Study

Carbon Footprint Calculation

of the „Koroneiki"-Olive oil „Kiari" from Peloponnes

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Content

Imprint

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pulswerk was founded in 2012 by Österreichisches Ökologie-Institut together with nine employees. Ökologie-Institut conducts research for the sustainable development of our society, while pulswerk counsels enterprises and policymakers in the planning and implementation of sustainable solutions.

Client:
τοΚαλό

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1. Summary

The subject of this study is Extra Virgin Olive Oil from an olive grove in Koroni on Peloponnese, which is regionally pressed and bottled. The olive grove measures approximately 2,5ha and includes 500 olive trees. The trees are 80 years old. Annually, 13.500 kg olives are harvested, which yield about 3.500 litres of olive oil.

The Austrian food retail company τοΚαλόν sources the olive oil directly from the producer in Koroni and has decided to commission a Carbon Footprint Calculation.

Austria and Europe have long joined the Paris Agreement and aim to achieve the decarbonization of our society. Accordingly, topics like sustainability, environmental protection and counteracting the contribution to climate change caused by products, services and personal habits are becoming increasingly important.

The goal of this study is to calculate the CO_2-footprint of the production and transportation of one litre of the „Koroneiki"-Olive oil „Kiari" from the Peloponnese.

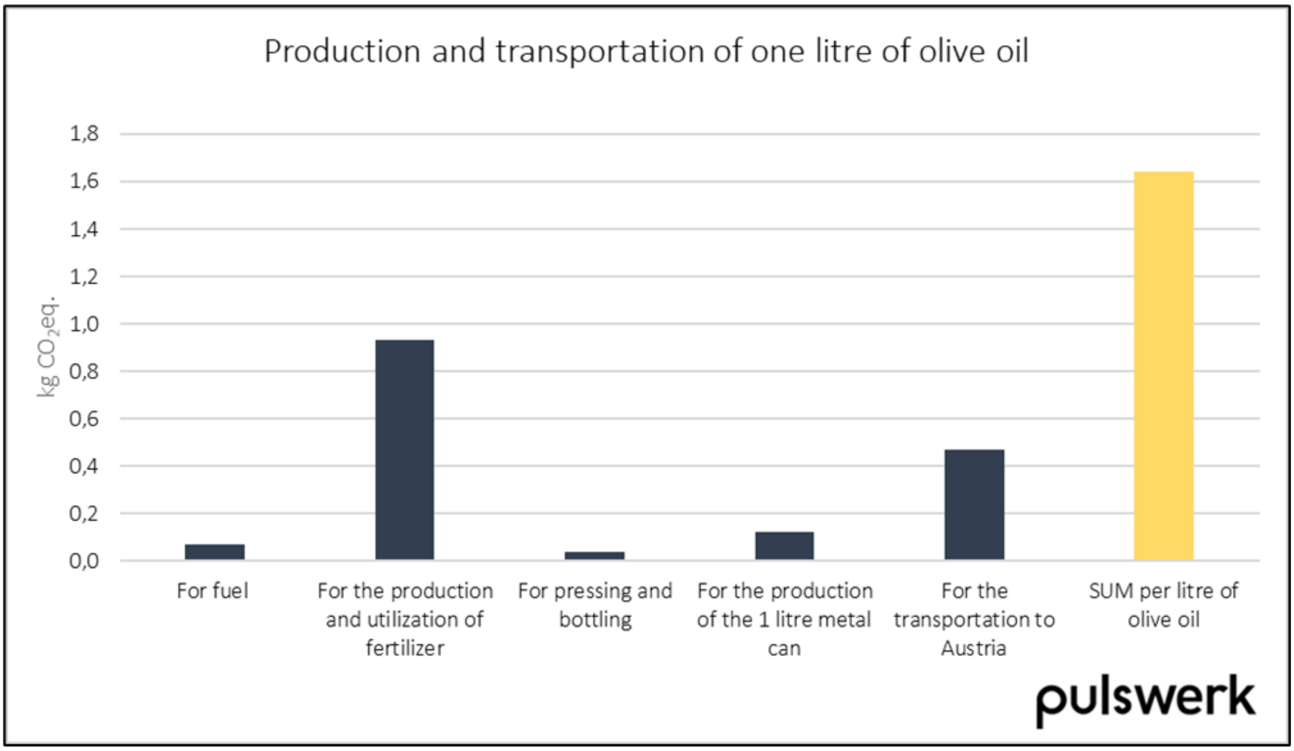

Figure 1: CO_2-equivalents for the production and transportation of one litre of olive oil

The production and transportation of one litre of olive oil generates approx. 1,6 kg CO_{2eq}. The outcomes are portrayed in figure 1.

The consumption of fuel for the cultivation, transportation (in-house and to the pressing plant) and running of essential machines generates approx. 0,1 kg CO_{2eq}. The production and use of **mineral fertilizer** produces approx. 0,9 kg CO_{2eq}, the pressing and bottling of olive oil approx. 0,04 kg CO_{2eq}. The production of the metal can emits approx. 0,1 kg $CO_{2eq.}$ and the transportation to Austria approx. 0,5 kg $CO_{2eq.}$.

Conclusions and Recommendations

The production and transportation of one litre of olive oil generates approx. 1,6 kg CO_{2eq}.

Based on these outcomes, the following conclusions have been drawn:

- The CO_2-footprint per litre of approx. 1,6 kg CO_{2eq}. is relatively small.
- The production is efficient and the use of machines is low, resulting in low fuel consumption.
- The biggest lever to reduce the CO_2-footprint is the current use of mineral fertilizer. The second biggest lever is the transportation from Greece to Austria.
- The entire cultivation and olive oil production of approx. 3.500 litres generates approx. 4 tons CO_{2eq}. (excluding the transportation to Austria).

Based on the outcomes, the authors issue the following recommendations:

- Reduce or replace the mineral fertilizer.
- The transportation from Greece to Austria should be assigned to logistics providers who are already active in reducing their CO_2 emissions (for example organisations who are participating in the program „Lean and Green“)
- Compensate the CO_2-equivalents by using the compensation scheme of the Viennese University for Natural Resources and Life Sciences (BOKU).

2. Introduction

The subject of this study is Extra Virgin Olive Oil from an olive grove in Koroni on Peloponnese, that is regionally pressed and bottled. The olive grove measures approximately 2,5ha and includes 500 olive trees.

The trees are 80 years old. Annually, 13.500 kg olives are harvested, which yield about 3.500 litres of olive oil. The Austrian food retail company τοΚαλόν sources the olive oil directly from the producer in Koroni and has decided to commission a Carbon Footprint calculation.

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At the moment, the worldwide consumption of resources translates to the use of 1,7 earths[1] per year. The Earth Overshoot Day took place on the 29th of July in 2019. The term overshoot describes the point when the depletion of natural resources is greater than the earth's annual regeneration capacity. Currently, 60% of the annual depletion of natural resources are connected to excessive CO_2-emissions[2]. The „Earth Overshoot Day" is reached earlier each year.

Austria and Europe have long joined the Paris Agreement and aim to achieve the decarbonization of our society. The European Parliament has recently declared the state of climate emergency, demanding concrete measures to face climate change and underlining their urgency. Accordingly, topics like sustainability, environmental protection and counteracting the contribution to climate change caused by products, services and personal habits are becoming increasingly important. Products and services with a small CO_2-footprint contribute significantly to these targets.

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Resources like energy and raw materials are put to use, transformed and spent during the entire production process. Each production stage has an impact on the environment.

[1] WWF: Living Planet Report, 2018

[2] http://www.footprint.at/index.php?id=eod2019info, abgerufen am 10.03.2020

3. Methodical Approach to determine the Ecological Relevance

The **Carbon Footprint** calculation for products has been aligned with the principles of ISO 14044 for life cycle assessments and the „Product Environmental Footprint Category 1 Rules Guidance[3]“. The calculation of the Carbon Footprint comprises the detection and evaluation of the CO_2 equivalents of products, processes, services etc. along their entire life cycles.

The Carbon Footprint calculation contains four steps (pursuant to the ISO 14044[4] procedure for life cycle assessments):

1. Definition of Goal and Scope
2. Inventory Analysis
3. Impact Assessment
4. Interpretation

In order to calculate the Carbon Footprint of a product, the target, functional unit and system boundaries have to be defined.

The specification of the target includes a detailed description of the goal and the assessed unit as well as a clear definition of the insights that are to be achieved. During the definition of the goal, the functional unit is defined in order to measure the impacts of the product system.

The **system boundaries** also have to be specified, in order to estimate of the spatial and temporal scope of the study. The upstream and downstream processes have to be captured as fully as possible to allow for a thorough calculation. The choice of cut-off criteria facilitates this task (see chapter 4).

During the **Inventory Analysis, the input-output-flows** along the life cycle of the assessed product are identified and compiled (see chapter 5).

During the subsequent **Impact Assessment**, the material flows, that have been determined in the Inventory Analysis, are assigned to different impact categories (in this respective case, exclusively to the Global Warming Potential measured in CO_2 equivalents (CO_{2eq}); see chapter 6).

During the **Interpretation**, the Impact Assessment (concluded from the findings of the whole assessment) is interpreted and conclusions and recommendations are drawn. In addition, a sensitivity analysis is carried out (see chapter 7 and 8).

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[3] European Commission (2017): PEFCR Guidance document, - Guidance for the 13 development of Product Environmental Footprint Category Rules (PEFCRs). Version 6.3. Brussels

[4] DIN EN ISO 14044, 2006: Umweltmanagement - Ökobilanz - Anforderungen und Anleitungen

4. Goal and Scope

The goal of the present study is to calculate the Carbon Footprint for the production and transportation of one litre of the „Koroneiki"-Olive oil „Kiari" from the Peloponnese.

The compiled data for the calculation encompasses cultivation procedures (i.e. production and use of fertilizers) including the utilized fuel for machines and harvesting, the transportation of the olives to the pressing plant, the pressing and bottling of the oil and it's transportation from Greece to Austria. The production of the metal can that contains the olive oil has also been included. The potential use of glass bottles was excluded from the Carbon Footprint calculation, but included in the sensitivity analysis.

5. Inventory Analysis

These aspects have been taken into account in the Carbon Footprint calculation:

- Production and utilization of mineral fertilizer (nitrogen fertilizer)
- The businesses total annual use of fuel (i.e. for the transporter, harvesting machine, chain saw)
- Energy consumption in pressing and bottling the olive oil
- Production of the packaging (1 litre metal can)
- Transportation from Greece to Austria

To calculate the effects of the metal can we assumed, that it was produced from 40% recycled material and presumed the recycling rate of 87 %[5] of Austria. These assumptions formed the basis for the calculation of the impacts and benefits of the metal can production.

The CO_2 equivalents[6] for the transportation from Greece to Austria were adopted from the calculations of the transport company.

Glass bottles for the olive oil were not part of the Carbon Footprint calculation, they were however included in the sensitivity analysis.

The data used in this study was gathered through research activities and a questionnaire, complemented by datasets from the Ecoinvent database. The following chart illustrates the data gathered during the Inventory Analysis:

Designation	Key Figures
Fertilizer application per year	320 kg
Fuel consumption of the business per year	80 Liter
Energy consumption of pressing and bottling	1,2 kWh
Weight of the metal can	0,1 kg
Olive oil production per year	3.500 Liter

Table 1: Data for the Carbon Footprint calculation

[5] Bundesabfallwirtschaftsplan 2017, BMNT, Wien
[6] Berechnung gemäß DIN EN 16258

6. Impact Assessment and Results

In this chapter, the fully calculated impacts of the production and transportation of one litre of olive oil are illustrated. The end-of-life scenario of the metal can was calculated in line with the „Product Environmental Footprint Category 1 Rules Guidance".

The production and transportation of one litre of olive oil generates in total approx. 1,6 kg CO_{2eq}. The results are plotted in figure 2.

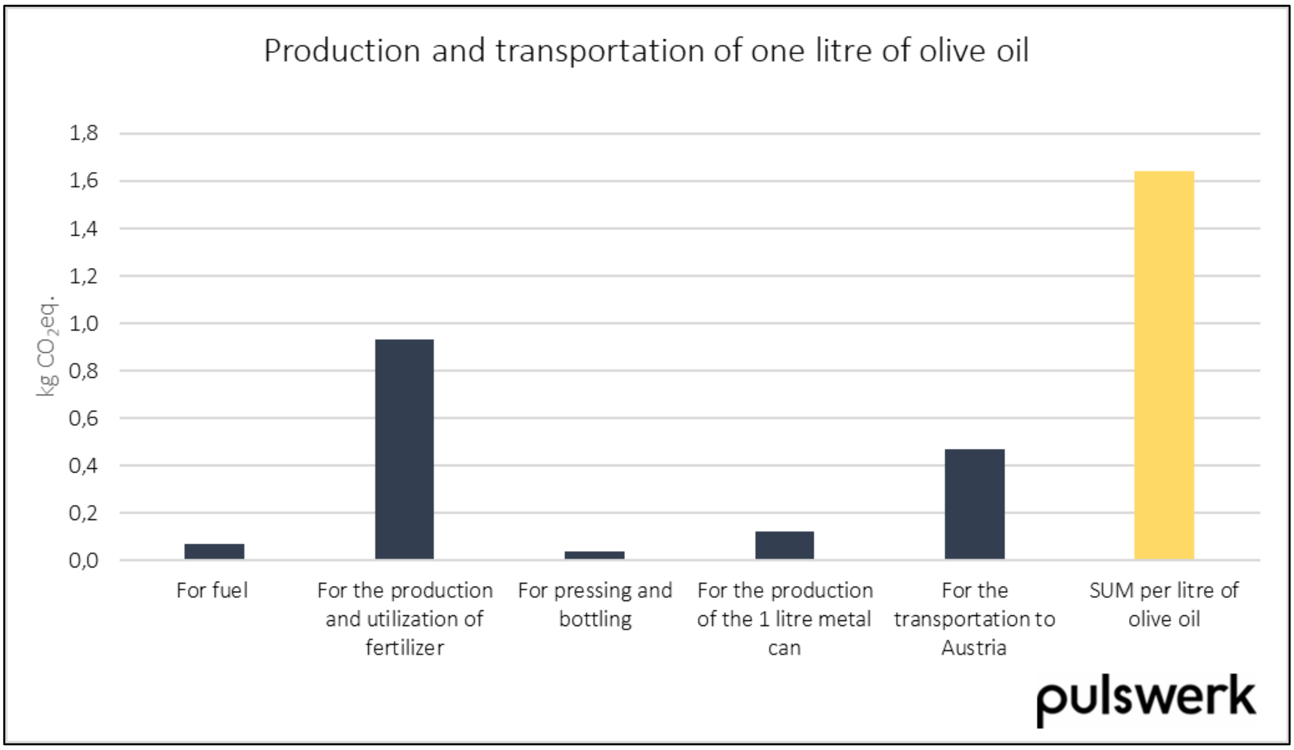

Figure 2: CO_2 equivalents for the production and transportation of one litre of olive oil

Table 2 displays the results of the calculation of the individual factors as well as their total sum.

The consumption of fuel for the cultivation, transportation (in-house and to the pressing plant) and running of essential machines generates approx. 0,1 kg CO_{2eq}. The production and use of **mineral fertilizer** produces approx. 0,9 kg CO_{2eq}, the pressing and bottling of olive oil approx. 0,04 kg CO_{2eq}. The production of the metal can emits approx. 0,1 kg $CO_{2eq.}$ and the transportation to Austria approx. 0,5 kg $CO_{2eq.}$.

kg $CO_{2eq.}$	Designation
0,1	For fuel
0,9	For the production and utilization of fertilizer
0,04	For pressing and bottling
0,1	For the production of the 1 litre metal can
0,5	For the transportation to Austria
1,6	**SUM per litre of olive oil**

Table 2: CO2 equivalents for the production of one litre of olive oil

7. Sensitivity Analysis

The sensitivity analysis determines how the key figures react to small changes of the input parameters. Whilst conducting a Carbon Footprint calculation it is sometimes necessary to make assumptions, that lack the adequate amount of empirical evidence or objective reasoning. During the sensitivity analysis, the parameters are altered in order to assess their effects on the results. The sensitivity analysis is an important part of every accounting. It allows to test the plausibility of the results. It also helps to identify those parameters, that have a substantial effect on the overall result. [7]

1. Utilisation of alternative fertilizers

The biggest effect was attributed to the production and utilisation of the mineral nitrogen fertilizer. This stems from the significant energy consumption during the production of mineral nitrogen fertilizers. By replacing it with natural nitrogen fertilizer (conforming to organic standards), the CO_2-Footprint could be lowered.

2. Transportation to Austria

The second biggest effect was attributed to the transportation from Greece to Austria. It is unlikely to come up with an alternative. Nevertheless, the transportation can be assigned to logistics providers who are already active in reducing their CO_2 emissions (for example organisations who are participating in the program „Lean and Green“[8]).

[7] Life Cycle Assessment -Theory and Practice: Michael Z. Hauschild et al. Springer International Publishing AG 2018, Dänemark 2018

[8] https://l-mw.at/wp-content/uploads/2020/01/Lean-Green_Kundeninformation_GS1-Austria.pdf, abgerufen am 25.03.2020

3. Changes in packaging

The metal packaging for one litre of olive oil generates approx. 0,1 kg $CO_{2eq.}$ By using alternative packaging materials (i.e. PET-bottles or cardboard packaging with inner plastic bags) the Carbon Footprint can be lowered, if not as significantly. Furthermore, the protective function of the packaging is essential to protect the product from damage during the distribution (storage and transportation).

It was determined, that glass bottles for 0,5 and 0,25 litres of olive oil would have a bigger CO_2-Footprint per litre of olive oil than the metal can. The glass bottle for 0,5 litres of olive oil weighs approx. 0,4 kg, the one for 0,25 litres approx. 0,2 kg. Since the calculation is carried out for one litre of olive oil, it has to be taken into account that two 0,5 litre glass bottles or four 0,25 litre glass bottle are necessary to contain the oil. This amounts to a CO_2-Footprint of approx. 0,3 kg $CO_{2eq.}$ for the 0,5 litre bottles and of approx. 0,4 kg CO_{2eq} for the 0,25 litre bottle.

8. Conclusions and Recommendations

The production and transportation of one litre of olive oil generates approx. 1,6 kg CO_{2eq}. The consumption of fuel for the cultivation, transportation (in-house and to the pressing plant) and running of essential machines generates approx. 0,1 kg CO_{2eq}. The production and use of **mineral fertilizer** produces approx. 0,9 kg CO_{2eq}, the pressing and bottling of olive oil approx. 0,04 kg CO_{2eq}. The production of the metal can emits approx. 0,1 kg $CO_{2eq.}$ and the transportation to Austria approx. 0,5 kg $CO_{2eq..}$

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