighted average of the average land-use change emissions of that commodity in the countries in which it is grown.

4. Default Calculation Assumptions

The calculation of land use biogenic carbon dioxide emissions or removals shall be carried out using site-specific data whenever possible. In case such type of model is applied, all data sources and assumptions must be clearly supported. The following assumptions shall be used as a default:

- Above-ground orchard and pasture residues (e.g., branches, leaves) shall be assumed to decay or combust immediately, releasing CO_2.
- Below-ground biomass (roots) shall also be assumed to fully decay post-harvest, converting to CO_2.
- For other parameters and assumptions, literature values can be used but they must be clearly justified
- The timing of land-use changes shall be assumed to match the year of assessment.
- Net orchard regrowth and removals must be calculated using a 4–20 year rolling average across the landscape.
- Parameters such as species, rotation period, carbon content, thinning intensity, and harvest fractions must be case-specific and justified.
- In the absence of primary models, ISO 14067 default rules and IPCC emission factors must be used.

5. Complementary Reporting of Carbon Flows

To ensure transparency and comparability, the following elements should also be reported (in addition to those counted in the inventory):

1. Net removals from direct land-use change or management transitions (e.g., afforestation of pasture).
2. Net removals from land management (e.g., annual tree growth) excluding stored carbon in the product.
3. Biogenic carbon temporarily stored in the product (not relevant for intermediate products).

6. Overview of GWP Emissions and Removals

[36] Equation 2.25 Chapter 2 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

The figure below summarizes the different GWP components handled in this PCR. Emissions are represented above the X-axis and removals below it.

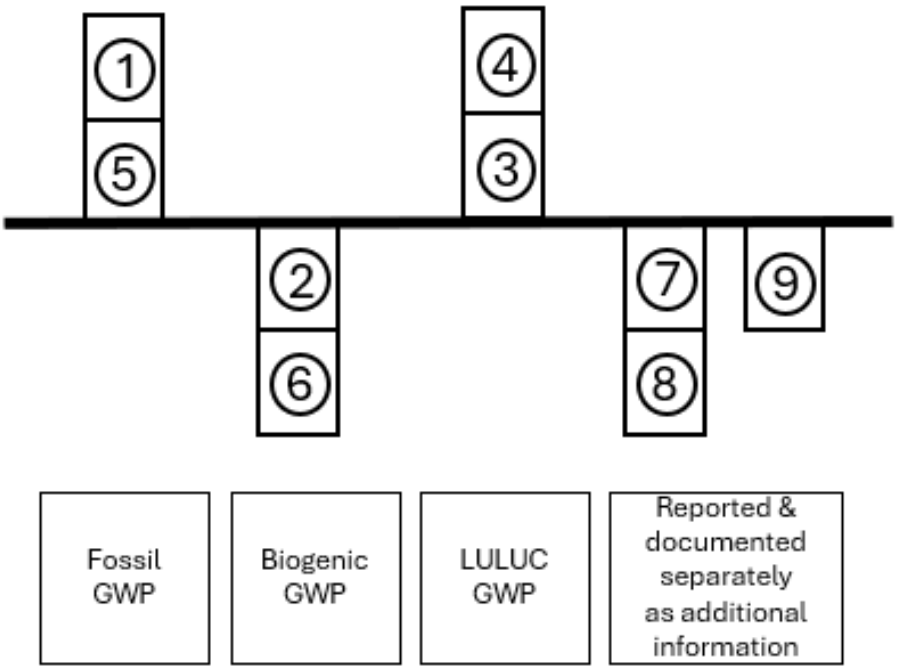

Figure 4. Accountability and reporting of the GWP components. The boxes above the x-axis represent emissions and the boxes below the x-axis represent uptakes. (Figure adapted from Figure 3from PCR (PCR Basic Products from Forestry; 2020).

The different components of GWP illustrated in the figure above are described below:

As a part of inventory:

1. GHG emissions other than specified. Emissions with unknown origin, e.g.: unspecified GHG emissions from production of energy wares.
2. Biogenic GHG emissions. From combustion of fuels of biogenic origin, including biogenic carbon transfer of biogenic carbon content in the product, e.g. combustion of biodiesel (only the biogenic share).
3. Emissions from direct LUC and change in the management of land. Net emissions due to difference in biogenic carbon uptake by orchard, grassland, pasturelands after land transformation.
4. Emissions from land use excluding changes in the management of land. GHG net emissions due to orchard management, e.g. biogenic carbon emissions from the decay of leaves and branches from orchard.
5. Net fossil GHG emissions. Fossil emissions of known origin, e.g. emissions from combustion of fossil fuels in forest machines and vehicles.
6. Biogenic GHG removal. CO2 uptake in orchard by photosynthesis corresponding to the content in the product for example in olive pit or nutshell.

To be reported and documented separately as additional information:

7. Removals from direct LUC and change in the management of land. Net removals due to the difference in biogenic carbon uptake in the orchard, pasture and grassland after land transformation, considering the land use baseline scenario.
8. Removals from land use excluding change in the management of land. GHG net removals due to orchard management, e.g. biogenic carbon uptake due to annual tree growth, excluding the biogenic carbon content in the product and considering the land use baseline scenario.
9. Biogenic carbon storage in the product. Effects from temporary biogenic carbon storage in products, not relevant for intermediate products, excluding the biogenic carbon content in the product.

Further references and resources:

IPCC. (2019). 2019 Refinement to the 2006 IPCC guidelines for National Greenhouse Gas Inventories. Volume 4: AFOLU; Chapter 5: Cropland. IPCC. https://www.ipcc-nggip.iges.or.jp/public/2019rf/vol4.html

IPCC. (2019). 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4: AFOLU Chapter 6. Grassland. Retrieved from https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch06_Grassland.pdf

IPCC. (2019). 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse gas Inventories. Volume 4: AFOLU, Chapter 2: Generic methodologies applicable to multiple land use categories. IPCC. Obtenido de https://www.ipcc-nggip.iges.or.jp/public/2019rf/vol4.html

IPCC. (2019). Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4: AFOLU Chapter 4: Forest Land. Retrieved from https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch04_Forest%20Land.pdf

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