Supplementary Materials: Assessing the Availability of Terrestrial Biotic Raw Materials in Product Systems (BIRD)

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1. Calculation of the Resource Availability for African Elephants

In the following the determination of the reference for the Biotic Resource Availability Indicator (BRAI) is explained. As shown in Equation (1) (in the main part of the article) the BRAI of a species is calculated by subtracting the regeneration rate from the extraction rate and setting the value into relation to the resource stock.

The extraction rate (based on data by World Wildlife Fund (2016)), regeneration rate (based on data by African Elephant Specialist Group (2013)), resource stock (based on data by World Wildlife Fund (2016)) and TSI (based on data by IUCN (2016)) are determined. As the African elephant is classified as vulnerable, the TSI value is set to 50. Thus, the BRAI of the African elephant (AI) can be calculated (see Equation (1)).

$$\mathrm{BRAI_{AI}} = \left[\frac{\text{extraction rate}_{\mathrm{AI}} - \text{regeneration rate}_{\mathrm{AI}}}{(\text{resource stocks}_{\mathrm{AI}})^2}\right] \times \mathrm{TSI_{AI}} = \left[\frac{30{,}000 - 23{,}500}{470{,}000^2}\right] \times 50 = 1.47 \times 10^{-6} \frac{1}{\text{individuals}} \quad (1)$$

The BRA of GIB is set to 1 as African elephants are also the reference species.

2. Determining the Food Security Index

In the following it is described how the Food Security Index (FSI) is established based on several Food Security Indicators by Food and Agriculture Organization of the United Nations (FAO) (2016). Based on data availability and relevance the following five indicators were chosen:

- Average dietary energy supply adequacy (DES)
- Depth of the food deficit (FD)
- Prevalence of food inadequacy (FI)
- Cereal import dependency ratio (CID)
- Prevalence of undernourishment (PU)

These indicators have to be converted to the same scale before they can be aggregated to the food security index (FSI).

The scaling occurs in three steps:

(1) Indicators with negative values are recalculated so that all values are positive. Therefore, the minimum value is subtracted from the original value.
(2) All indicators are scaled to the range from 0 to 100 by dividing the original value by the maximal value and multiplying it with 100.
(3) All indicators need to have the same direction, e.g., high numbers refer to big impacts. Thus the direction has to be changed if necessary. This can be achieved by subtracting the original value from 100.

The final FSI is calculated by determining the average of all five indicators according to Equation (2).

$$\mathrm{FSI_i} = \frac{\mathrm{DES_i} + \mathrm{FD_i} + \mathrm{FI_i} + \mathrm{CID_i} + \mathrm{PU_i}}{5} \quad (2)$$

3. Case Study

In the following additional calculations for the introduced case study are presented.

3.1. Physical Constraints

Next the calculations for the dimension physical constraints are shown.

3.1.1. Ecological Constraints

The introduced case study does not consider biotic resources. However, to show how the final BRA is calculated an example is introduced, for which the detailed calculation steps are shown. The biotic resource considered is the Great Indian Bustard, which is hunted for sport as well as for food. As shown in Equation (1) (in the main part of the article) the BRAI of a species is calculated by subtracting the regeneration rate from the extraction rate and setting the value into relation to the stock. Furthermore, the Threatened Species Index (TSI) of the Great Indian Bustard (GIB) is taken into account (see Equation (3)). The Great Indian Bustard is a bird, which is classified as critically endangered.

$$\mathrm{BRAI_{GIB}} = \left[\frac{\text{extraction rate}_{\mathrm{GIB}} - \text{regeneration rate}_{\mathrm{GIB}}}{(\text{resource stocks}_{\mathrm{GIB}})^2}\right] \times \mathrm{TSI_{GIB}} = \left[\frac{24-50}{300^2}\right] \times 100 = -2.89 \times 10^{-2} \frac{1}{\text{individuals}} \quad (3)$$

The extraction rate is determined by considering the population rate of the year 1969 (before depletion occurred) and comparing it with the population of the year 2009 (see Equation (4)) based on data by Dutta et al. (2011). The current resource stock consists of 300 individuals (current population).

$$\text{Extraction rate}_{\mathrm{GIB}} = \frac{1260-300}{40} = 24 \text{ individuals} \quad (4)$$

The regenerated rate can be determined according to Equation (5) based on data published by Mohammed and Indira (2015).

$$\begin{aligned} &\text{Replenishment rate} \\ &\quad = \text{amount of mature female individuals} \\ &\quad \times \text{ amount of descendants per individual} \times \text{mortality rate in first year} \\ &\quad = 100 \times 1 \times 0.5 = 50 \text{ individuals} \end{aligned} \quad (5)$$

The TSI is defined according to Table S1 (in the main part of the article) and according to data by International Union for Conservation of Nature (2016). As the GIB is classified as critically endangered, the TSI value is set to 100.

Table S1. Overview of countries consuming rape seed and soy beans, the share of the categories as determined in Table S2 (in the main part of the article) and the corresponding factor.

Country	Biotic Material	Share of Categories	Factor(s)
EU	Rapeseed	100% category F	1
	Soybeans	100% category F	1
USA	Rapeseed	100% category F	1
	Soybeans	100% category F	1
Brazil	Soybeans	100% category F	1
Argentina	Soybeans	100% category F	1
Canada	Rapeseed	100% category F	1
India	Rapeseed	100% category F	1

Thus, the overall BRAI of the GIB sums up to $-2.89 \times 10^{-2} \times \frac{1}{\text{individuals}}$. As the current regeneration rate per year is higher as the extraction rate, no resource stocks are depleted. The stock is rather growing. Thus, the calculated value is negative.

To compare BRAs of different biotic resources the BRAIs have to be set in relation to the reference resource African elephants. Thus, for the GIB the resource depletion adds up to -2.1×10^5. The negative value refers to the replenishment of the resource stock compared to African elephants, which are still hunted in larger amounts as they can replenish.

3.1.2. Anthropogenic Stock

In the following the calculation of the factor determining the anthropogenic stock for soy bean and rapeseed is demonstrated. As there is no data available on the amount of the globally produced rapeseed and soy bean used for biofuel, the shares of the largest consumers of rapeseed and soy beans are applied instead based on the data by Barrientos and Soria (2016) [1]. As shown in Table S1 rapeseeds and soy beans in the considered countries are used for food, feed and fuel production. No data was found stating if soy beans and rapeseeds are used within any products. However, if they are used for products the amount is most likely very small and would not change the overall result significantly.

As the factor for both materials in all considered countries is 1 the overall anthropogenic constraints results in 1 as well.

3.2. Socio-Economic Availability

Next the calculations for the categories of the dimension socio-economic constraints are introduced.

3.2.1. Political Instability

In the following the calculations to determine the political instability of the product system are shown. Possible limitations due to political instable countries can occur during the cultivation as well as during processing of the materials and production of biofuel. It is assumed that the production of soy bean and rapeseed oil occurs in the same country as the production of biodiesel. Thus, two values are determined based on Equation (3) (in the main part of the article). The political instability for soy bean producing countries is determined as shown in Table S2.

Table S2. Data to determine the political instability of soy bean producing countries: countries, global production share and Worldwide Governance Index.

Soy Bean Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Worldwide Governance Index (WGII) Based on World Bank Group (2013)	Global Production Share × WGII
USA	33.5%	1.34	4.50×10^{-1}
Brazil	31.3%	2.14	6.71×10^{-1}
Argentina	17.9%	2.48	4.43×10^{-1}
China	3.8%	2.66	1.00×10^{-1}
Paraguay	2.8%	2.76	7.61×10^{-2}
India	2.5%	2.46	6.18×10^{-2}
Canada	2.0%	0.52	1.01×10^{-2}
Ukraine	1.2%	1.49	1.77×10^{-2}
Uruguay	1.0%	0.90	8.82×10^{-3}
Bolivia	1.0%	2.66	2.59×10^{-2}
Russia	0.9%	2.83	2.53×10^{-2}
South Africa	0.3%	1.89	5.26×10^{-3}
Nigeria	0.2%	3.26	6.65×10^{-3}
Indonesia	0.2%	2.47	4.79×10^{-3}
Serbia	0.2%	2.22	3.68×10^{-3}
Mexico	0.1%	2.27	2.57×10^{-3}
Japan	0.1%	0.81	5.58×10^{-4}
Zambia	0.1%	2.34	1.57×10^{-3}
Myanmar	0.1%	3.44	2.16×10^{-3}
Iran	0.1%	3.24	1.98×10^{-3}

Table S2. *Cont.*

Soy Bean Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Worldwide Governance Index (WGII) Based on World Bank Group (2013)	Global Production Share × WGII
Uganda	0.1%	2.72	1.62×10^{-3}
Vietnam	0.1%	2.63	1.44×10^{-3}
Korea, Dem. Rep.	4.7×10^{-4}%	3.75	1.76×10^{-3}
Korea, Rep.	3.8×10^{-4}%	1.36	5.13×10^{-4}
Turkey	2.8×10^{-4}%	2.19	6.19×10^{-4}
Zimbabwe	2.8×10^{-4}%	3.44	9.70×10^{-4}
Venezuela	2.4×10^{-4}%	3.43	8.06×10^{-4}
Colombia	2.3×10^{-4}%	2.42	5.54×10^{-4}
Ecuador	2.2×10^{-4}%	2.69	5.91×10^{-4}
Australia	1.9×10^{-4}%	0.55	1.04×10^{-4}
Thailand	1.6×10^{-4}%	2.41	3.78×10^{-4}
Guatemala	1.1×10^{-4}%	2.73	3.09×10^{-4}
Egypt	6.3×10^{-5}%	3.02	1.90×10^{-4}
Bosnia	2.2×10^{-5}%	2.36	5.17×10^{-5}
Nicaragua	2.2×10^{-5}%	2.65	5.81×10^{-5}
Taiwan	1.9×10^{-5}%	3.31	6.23×10^{-5}
Peru	9.4×10^{-6}%	2.36	2.22×10^{-5}
Switzerland	9.4×10^{-6}%	0.38	3.62×10^{-6}
Pakistan	6.3×10^{-6}%	3.24	2.03×10^{-5}
Syrian Arab.Rep.	6.3×10^{-6}%	3.80	2.38×10^{-5}
Philippines	3.1×10^{-6}%	2.43	7.63×10^{-6}
		$\Sigma = 1.93$	

The political instability for soy bean producing countries adds up to 1.93. For rapeseed the political stability with regard to production is shown in Table S3 and sums up to 1.43.

Table S3. Data to determine the political instability of rapeseed producing countries: countries, global production share and Worldwide Governance Index.

Rapeseed Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Worldwide Governance Index (WGII) Based on World Bank Group (2013)	Global Production Share × WGII
Canada	32%	1.31×10^{-1}	0.41
China	25%	5.54×10^{-1}	2.18
India	21%	2.18×10^{-1}	1.05
Australia	9%	7.73×10^{-2}	0.96
France	8.07%	4.62×10^{-2}	0.65
Germany	7.12%	2.52×10^{-2}	0.28
Ukraine	5%	1.07×10^{-1}	2.83
UK	3.79%	3.51×10^{-2}	1.28
USA	3%	3.73×10^{-2}	0.82
Poland	2.74%	2.59×10^{-2}	1.03
Russia	2%	4.70×10^{-2}	2.44
Belarus	2%	2.05×10^{-2}	1.25
Czech Rep.	1.64%	1.21×10^{-2}	1.29
Lithuania	0.93%	2.39×10^{-3}	0.33
Denmark	0.72%	8.68×10^{-3}	1.47
Hungary	0.59%	1.49×10^{-3}	0.31
Sweden	0.48%	6.33×10^{-3}	1.41
Latvia	0.45%	1.31×10^{-2}	0.79
Bulgaria	0.40%	7.97×10^{-3}	1.99
Slovakia	0.31%	1.03×10^{-2}	2.33

Table S3. *Cont.*

Rapeseed Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Worldwide Governance Index (WGII) Based on World Bank Group (2013)	Global Production Share × WGII
Estonia	0.24%	9.29×10^{-3}	2.74
Romania	0.23%	4.43×10^{-3}	1.41
Austria	0.22%	2.78×10^{-3}	0.84
Finland	0.11%	2.48×10^{-3}	1.03
Spain	0.08%	7.66×10^{-3}	2.59
Belgium	0.07%	4.63×10^{-3}	1.97
Italy	0.04%	1.28×10^{-3}	0.58
Ireland	0.04%	3.58×10^{-3}	1.51
Slovenia	0.03%	2.90×10^{-4}	0.27
Luxembourg	0.02%	3.92×10^{-4}	0.33
Netherlands	0.01%	1.94×10^{-3}	1.91
Greece	0.01%	1.00×10^{-3}	1.30
Bangladesh	4×10^{-3}%	5.30×10^{-4}	0.75
Kazakhstan	3×10^{-3}%	1.87×10^{-3}	2.12
Chile	3×10^{-3}%	2.89×10^{-4}	0.70
Pakistan	3×10^{-3}%	5.97×10^{-4}	1.62
Ethiopia	2×10^{-3}%	3.17×10^{-4}	1.26
Switzerland	1×10^{-3}%	9.11×10^{-5}	0.41
Turkey	1×10^{-3}%	4.95×10^{-5}	0.07
Paraguay	9×10^{-4}%	4.48×10^{-5}	0.43
Norway	7×10^{-4}%	1.33×10^{-4}	1.81
Japan	2×10^{-4}%	2.39×10^{-5}	0.15
Korea, Rep.	3×10^{-5}%	2.01×10^{-5}	0.68
Morocco	1×10^{-5}%	3.63×10^{-5}	2.46
		$\Sigma = 1.43$	

To determine the political instability with regard to the processing step (oil production) and the production of biofuel the countries global consumption share of rapeseed and soy bean is multiplied with the corresponding WGII. The calculation for rapeseed is shown in Table S4 and the calculation for soy bean in Table S5. For rapeseed the political instability adds up to 1.32 and for soy bean to 2.14.

Table S4. Data to determine the political instability of soy bean consuming countries: countries, global consumption share and Worldwide Governance Index.

Soy Bean Consuming Countries	Global Consumption Share (gps) Based on Barrientos and Soria (2016)	Worldwide Governance Index (WGII) Based on World Bank Group (2013)	Global Consumption Share × WGII
China	30.29%	1.34	2.37×10^{-1}
USA	17.69%	2.14	2.96×10^{-1}
Argentina	15.41%	2.48	3.82×10^{-1}
Brazil	13.83%	2.66	8.06×10^{-1}
India	2.60%	2.76	3.73×10^{-2}
Russia	1.46%	2.46	6.41×10^{-2}
Mexico	1.41%	0.52	4.04×10^{-3}
Paraguay	1.35%	1.49	8.02×10^{-3}
Japan	1.00%	0.90	8.00×10^{-4}
Indonesia	0.94%	2.66	2.36×10^{-2}
Bolivia	0.89%	2.83	4.14×10^{-2}
Taiwan	0.81%	1.89	6.77×10^{-3}
Turkey	0.79%	3.26	8.40×10^{-3}
Thailand	0.79%	2.47	2.31×10^{-2}

Table S4. *Cont.*

Soy Bean Consuming Countries	Global Consumption Share (gps) Based on Barrientos and Soria (2016)	Worldwide Governance Index (WGII) Based on World Bank Group (2013)	Global Consumption Share × WGII
Canada	0.78%	2.22	2.71×10^{-3}
Egypt	0.67%	2.27	3.21×10^{-2}
Vietnam	0.63%	0.81	8.06×10^{-3}
Ukraine	0.54%	2.34	1.61×10^{-3}
Iran	0.49%	3.44	2.21×10^{-3}
Pakistan	0.48%	3.24	1.57×10^{-2}
Korea, Rep.	0.45%	2.72	1.62×10^{-3}
South Africa	0.36%	2.63	1.66×10^{-2}
Nigeria	0.26%	3.75	1.98×10^{-3}
Colombia	0.21%	1.36	6.16×10^{-3}
Serbia	0.12%	2.19	1.73×10^{-2}
Peru	0.11%	3.44	9.96×10^{-4}
Uruguay	0.09%	3.43	3.05×10^{-3}
Venezuela	0.09%	2.42	5.06×10^{-3}
Zambia	0.07%	2.69	6.07×10^{-4}
Myanmar	0.06%	0.55	1.05×10^{-4}
Uganda	0.06%	2.41	1.90×10^{-2}
Korea, Dem. Rep.	0.05%	2.73	5.72×10^{-4}
Philippines	0.04%	3.02	2.03×10^{-2}
Zimbabwe	0.03%	2.36	2.96×10^{-4}
Ecuador	0.02%	2.65	5.96×10^{-5}
Australia	0.02%	3.31	2.70×10^{-2}
Guatemala	0.02%	2.36	2.67×10^{-3}
Syrian Arab. Rep.	0.02%	0.38	2.23×10^{-5}
Switzerland	0.01%	3.24	1.57×10^{-2}
Bosnia	0.01%	3.80	8.81×10^{-4}
Nicaragua	0.00%	2.43	1.03×10^{-3}
		$\Sigma = 2.14$	

Table S5. Data to determine the political instability of rapeseed consuming countries: countries, global consumption share and Worldwide Governance Index.

Rapeseed Consuming Countries	Global Consumption Share (gcs) Based on Barrientos and Soria (2016)	Worldwide Governance Index (WGII) Based on World Bank Group (2013)	Global Consumption Share × WGII
EU-27	36.91%	1.14	4.20×10^{-1}
China	27.83%	2.18	6.07×10^{-1}
Canada	13.06%	0.41	5.32×10^{-2}
India	9.00%	1.05	9.44×10^{-2}
Japan	3.65%	0.15	5.38×10^{-3}
USA	2.48%	1.03	2.55×10^{-2}
Russia	1.53%	2.44	3.72×10^{-2}
Australia	1.40%	0.28	3.99×10^{-3}
Pakistan	1.19%	2.59	3.09×10^{-2}
Turkey	0.74%	1.91	1.41×10^{-2}
Ukraine	0.48%	0.82	3.88×10^{-3}
Belarus	0.45%	0.79	3.54×10^{-3}
Bangladesh	0.45%	2.33	1.04×10^{-2}
Chile	0.28%	0.84	2.35×10^{-3}
Kazakhstan	0.25%	2.74	6.88×10^{-3}
Ethiopia	0.12%	1.51	1.80×10^{-3}
Switzerland	0.11%	0.33	3.75×10^{-4}
Paraguay	0.04%	2.12	9.45×10^{-4}
Norway	0.03%	0.07	2.17×10^{-5}
		$\Sigma = 1.32$	

3.2.2. Demand Growth

In the following it is shown how the demand growth for soy bean for the cultivation (and harvesting) step is calculated (see Equation (6)) based on the data by U.S. Department of Agriculture (USDA) (2016). In Table S6 it is shown how to calculate the yearly growth (numerator of Equation (5)) for soy beans.

$$DG_{soybeans,cultivation} = \frac{\sum_1^5 \left(\frac{\text{global cultivation of year n + 1}}{\text{global cultivation of year n}} - 1 \right)}{4} = \frac{\sum(11.78+5.26+12.67+0.51)}{4} = \frac{30.22}{4} = 7.55\% \quad (6)$$

Table S6. Data for calculating the yearly change in demand growth: year and global production.

Year	Global Production in Million Metric Tons Based on USDA (2016)	Calculation	Yearly Change
2015	320.21	$\frac{320.21}{318.57} - 1$	0.51%
2014	318.57	$\frac{318.57}{282.75} - 1$	12.67%
2013	282.75	$\frac{282.75}{268.63} - 1$	5.26%
2012	268.63	$\frac{268.63}{240.32} - 1$	11.78%
2011	240.32		

To determine the demand growth in the processing step the share of yearly consumption of all produced oil used for biodiesel has to be identified. Thus, yearly production data of all countries producing biodiesel out of soy beans have to be determined. As these data is not available for all countries, only the three biggest producers are taken into account: USA, Brazil and China. The data for China is not available, that's why the fourth biggest producing country Argentina is considered. For these three countries the yearly growth of soybean derived biodiesel is calculated based on data by USDA (2015) to determine the overall demand growth for soy bean in the processing stage (see Equation (7)).

$$DG_{soybeans,processing} = \frac{\sum_1^5 \left(\frac{\text{global processing of year n + 1}}{\text{global processing of year n}} - 1 \right)}{4} = \frac{\sum(2.42 + 5.28 + 14.72 + 13.15)}{4} = \frac{35.56}{4} = 8.89\% \quad (7)$$

Thus, the demand growth for soy beans is 7.55% in the cultivation stage and 8.89% in the processing stage.

For rapeseed the demand growth is calculated as shown in Equations (8) and (9) using the data from USDA (2015) and USDA (2016).

$$DG_{rapeseed,cultivation} = \frac{\sum_1^5 \left(\frac{\text{global cultivation of year n + 1}}{\text{global cultivation of year n}} - 1 \right)}{4} = \frac{\sum(3.54 + 13.05 + 0.19 + (-6.27))}{4} = \frac{10.51}{4} = 2.63\% \quad (8)$$

$$DG_{rapeseed,processing} = \frac{\sum_1^5 \left(\frac{\text{global processing of year n + 1}}{\text{global processing of year n}} - 1 \right)}{4} = \frac{\sum(0.18 + 7.31 + 7.31 + (-8.14))}{4} = \frac{6.3}{4} = 1.58\% \quad (9)$$

For rapeseed the demand growth sums up to 2.63% in the cultivation stage and 1.58% in the processing stage.

3.2.3. Trade Barriers

The trade barriers are determined by multiplying the global production share with the Enabling Trade Indicator [2] and summing it up for the production as well as for the consumption of soy beans and rapeseed (see Tables S7–S10). The trade barriers for producing countries add up to 3.36 for soy bean and to 2.89 for rapeseed. For the processing step the trade barriers sum up to 3.23 for soy beans and to 2.42 for rapeseed.

Table S7. Data to determine the trade barriers of soy bean producing countries: countries, global production share and Enabling Trade Indicator.

Soy Bean Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Enabling Trade Indicator (ETI) Based on Hanouz et al. (2014)	Global Production Share × EPI
USA	33.5%	2.60	8.72×10^{-1}
Brazil	31.3%	3.80	1.19
Argentina	17.9%	3.90	6.97×10^{-1}
China	3.8%	3.30	1.24×10^{-1}
Paraguay	2.8%	4.10	1.13×10^{-1}
India	2.5%	4.00	1.00×10^{-1}
Canada	2.0%	2.60	5.08×10^{-2}
Ukraine	1.2%	3.80	4.53×10^{-2}
Uruguay	1.0%	3.40	3.31×10^{-2}
Bolivia	1.0%	3.90	3.79×10^{-2}
Russia	0.9%	4.10	3.66×10^{-2}
South Africa	0.3%	3.40	9.49×10^{-3}
Nigeria	0.2%	4.50	9.17×10^{-3}
Indonesia	0.2%	3.40	6.61×10^{-3}
Serbia	0.2%	3.90	6.48×10^{-3}
Mexico	0.1%	3.50	3.95×10^{-3}
Japan	0.1%	2.50	1.72×10^{-3}
Zambia	0.1%	3.90	2.62×10^{-3}
Myanmar	0.1%	4.40	2.76×10^{-3}
Iran	0.1%	4.60	2.81×10^{-3}
Uganda	0.1%	4.00	2.38×10^{-3}
Vietnam	0.1%	3.60	1.97×10^{-3}
Korea, Dem. Rep.	4.7×10^{-4}%	3.70	1.74×10^{-3}
Korea, Rep.	3.8×10^{-4}%	2.90	1.09×10^{-3}
Turkey	2.8×10^{-4}%	3.30	9.31×10^{-4}
Zimbabwe	2.8×10^{-4}%	4.70	1.33×10^{-3}
Venezuela	2.4×10^{-4}%	4.37	1.03×10^{-3}
Colombia	2.3×10^{-4}%	3.60	8.24×10^{-4}
Ecuador	2.2×10^{-4}%	3.50	7.68×10^{-4}
Australia	1.9×10^{-4}%	2.70	5.08×10^{-4}
Thailand	1.6×10^{-4}%	3.40	5.33×10^{-4}
Guatemala	1.1×10^{-4}%	3.50	3.95×10^{-4}
Egypt	6.3×10^{-5}%	4.00	2.51×10^{-4}
Bosnia	2.2×10^{-5}%	3.70	8.12×10^{-5}
Nicaragua	2.2×10^{-5}%	3.60	7.90×10^{-5}
Taiwan	1.9×10^{-5}%	2.70	5.08×10^{-5}
Peru	9.4×10^{-6}%	3.30	3.10×10^{-5}
Switzerland	9.4×10^{-6}%	2.40	2.26×10^{-5}
Pakistan	6.3×10^{-6}%	4.10	2.57×10^{-5}
Syrian Arab. Rep.	6.3×10^{-6}%	4.10	2.57×10^{-5}
Philippines	3.1×10^{-6}%	3.50	1.10×10^{-5}
		$\Sigma = 3.36$	

Table S8. Data to determine trade barriers of rapeseed producing countries: countries, global production share and Enabling Trade Indicator.

Rapeseed Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Enabling Trade Indicator (ETI) Based on Hanouz et al. (2014)	Global Production Share × ETI
Canada	32%	2.05	6.60×10^{-1}
China	25%	2.71	6.87×10^{-1}
India	21%	1.70	3.54×10^{-1}
Australia	9%	0.76	2.18×10^{-1}
France	8.07%	0.71	1.78×10^{-1}
Germany	7.12%	1.40	1.24×10^{-1}
Ukraine	5%	0.68	9.09×10^{-2}
UK	3.79%	0.93	9.05×10^{-2}
USA	3%	2.08	9.54×10^{-2}
Poland	2.74%	2.00	5.01×10^{-2}
Russia	2%	3.53	6.81×10^{-2}
Belarus	2%	0.91	5.24×10^{-2}
Czech Rep.	1.64%	0.91	2.99×10^{-2}
Lithuania	0.93%	0.74	1.86×10^{-2}
Denmark	0.72%	0.93	1.95×10^{-2}
Hungary	0.59%	0.71	1.19×10^{-2}
Sweden	0.48%	0.91	1.44×10^{-2}
Latvia	0.45%	0.99	1.64×10^{-2}
Bulgaria	0.40%	1.02	1.44×10^{-2}
Slovakia	0.31%	3.22	1.43×10^{-2}
Estonia	0.24%	3.82	1.30×10^{-2}
Romania	0.23%	0.93	1.04×10^{-2}
Austria	0.22%	2.22	7.38×10^{-3}
Finland	0.11%	0.79	6.74×10^{-3}
Spain	0.08%	3.28	9.69×10^{-3}
Belgium	0.07%	1.05	8.69×10^{-3}
Italy	0.04%	0.74	5.72×10^{-3}
Ireland	0.04%	2.20	5.20×10^{-3}
Slovenia	0.03%	0.68	2.59×10^{-3}
Luxembourg	0.02%	2.07	2.45×10^{-3}
Netherlands	0.01%	2.87	2.92×10^{-3}
Greece	0.01%	0.79	2.15×10^{-3}
Bangladesh	4×10^{-3}%	0.76	1.91×10^{-3}
Kazakhstan	3×10^{-3}%	3.14	2.79×10^{-3}
Chile	3×10^{-3}%	0.79	1.16×10^{-3}
Pakistan	3×10^{-3}%	0.93	1.22×10^{-3}
Ethiopia	2×10^{-3}%	0.91	8.03×10^{-4}
Switzerland	1×10^{-3}%	0.71	5.54×10^{-4}
Turkey	1×10^{-3}%	0.60	4.06×10^{-4}
Paraguay	9×10^{-4}%	0.65	2.38×10^{-4}
Norway	7×10^{-4}%	1.02	2.66×10^{-4}
Japan	2×10^{-4}%	0.45	7.38×10^{-5}
Korea, Rep.	3×10^{-5}%	1.45	4.28×10^{-5}
Morocco	1×10^{-5}%	3.20	4.73×10^{-5}
		$\Sigma = 2.89$	

Table S9. Data to determine trade barriers of soy bean consuming countries: countries, global consumption share and Worldwide Governance Index.

Soy Bean Consuming Countries	Global Consumption Share (gps) Based on Barrientos and Soria (2016)	Enabling Trade Indicator (ETI) Based on Hanouz et al. (2014)	Global Consumption Share × ETI
China	30.29%	2.60	4.60×10^{-1}
USA	17.69%	3.80	5.26×10^{-1}
Argentina	15.41%	3.90	6.01×10^{-1}
Brazil	13.83%	3.30	9.99×10^{-1}
India	2.60%	4.10	5.54×10^{-2}
Russia	1.46%	4.00	1.04×10^{-1}
Mexico	1.41%	2.60	2.03×10^{-2}
Paraguay	1.35%	3.80	2.05×10^{-2}
Japan	1.00%	3.40	3.01×10^{-3}
Indonesia	0.94%	3.90	3.46×10^{-2}
Bolivia	0.89%	4.10	6.00×10^{-2}
Taiwan	0.81%	3.40	1.22×10^{-2}
Turkey	0.79%	4.50	1.16×10^{-2}
Thailand	0.79%	3.40	3.18×10^{-2}
Canada	0.78%	3.90	4.77×10^{-3}
Egypt	0.67%	3.50	4.94×10^{-2}
Vietnam	0.63%	2.50	2.49×10^{-2}
Ukraine	0.54%	3.90	2.68×10^{-3}
Iran	0.49%	4.40	2.83×10^{-3}
Pakistan	0.48%	4.60	2.23×10^{-2}
Korea, Rep.	0.45%	4.00	2.38×10^{-3}
South Africa	0.36%	3.60	2.27×10^{-2}
Nigeria	0.26%	3.70	1.95×10^{-3}
Colombia	0.21%	2.90	1.31×10^{-2}
Serbia	0.12%	3.30	2.60×10^{-2}
Peru	0.11%	4.70	1.36×10^{-3}
Uruguay	0.09%	4.37	3.89×10^{-3}
Venezuela	0.09%	3.60	7.53×10^{-3}
Zambia	0.07%	3.50	7.88×10^{-4}
Myanmar	0.06%	2.70	5.12×10^{-4}
Uganda	0.06%	3.40	2.68×10^{-2}
Korea, Dem. Rep.	0.05%	3.50	7.32×10^{-4}
Philippines	0.04%	4.00	2.69×10^{-2}
Zimbabwe	0.03%	3.70	4.64×10^{-4}
Ecuador	0.02%	3.60	8.11×10^{-5}
Australia	0.02%	2.70	2.20×10^{-2}
Guatemala	0.02%	3.30	3.74×10^{-3}
Syrian Arab. Rep.	0.02%	2.40	1.39×10^{-4}
Switzerland	0.01%	4.10	1.98×10^{-2}
Bosnia	0.01%	4.10	9.50×10^{-4}
Nicaragua	0.00%	3.50	1.49×10^{-3}
		$\Sigma = 3.23$	

Table S10. Data to determine trade barriers of rapeseed consuming countries: countries, global consumption share and Enabling Trade Indicator.

Rapeseed Consuming Countries	Global Consumption Share (gcs) Based on Barrientos and Soria (2016)	Enabling Trade Indicator (ETI) Based on Hanouz et al. (2014)	Global Consumption Share × ETI
EU-27	36.91%	0.83	3.07×10^{-1}
China	27.83%	2.71	6.87×10^{-1}
Canada	13.06%	2.05	6.60×10^{-1}
India	9.00%	1.70	3.54×10^{-1}
Japan	3.65%	0.45	7.38×10^{-5}
USA	2.48%	2.00	5.01×10^{-2}
Russia	1.53%	3.53	6.81×10^{-2}
Australia	1.40%	1.40	1.24×10^{-1}
Pakistan	1.19%	3.28	9.69×10^{-3}
Turkey	0.74%	2.87	2.92×10^{-3}
Ukraine	0.48%	2.08	9.54×10^{-2}
Belarus	0.45%	0.99	1.64×10^{-2}
Bangladesh	0.45%	3.22	1.43×10^{-2}
Chile	0.28%	2.22	7.38×10^{-3}
Kazakhstan	0.25%	3.82	1.30×10^{-2}
Ethiopia	0.12%	2.20	5.20×10^{-3}
Switzerland	0.11%	2.07	2.45×10^{-3}
Paraguay	0.04%	3.14	2.79×10^{-3}
Norway	0.03%	0.60	4.06×10^{-4}
		$\Sigma = 2.42$	

3.2.4. Concentration of Harvesting

In the following it is explained how the Herfindahl-Hirschmann-Index (HHI) is calculated for the harvesting step for soy beans and rapeseeds. To determine the HHI the global production shares are squared and summed up (see Tables S11 and S12). For soy bean the HHI is 0.25 and for rapeseed it is 0.13.

Table S11. Production data to determine Herfindahl-Hirschmann-Index for soy beans.

Soy Bean Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Squared Global Production Shares
USA	33.5%	1.12×10^{-1}
Brazil	31.3%	9.83×10^{-2}
Argentina	17.9%	3.19×10^{-2}
China	3.8%	1.42×10^{-3}
Paraguay	2.8%	7.61×10^{-4}
India	2.5%	6.29×10^{-4}
Canada	2.0%	3.82×10^{-4}
Ukraine	1.2%	1.42×10^{-4}
Uruguay	1.0%	9.50×10^{-5}
Bolivia	1.0%	9.44×10^{-5}
Russia	0.9%	7.98×10^{-5}
South Africa	0.3%	7.78×10^{-6}
Nigeria	0.2%	4.15×10^{-6}
Indonesia	0.2%	3.78×10^{-6}
Serbia	0.2%	2.76×10^{-6}

Table S11. *Cont.*

Soy Bean Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Squared Global Production Shares
Mexico	0.1%	1.27×10^{-6}
Japan	0.1%	4.76×10^{-7}
Zambia	0.1%	4.50×10^{-7}
Myanmar	0.1%	3.93×10^{-7}
Iran	0.1%	3.74×10^{-7}
Uganda	0.1%	3.55×10^{-7}
Vietnam	0.1%	3.01×10^{-7}
Korea, Dem. Rep.	4.7×10^{-4}%	2.21×10^{-7}
Korea, Rep.	3.8×10^{-4}%	1.42×10^{-7}
Turkey	2.8×10^{-4}%	7.96×10^{-8}
Zimbabwe	2.8×10^{-4}%	7.96×10^{-8}
Venezuela	2.4×10^{-4}%	5.53×10^{-8}
Colombia	2.3×10^{-4}%	5.24×10^{-8}
Ecuador	2.2×10^{-4}%	4.81×10^{-8}
Australia	1.9×10^{-4}%	3.54×10^{-8}
Thailand	1.6×10^{-4}%	2.46×10^{-8}
Guatemala	1.1×10^{-4}%	1.27×10^{-8}
Egypt	6.3×10^{-5}%	3.93×10^{-9}
Bosnia	2.2×10^{-5}%	4.81×10^{-10}
Nicaragua	2.2×10^{-5}%	4.81×10^{-10}
Taiwan	1.9×10^{-5}%	3.54×10^{-10}
Peru	9.4×10^{-6}%	8.84×10^{-11}
Switzerland	9.4×10^{-6}%	8.84×10^{-11}
Pakistan	6.3×10^{-6}%	3.93×10^{-11}
Syrian Arab.Rep.	6.3×10^{-6}%	3.93×10^{-11}
Philippines	3.1×10^{-6}%	9.83×10^{-12}
	$\Sigma = 0.25$	

Table S12. Production data to determine Herfindahl-Hirschmann-Index for rapeseed.

Rapeseed Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Squared Global Production Shares
Canada	32%	6.45×10^{-2}
China	25%	4.34×10^{-2}
India	21%	7.85×10^{-3}
Australia	9%	2.10×10^{-3}
France	8.07%	6.51×10^{-3}
Germany	7.12%	5.07×10^{-3}
Ukraine	5%	6.30×10^{-4}
UK	3.79%	1.43×10^{-3}
USA	3%	3.71×10^{-4}
Poland	2.74%	7.52×10^{-4}
Russia	2%	2.76×10^{-4}
Belarus	2%	1.96×10^{-5}
Czech Rep.	1.64%	2.68×10^{-4}
Lithuania	0.93%	8.74×10^{-5}
Denmark	0.72%	5.13×10^{-5}
Hungary	0.59%	3.51×10^{-5}

Table S12. *Cont.*

Rapeseed Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Squared Global Production Shares
Sweden	0.48%	2.28×10^{-5}
Latvia	0.45%	2.02×10^{-5}
Bulgaria	0.40%	1.60×10^{-5}
Slovakia	0.31%	9.89×10^{-6}
Estonia	0.24%	5.79×10^{-6}
Romania	0.23%	5.51×10^{-6}
Austria	0.22%	4.84×10^{-6}
Finland	0.11%	1.16×10^{-6}
Spain	0.08%	5.90×10^{-7}
Belgium	0.07%	5.02×10^{-7}
Italy	0.04%	1.36×10^{-7}
Ireland	0.04%	1.71×10^{-7}
Slovenia	0.03%	6.30×10^{-8}
Luxembourg	0.02%	4.91×10^{-8}
Netherlands	0.01%	1.07×10^{-8}
Greece	0.01%	5.45×10^{-9}
Bangladesh	4×10^{-3}%	1.15×10^{-5}
Kazakhstan	3×10^{-3}%	1.10×10^{-5}
Chile	3×10^{-3}%	8.72×10^{-6}
Pakistan	3×10^{-3}%	5.58×10^{-6}
Ethiopia	2×10^{-3}%	1.40×10^{-6}
Switzerland	1×10^{-3}%	1.04×10^{-6}
Turkey	1×10^{-3}%	7.85×10^{-7}
Paraguay	9×10^{-4}%	4.61×10^{-7}
Norway	7×10^{-4}%	2.64×10^{-8}
Japan	2×10^{-4}%	8.72×10^{-10}
	$\Sigma = 0.13$	

3.2.5. Storage Complexity

In the following it is shown how the category storage complexity is calculated for soy beans and rapeseeds (see Tables S13 and S14). For soy beans the results add up to 7.78 and for rapeseed to 31.04. Furthermore according to Equation (7) (in the main part of the article) the moisture content of the material in storage has to be considered as well. For soy beans and rapeseed the average moisture content during storage is 11%–15% [3,4]. Thus, to both values 13 (average of 11 and 15) is added. The values for the storage complexity for soy beans is 20.78 and for rapeseed 44.04.

Table S13. Data to determine the storage complexity of soy bean producing countries: countries, global production share and Economic Vulnerability Indicator.

Soy Bean Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Economic Vulnerability Indicator (EVI) Based on Organisation for Economic Co-Operation and Development (2016)	Global Production Share × EVI
USA	33.5%	5.01	1.68
Brazil	31.3%	0.11	3.41×10^{-2}
Argentina	17.9%	8.39	1.50
China	3.8%	0.00	0
Paraguay	2.8%	24.72	6.82×10^{-1}
India	2.5%	16.77	4.21×10^{-1}
Canada	2.0%	86.00	1.68
Ukraine	1.2%	58.25	6.94×10^{-1}
Uruguay	1.0%	24.07	2.35×10^{-1}
Bolivia	1.0%	24.94	2.42×10^{-1}
Russia	0.9%	20.04	1.79×10^{-1}
South Africa	0.3%	12.31	3.43×10^{-2}
Nigeria	0.2%	56.42	1.15×10^{-1}
Indonesia	0.2%	14.49	2.82×10^{-2}
Serbia	0.2%	44.68	7.42×10^{-2}
Mexico	0.1%	3.81	4.30×10^{-3}
Japan	0.1%	8.82	6.08×10^{-3}
Zambia	0.1%	42.33	2.84×10^{-2}
Iran	0.1%	42.37	2.59×10^{-2}
Uganda	0.1%	49.78	2.96×10^{-2}
Vietnam	0.1%	36.97	2.03×10^{-2}
Korea, Rep.	3.8×10^{-4}%	60.55	2.28×10^{-2}
Turkey	2.8×10^{-4}%	15.25	4.30×10^{-3}
Zimbabwe	2.8×10^{-4}%	21.90	6.18×10^{-3}
Venezuela	2.4×10^{-4}%	38.77	9.12×10^{-3}
Colombia	2.3×10^{-4}%	21.13	4.84×10^{-3}
Ecuador	2.2×10^{-4}%	35.78	7.85×10^{-3}
Australia	1.9×10^{-4}%	15.36	2.89×10^{-3}
Thailand	1.6×10^{-4}%	30.28	4.75×10^{-3}
Guatemala	1.1×10^{-4}%	35.03	3.95×10^{-3}
Egypt	6.3×10^{-5}%	54.89	3.44×10^{-3}
Bosnia	2.2×10^{-5}%	42.05	9.23×10^{-4}
Nicaragua	2.2×10^{-5}%	48.14	1.06×10^{-3}
Peru	9.4×10^{-6}%	20.26	1.91×10^{-4}
Switzerland	9.4×10^{-6}%	14.81	1.39×10^{-4}
Pakistan	6.3×10^{-6}%	29.08	1.82×10^{-4}
Syrian Arab.Rep.	6.3×10^{-6}%	15.15	9.50×10^{-5}
Philippines	3.1×10^{-6}%	40.41	1.27×10^{-4}
		$\Sigma = 7.78$	

Table S14. Data to determine storage complexity of rapeseed producing countries: countries, global production share and Economic Vulnerability Indicator.

Rapeseed Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Economic Vulnerability Indicator (EVI) Based on Organisation for Economic Co-Operation and Development (2016)	Global Production Share × EVI
Canada	25.40%	67.85	2.18×10^{1}
China	20.82%	0.00	0.00
India	8.86%	7.14	1.49
France	8.07%	10.78	8.70×10^{-1}
Germany	7.12%	8.28	5.89×10^{-1}
Australia	4.58%	7.93	7.03×10^{-1}
UK	3.79%	8.82	3.34×10^{-1}
Poland	2.74%	14.59	4.00×10^{-1}
Ukraine	2.51%	31.94	1.46
USA	1.93%	3.85	9.66×10^{-2}
Russia	1.66%	17.28	3.33×10^{-1}
Czech Republic	1.64%	25.70	4.21×10^{-1}
Lithuania	0.93%	38.88	3.63×10^{-1}
Denmark	0.72%	33.87	2.43×10^{-1}
Hungary	0.59%	24.51	1.45×10^{-1}
Sweden	0.48%	17.32	8.26×10^{-2}
Latvia	0.45%	59.90	2.69×10^{-1}
Belarus	0.44%	8.27	1.37×10^{-1}
Bulgaria	0.40%	48.83	1.95×10^{-1}
Bangladesh	0.34%	20.04	8.88×10^{-2}
Kazakhstan	0.33%	33.12	1.12×10^{-1}
Slovakia	0.31%	29.73	9.35×10^{-2}
Chile	0.30%	88.89	2.95×10^{-1}
Estonia	0.24%	75.70	1.82×10^{-1}
Pakistan	0.24%	23.26	6.87×10^{-2}
Austria	0.22%	18.08	3.98×10^{-2}
Ethiopia	0.12%	14.79	3.50×10^{-2}
Finland	0.11%	23.85	2.57×10^{-2}
Switzerland	0.10%	12.78	1.51×10^{-2}
Turkey	0.09%	13.26	1.35×10^{-2}
Spain	0.08%	20.91	1.61×10^{-2}
Belgium	0.07%	32.02	2.27×10^{-2}
Paraguay	0.07%	18.96	1.68×10^{-2}
Ireland	0.04%	30.93	1.28×10^{-2}
Italy	0.04%	6.75	2.49×10^{-3}
Slovenia	0.03%	25.60	6.43×10^{-3}
Norway	0.02%	10.83	7.36×10^{-3}
Netherlands	0.01%	30.39	3.14×10^{-3}
Greece	0.01%	54.57	4.03×10^{-3}
Japan	0.00%	1.60	2.61×10^{-4}
		$\Sigma = 31.04$	

3.2.6. Application of Distance-to-Target Approach

In the following the in Section 2 (in the main part of the article) introduced Distance-to-Target (DtT) approach is applied. For more information regarding this approach in relation to the assessment of socio-economic availability see publications by Bach et al. (2016).

(Step 1) Determination of indicator values is carried out for soy beans and rapeseeds (see Table S15). The category storage complexity has been excluded as no targets are available for this category.

Table S15. Indicator results of case study for considered categories and supply chain stages.

Categories	Biotic Materials	Cultivation and Harvesting Step	Process Step	(Intermediate) Product
Political instability	Soy beans	2.66	2.24	2.24
	Rapeseeds	2.04	2.95	2.95
Demand growth	Soy beans	7.55	8.99	8.99
	Rapeseeds	2.6	1.6	1.6
Trade barriers	Soy beans	3.65	3.23	3.23
	Rapeseeds	2.89	2.73	2.73
Price fluctuations	Soy beans	7.14	n.a.	n.a.
	Rapeseeds	2.7	n.a.	n.a.
Occurence as co-product	Soy beans	0	0.5	0
	Rapeseeds	0	0.5	0
Concentration of harvesting	Soy beans	0.25	0	0
	Rapeseeds	0.13	0	0
Storage capacity	Soy beans	20.78	0	0
	Rapeseeds	44.04	0	0
Recycling	Soy beans	0	0	100
	Rapeseeds	0	0	100

(Step 2a) Determination of targets: Targets were identified in the previous project by Bach et al. (2016a). These are shown in Table S4 (in the main part of the article).

(Step 2b) Calculation of DtT-value (see Equation (9) in the main part of the article). Calculations and results are presented here exemplary for soy beans in the supply chain stage cultivation and harvest in Table S16.

Table S16. Calculation and results of DtT-value for considered categories for soy beans.

Categories	Indicator Results	Targets	DtT Calculation and Results
Political instability	2.66	1.9	$\left(\frac{2.66}{1.9}\right)^2 = 1.96$
Demand growth	7.55	5	$\left(\frac{7.55}{5}\right)^2 = 22801$
Trade barriers	3.65	3.15	$\left(\frac{3.65}{3.15}\right)^2 = 1.34$
Price fluctuations	7.14	20	$\left(\frac{7.14}{20}\right)^2 = 1275$
Occurence as co-product	0	0.5	$\left(\frac{0}{0.5}\right)^2 = 0$
Concentration of harvesting	0.25	0.15	$\left(\frac{0.25}{0.15}\right)^2 = 2.78$
Storage complexity	20.78	60	$\left(\frac{20.78}{60}\right)^2 = 0.12$ >>set to zero
Recycling	0	0.75	$\left(\frac{0}{0.75}\right)^2 = 0$

(Step 3) Normalization with the global production amount: results are presented exemplarily for soy beans and the supply chain stage cultivation and harvest (see Table S17). The global production for soy beans is 319 million tones [1].

Table S17. Calculation and results of normalized DtT-value for considered categories.

Categories	DtT values	Calculation and Results of Normalized DtT Values
Political instability	1.96	$\frac{1.96}{319\,008\,000} = 6.14 \times 10^{-9}$
Demand growth	22801	$\frac{22801}{319\,008\,000} = 7.15 \times 10^{-5}$
Trade barriers	1.34	$\frac{1.34}{319\,008\,000} = 4.21 \times 10^{-9}$
Price fluctuations	1275	$\frac{1275}{319\,008\,000} = 4.0 \times 10^{-6}$
Occurence as co-product	0	0
Concentration of harvesting	2.78	$\frac{2.78}{319\,008\,000} = 8.71 \times 10^{-9}$
Recycling	0	0
Storage complexity	0	0

(Step 4) Scaling of results: the determined results are rescaled to the 6.30×10^{15} (overall amount of cereals being produced in a year [5]). Furthermore, the largest value for each category has to be determined. Therefore, the results for all supply chain stages for soy bean and rapeseed are summed up (see Table S18). For some categories the overall value for soy beans is higher (demand growth), for some categories the overall value for rapeseeds is higher (political instability, trade barriers, price fluctuations, occurrence as co-product and recycling).

Table S18. Overall results for the biotic materials soy bean and rapeseed for considered categories.

Category/Biotic Material	Political Instability	Demand Growth	Trade Barriers	Price Fluc-Tuations	Occurence as co-Product	Concentration of Harvesting	Recycling
Soy beans	1.49×10^{-8}	2.74×10^{-4}	1.08×10^{-8}	4.00×10^{-6}	3.92×10^{-8}	8.71×10^{-9}	5.57×10^{-5}
Rapeseeds	8.82×10^{-8}	7.02×10^{-5}	1.24×10^{-8}	2.69×10^{-6}	1.85×10^{-7}	0	2.63×10^{-4}

The calculations are shown exemplary for soy beans and the supply chain stage cultivation and harvest (see Table S19) based on Equation (11) (in the main part of the article).

Table S19. Calculation and results of scaled values for considered categories.

Categories	Normalized DtT Values	Calculation and Results of Scaled Values
Political instability	6.14×10^{-9}	$\frac{6.3 \times 10^{15} \times 6.14 \times 10^{-9}}{8.82 \times 10^{-8}} = 4.39 \times 10^{14}$
Demand growth	7.15×10^{-5}	$\frac{6.3 \times 10^{15} \times 7.15 \times 10^{-5}}{2.74 \times 10^{-4}} = 1.64 \times 10^{15}$
Trade barriers	4.21×10^{-9}	$\frac{6.3 \times 10^{15} \times 4.21 \times 10^{-9}}{1.23 \times 10^{-8}} = 2.13 \times 10^{15}$
Price fluctuations	4.0×10^{-6}	$\frac{6.3 \times 10^{15} \times 4.0 \times 10^{-6}}{2.69 \times 10^{-6}} = 9.35 \times 10^{15}$
Occurence as co-product	0	0
Concentration of harvesting	8.71×10^{-9}	$\frac{6.3 \times 10^{15} \times 6.14 \times 10^{-9}}{8.82 \times 10^{-8}} = 4.39 \times 10^{14}$
Recycling	0	0

3.3. Abiotic Constraints

In the following it is shown how the abiotic constraints water availability and natural disasters are calculated.

3.3.1. Water Availability

Next it is explained how the water availability is determined for soy beans and rapeseeds according to Equation (12) (in the main part of the article) (see Tables S20 and S21). The water availability sums up to 0.33 for both biotic materials.

Table S20. Data for determination of the water availability of soy bean producing countries: countries, global production share and Water Depletion Index.

Soy Bean Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Water Depletion Index (WDI) Based on Berger et al. (2014)	Global Production Share × WDI
USA	33.5%	0.55	1.83×10^{-1}
Brazil	31.3%	0.08	2.48×10^{-2}
Argentina	17.9%	0.38	6.82×10^{-2}
China	3.8%	0.58	2.17×10^{-2}
Paraguay	2.8%	0.01	2.76×10^{-4}
India	2.5%	0.74	1.86×10^{-2}
Canada	2.0%	0.07	1.39×10^{-3}
Ukraine	1.2%	0.46	5.52×10^{-3}
Uruguay	1.0%	0.01	1.37×10^{-4}
Bolivia	1.0%	0.22	2.09×10^{-3}
Russia	0.9%	0.08	7.37×10^{-4}
South Africa	0.3%	0.83	2.33×10^{-3}
Nigeria	0.2%	0.28	5.68×10^{-4}
Indonesia	0.2%	0.17	3.25×10^{-4}
Serbia	0.2%	0.18	2.92×10^{-4}
Mexico	0.1%	0.78	8.76×10^{-4}
Japan	0.1%	0.48	3.33×10^{-4}
Myanmar	0.1%	0.02	1.07×10^{-5}
Iran	0.1%	0.95	5.80×10^{-4}
Uganda	0.1%	0.01	6.92×10^{-6}
Vietnam	0.1%	0.28	1.55×10^{-4}
Korea, Dem. Rep.	4.7×10^{-4}%	0.50	2.34×10^{-4}
Korea, Rep.	3.8×10^{-4}%	0.42	1.59×10^{-4}
Turkey	2.8×10^{-4}%	0.72	2.02×10^{-4}
Venezuela	2.4×10^{-4}%	0.39	9.27×10^{-5}
Colombia	2.3×10^{-4}%	0.02	3.78×10^{-6}
Ecuador	2.2×10^{-4}%	0.19	4.13×10^{-5}
Australia	1.9×10^{-4}%	0.91	1.70×10^{-4}
Thailand	1.6×10^{-4}%	0.05	8.24×10^{-6}
Guatemala	1.1×10^{-4}%	0.01	1.13×10^{-6}
Egypt	6.3×10^{-5}%	1.00	6.27×10^{-5}
Bosnia	2.2×10^{-5}%	0.18	3.88×10^{-6}
Nicaragua	2.2×10^{-5}%	0.01	2.20×10^{-7}
Peru	9.4×10^{-6}%	0.73	6.89×10^{-6}
Switzerland	9.4×10^{-6}%	0.36	3.35×10^{-6}
Pakistan	6.3×10^{-6}%	0.97	6.07×10^{-6}
Syrian Arab.Rep.	6.3×10^{-6}%	0.94	5.88×10^{-6}
Philippines	3.1×10^{-6}%	0.02	7.21×10^{-8}
		$\Sigma = 0.33$	

Table S21. Data for determination of water availability of rapeseed producing countries: countries, global production share and Water Depletion Index.

Rapeseed Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Water Depletion Index (WDI) Based on Berger et al. (2014)	Global Production Share × WDI
Canada	32%	0.06	1.80×10^{-2}
China	25%	0.47	1.20×10^{-1}
India	21%	0.32	6.57×10^{-2}
Australia	9%	0.47	4.14×10^{-2}
France	8.07%	0.22	1.75×10^{-2}
Germany	7.12%	0.17	1.24×10^{-2}
Ukraine	5%	0.25	1.16×10^{-2}
UK	3.79%	0.28	1.06×10^{-2}
USA	3%	0.42	1.05×10^{-2}
Poland	2.74%	0.04	1.03×10^{-3}
Russia	2%	0.07	1.37×10^{-3}
Belarus	2%	0.03	4.66×10^{-4}
Czech Rep.	1.64%	0.14	2.37×10^{-3}
Lithuania	0.93%	0.02	1.78×10^{-4}
Denmark	0.72%	0.28	2.02×10^{-3}
Hungary	0.59%	0.18	1.07×10^{-3}
Sweden	0.48%	0.15	7.37×10^{-4}
Latvia	0.45%	0.02	8.54×10^{-5}
Bulgaria	0.40%	0.56	2.26×10^{-3}
Slovakia	0.31%	0.18	5.57×10^{-4}
Estonia	0.24%	0.02	3.66×10^{-5}
Romania	0.24%	0.21	4.85×10^{-4}
Austria	0.22%	0.18	3.86×10^{-4}
Finland	0.11%	0.20	2.11×10^{-4}
Spain	0.08%	0.72	5.53×10^{-4}
Belgium	0.07%	0.86	6.12×10^{-4}
Italy	0.04%	0.64	2.36×10^{-4}
Ireland	0.04%	0.10	4.10×10^{-5}
Slovenia	0.03%	0.17	4.36×10^{-5}
Luxembourg	0.02%	0.25	5.47×10^{-5}
Netherlands	0.01%	0.74	7.63×10^{-5}
Greece	0.01%	0.69	5.09×10^{-5}
Bangladesh	4×10^{-3}%	0.15	6.50×10^{-4}
Kazakhstan	3×10^{-3}%	0.93	3.15×10^{-3}
Chile	3×10^{-3}%	0.61	2.03×10^{-3}
Pakistan	3×10^{-3}%	0.77	2.29×10^{-3}
Ethiopia	2×10^{-3}%	0.26	6.09×10^{-4}
Switzerland	1×10^{-3}%	0.31	3.63×10^{-4}
Turkey	1×10^{-3}%	0.62	6.34×10^{-4}
Paraguay	9×10^{-4}%	0.01	6.79×10^{-6}
Norway	7×10^{-4}%	0.06	3.80×10^{-5}
Japan	2×10^{-4}%	0.09	1.43×10^{-5}
Korea, Rep.	3×10^{-5}%	0.21	6.25×10^{-6}
Morocco	1×10^{-5}%	0.99	1.46×10^{-5}
		$\Sigma = 0.33$	

3.3.2. Natural Disasters

In the following it is explained how the results for the category natural disasters are obtained. Based on Equation (13) (in the main part of the article) the global production shares are multiplied with the Natural Disaster Index (NDI) per country and are summed up (see Tables S22 and S23). For soy beans the natural disaster risk adds up to 16.75. For rapeseed the overall risk is 10.84.

Table S22. Data for determination of the natural disaster risk of soy bean producing countries: countries, global production share and natural disaster index.

Soy Bean Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Natural Disaster Index (NDI) Based on United Nations Office for Disaster Risk Reduction (2013)	Global Production Share × NDI
USA	33.5%	31.37	1.05×10^{1}
Brazil	31.3%	10.88	3.41
Argentina	17.9%	5.79	1.03
China	3.8%	25.37	9.54×10^{-1}
Paraguay	2.8%	1.26	3.46×10^{-2}
India	2.5%	15.21	3.81×10^{-1}
Canada	2.0%	7.10	1.39×10^{-1}
Ukraine	1.2%	1.38	1.64×10^{-2}
Uruguay	1.0%	0.95	9.24×10^{-3}
Bolivia	1.0%	2.63	2.55×10^{-2}
Russia	0.9%	14.33	1.28×10^{-1}
South Africa	0.3%	5.16	1.44×10^{-2}
Nigeria	0.2%	2.74	5.59×10^{-3}
Indonesia	0.2%	7.14	1.39×10^{-2}
Serbia	0.2%	0.43	7.08×10^{-4}
Mexico	0.1%	8.09	9.13×10^{-3}
Japan	0.1%	2.55	1.76×10^{-3}
Myanmar	0.1%	3.51	2.20×10^{-3}
Iran	0.1%	5.80	3.55×10^{-3}
Uganda	0.1%	1.19	7.11×10^{-4}
Vietnam	0.1%	2.96	1.63×10^{-3}
Korea, Dem. Rep.	4.7×10^{-4}%	1.10	5.17×10^{-4}
Korea, Rep.	3.8×10^{-4}%	1.72	6.48×10^{-4}
Turkey	2.8×10^{-4}%	2.67	7.52×10^{-4}
Venezuela	2.4×10^{-4}%	2.50	5.88×10^{-4}
Colombia	2.3×10^{-4}%	3.06	7.00×10^{-4}
Ecuador	2.2×10^{-4}%	0.79	1.74×10^{-4}
Australia	1.9×10^{-4}%	23.77	4.47×10^{-3}
Thailand	1.6×10^{-4}%	3.88	6.08×10^{-4}
Guatemala	1.1×10^{-4}%	0.47	5.25×10^{-5}
Egypt	6.3×10^{-5}%	1.07	6.70×10^{-5}
Bosnia	2.2×10^{-5}%	0.37	8.09×10^{-6}
Nicaragua	2.2×10^{-5}%	0.63	1.39×10^{-5}
Taiwan	1.9×10^{-5}%	0.81	1.52×10^{-5}
Peru	9.4×10^{-6}%	3.63	3.42×10^{-5}
Switzerland	9.4×10^{-6}%	0.35	3.25×10^{-6}
Pakistan	6.3×10^{-6}%	4.73	2.96×10^{-5}
Syrian Arab.Rep.	6.3×10^{-6}%	0.66	4.14×10^{-6}
Philippines	3.1×10^{-6}%	7.16	2.24×10^{-5}
		$\Sigma = 16.75$	

Table S23. Data for determination of the natural disaster risk of rapeseed producing countries: countries, global production share and natural disaster index.

Rapeseed Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Natural Disaster Index (NDI) Based on United Nations Office for Disaster Risk Reduction (2013)	Global Production Share × NDI
Canada	32%	7.10	1.80
China	25%	25.37	5.28
India	21%	15.21	1.35
Australia	9%	23.77	1.09
France	8.07%	2.59	2.09×10^{-1}
Germany	7.12%	0.90	6.39×10^{-2}
Ukraine	5%	1.38	3.47×10^{-2}
UK	3.79%	1.64	6.19×10^{-2}
USA	3%	31.37	6.05×10^{-1}
Poland	2.74%	0.74	2.02×10^{-2}
Russia	2%	14.33	2.38×10^{-1}
Czech Rep.	1.64%	0.52	8.59×10^{-3}
Lithuania	0.93%	0.06	5.66×10^{-4}
Denmark	0.72%	0.34	2.44×10^{-3}
Hungary	0.59%	0.30	1.75×10^{-3}
Sweden	0.48%	0.47	2.25×10^{-3}
Latvia	0.45%	0.26	1.16×10^{-3}
Bulgaria	0.40%	0.79	3.14×10^{-3}
Slovakia	0.31%	0.24	7.56×10^{-4}
Estonia	0.24%	0.03	7.38×10^{-5}
Romania	0.24%	1.74	4.08×10^{-3}
Austria	0.22%	0.37	8.07×10^{-4}
Finland	0.11%	0.56	5.99×10^{-4}
Spain	0.08%	3.07	2.36×10^{-3}
Belgium	0.07%	0.07	5.13×10^{-5}
Italy	0.04%	2.87	1.06×10^{-3}
Ireland	0.04%	0.03	1.32×10^{-5}
Slovenia	0.03%	0.44	1.11×10^{-4}
Luxembourg	0.02%	0.00	0.00
Greece	0.01%	2.66	1.96×10^{-4}
Bangladesh	4×10^{-3}%	5.43	1.84×10^{-2}
Kazakhstan	3×10^{-3}%	3.24	1.08×10^{-2}
Chile	3×10^{-3}%	2.17	6.40×10^{-3}
Pakistan	3×10^{-3}%	4.73	1.12×10^{-2}
Ethiopia	2×10^{-3}%	3.16	3.74×10^{-3}
Switzerland	1×10^{-3}%	0.35	3.53×10^{-4}
Turkey	1×10^{-3}%	2.67	2.36×10^{-3}
Paraguay	9×10^{-4}%	1.26	8.53×10^{-4}
Norway	7×10^{-4}%	1.22	1.99×10^{-4}
Japan	2×10^{-4}%	2.55	7.52×10^{-5}
Korea, Rep.	3×10^{-5}%	1.72	2.55×10^{-5}
Morocco	1×10^{-5}%	1.93	2.85×10^{-5}
		$\Sigma = 10.84$	

3.4. Social Constraints

Next it is described how social constraints are determined.

3.4.1. Food Security

In the following it is explained how the food security is calculated for soy beans and rapeseeds according to Equation (14) (in the main part of the article) (see Tables S24 and S25). The food security sums up to 25.39 for soy beans and to 19.13 for rapeseed.

Table S24. Data for determination of the food security of soy bean producing countries: countries, global production share and Food Security Index.

Soy bean Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Food Security Index (FSI) Based on FAO (2016)	Global Production Share × FSI
USA	33.5%	15.29	5.13
Brazil	31.3%	39.50	1.24×10^{1}
Argentina	17.9%	20.64	3.69
China	3.8%	28.64	1.08
Paraguay	2.8%	28.86	7.96×10^{-1}
India	2.5%	32.55	8.16×10^{-1}
Canada	2.0%	11.27	2.20×10^{-1}
Ukraine	1.2%	19.66	2.34×10^{-1}
Uruguay	1.0%	28.77	2.80×10^{-1}
Bolivia	1.0%	4.85	4.71×10^{-2}
Russia	0.9%	13.85	1.24×10^{-1}
South Africa	0.3%	71.91	2.01×10^{-1}
Nigeria	0.2%	27.89	5.68×10^{-2}
Indonesia	0.2%	34.91	6.78×10^{-2}
Serbia	0.2%	32.55	5.41×10^{-2}
Mexico	0.1%	35.42	4.00×10^{-2}
Japan	0.1%	17.14	1.18×10^{-2}
Myanmar	0.1%	26.40	1.65×10^{-2}
Iran	0.1%	36.65	2.24×10^{-2}
Uganda	0.1%	34.50	2.05×10^{-2}
Vietnam	0.1%	48.46	2.66×10^{-2}
Korea, Dem. Rep.	4.7×10^{-4}%	28.15	1.32×10^{-2}
Korea, Rep.	3.8×10^{-4}%	45.20	1.70×10^{-2}
Turkey	2.8×10^{-4}%	35.77	1.01×10^{-2}
Venezuela	2.4×10^{-4}%	14.04	3.30×10^{-3}
Colombia	2.3×10^{-4}%	24.69	5.65×10^{-3}
Ecuador	2.2×10^{-4}%	32.82	7.20×10^{-3}
Australia	1.9×10^{-4}%	32.55	6.12×10^{-3}
Thailand	1.6×10^{-4}%	32.55	5.10×10^{-3}
Guatemala	1.1×10^{-4}%	36.13	4.08×10^{-3}
Egypt	6.3×10^{-5}%	24.29	1.52×10^{-3}
Bosnia	2.2×10^{-5}%	32.55	7.14×10^{-4}
Nicaragua	2.2×10^{-5}%	24.48	5.37×10^{-4}
Peru	9.4×10^{-6}%	20.08	1.89×10^{-4}
Switzerland	9.4×10^{-6}%	15.78	1.48×10^{-4}
Pakistan	6.3×10^{-6}%	27.11	1.70×10^{-4}
Syrian Arab.Rep.	6.3×10^{-6}%	25.96	1.63×10^{-4}
Philippines	3.1×10^{-6}%	35.18	1.10×10^{-4}
		$\Sigma = 25.39$	

Table S25. Data for determination of food security of rapeseed producing countries: countries, global production share and Food security Index.

Rapeseed Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Food Security Index Based on FAO (2016)	Global Production Share × FSI
Canada	32%	8.89	2.86
China	25%	23.48	5.96
India	21%	13.85	2.88
Australia	9%	16.82	1.49
France	8.07%	14.69	1.19
Germany	7.12%	8.30	5.91×10^{-1}
Ukraine	5%	10.78	4.94×10^{-1}
UK	3.79%	12.41	4.70×10^{-1}
USA	3%	11.74	2.95×10^{-1}
Poland	2.74%	18.40	5.05×10^{-1}
Russia	2%	11.94	2.30×10^{-1}
Belarus	2%	3.80	6.32×10^{-2}
Czech Rep.	1.64%	26.29	4.31×10^{-1}
Lithuania	0.93%	32.55	3.04×10^{-1}
Denmark	0.72%	13.00	9.31×10^{-2}
Hungary	0.59%	32.55	1.93×10^{-1}
Sweden	0.48%	19.69	9.39×10^{-2}
Latvia	0.45%	24.57	1.10×10^{-1}
Bulgaria	0.40%	19.37	7.75×10^{-2}
Slovakia	0.31%	32.55	1.02×10^{-1}
Estonia	0.24%	15.13	3.64×10^{-2}
Romania	0.24%	17.21	4.04×10^{-2}
Austria	0.22%	5.24	1.15×10^{-2}
Finland	0.11%	32.55	3.51×10^{-2}
Spain	0.08%	19.77	1.52×10^{-2}
Belgium	0.07%	16.26	1.15×10^{-2}
Italy	0.04%	19.50	7.20×10^{-3}
Ireland	0.04%	16.28	6.73×10^{-3}
Slovenia	0.03%	16.34	4.10×10^{-3}
Luxembourg	0.02%	9.10	2.02×10^{-3}
Netherlands	0.01%	20.93	2.16×10^{-3}
Greece	0.01%	32.55	2.40×10^{-3}
Bangladesh	4×10^{-3}%	38.74	1.72×10^{-1}
Kazakhstan	3×10^{-3}%	32.39	1.10×10^{-1}
Chile	3×10^{-3}%	17.29	5.75×10^{-2}
Pakistan	3×10^{-3}%	21.69	6.41×10^{-2}
Ethiopia	2×10^{-3}%	18.16	4.29×10^{-2}
Switzerland	1×10^{-3}%	13.61	1.61×10^{-2}
Turkey	1×10^{-3}%	31.10	3.17×10^{-2}
Paraguay	9×10^{-4}%	22.13	1.96×10^{-2}
Norway	7×10^{-4}%	4.49	3.05×10^{-3}
Japan	2×10^{-4}%	3.12	5.06×10^{-4}
Korea, Rep.	3×10^{-5}%	22.60	6.68×10^{-4}
Morocco	1×10^{-5}%	39.40	5.82×10^{-4}
		$\Sigma = 19.13$	

3.4.2. Societal Acceptance

In the following the calculations for the categories compliance with social and environmental standards is shown.

Compliance with Social Standards

In the following it is shown how the results for the category compliance with social standards are determined according to Equation (15) (in the main part of the article) (see Tables S26 and S27). The compliance with social standards sums up to 9.03 for soy beans and to 7.04 for rapeseed.

Table S26. Data to determine the societal acceptance of soy bean producing countries: countries, global production share and indicator for compliance with social standards.

Soy Bean Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Indicator for Compliance with Social Standards (ICS) Based on Norris et al. (2013)	Global Production Share × ICS
USA	33.5%	8.3	2.78
Brazil	31.3%	10.9	3.42
Argentina	17.9%	3.67	6.56×10^{-1}
China	3.8%	18.3	6.88×10^{-1}
Paraguay	2.8%	10.5	2.90×10^{-1}
India	2.5%	20.9	5.24×10^{-1}
Ukraine	1.2%	13.1	1.56×10^{-1}
Uruguay	1.0%	4	3.90×10^{-2}
Bolivia	1.0%	14	1.36×10^{-1}
Russia	0.9%	15.8	1.41×10^{-1}
South Africa	0.3%	17.7	4.94×10^{-2}
Nigeria	0.2%	22.6	4.60×10^{-2}
Indonesia	0.2%	14.8	2.88×10^{-2}
Serbia	0.2%	9.6	1.59×10^{-2}
Mexico	0.1%	9.7	1.09×10^{-2}
Japan	0.1%	1.5	1.03×10^{-3}
Myanmar	0.1%	20.3	1.27×10^{-2}
Iran	0.1%	14.1	8.62×10^{-3}
Uganda	0.1%	20.6	1.23×10^{-2}
Korea, Rep.	3.8×10^{-4}%	5.9	2.22×10^{-3}
Turkey	2.8×10^{-4}%	13.9	3.92×10^{-3}
Venezuela	2.4×10^{-4}%	7.2	1.69×10^{-3}
Colombia	2.3×10^{-4}%	12.9	2.95×10^{-3}
Ecuador	2.2×10^{-4}%	8.3	1.82×10^{-3}
Australia	1.9×10^{-4}%	3.5	6.58×10^{-4}
Thailand	1.6×10^{-4}%	10.3	1.61×10^{-3}
Guatemala	1.1×10^{-4}%	10.9	1.23×10^{-3}
Egypt	6.3×10^{-5}%	8	5.02×10^{-4}
Bosnia	2.2×10^{-5}%	10.8	2.37×10^{-4}
Nicaragua	2.2×10^{-5}%	10.1	2.22×10^{-4}
Taiwan	1.9×10^{-5}%	2.7	5.08×10^{-5}
Peru	9.4×10^{-6}%	14	1.32×10^{-4}
Pakistan	6.3×10^{-6}%	19.8	1.24×10^{-4}
Syrian Arab. Rep.	6.3×10^{-6}%	12.3	7.71×10^{-5}
Philippines	3.1×10^{-6}%	18.2	5.71×10^{-5}
		$\Sigma = 9.03$	

Table S27. Data to determine the societal acceptance of rapeseed producing countries: countries, global production share and indicator for compliance with social standards.

Rapeseed Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	Indicator for Compliance with Social Standards (ICS) Based on Norris et al. (2013)	Global Production Share × ICS
China	25%	15.00	3.81
India	21%	8.89	1.85
Australia	9%	1.81	1.60×10^{-1}
France	8.07%	1.00	8.07×10^{-2}
Germany	7.12%	0.26	1.85×10^{-2}
Ukraine	5%	7.18	3.29×10^{-1}
USA	3%	6.37	1.60×10^{-1}
Poland	2.74%	1.00	2.74×10^{-2}
Russia	2%	13.62	2.62×10^{-1}
Belarus	2%	2.64	4.39×10^{-2}
Czech Rep.	1.64%	0.70	1.15×10^{-2}
Lithuania	0.93%	1.70	1.59×10^{-2}
Hungary	0.59%	4.10	2.43×10^{-2}
Latvia	0.45%	1.80	8.08×10^{-3}
Bulgaria	0.40%	6.00	2.40×10^{-2}
Slovakia	0.31%	0.67	2.11×10^{-3}
Estonia	0.24%	6.00	1.41×10^{-2}
Austria	0.22%	1.50	3.30×10^{-3}
Greece	0.01%	2.40	1.77×10^{-4}
Bangladesh	4×10^{-3}%	11.04	4.89×10^{-2}
Kazakhstan	3×10^{-3}%	8.71	2.96×10^{-2}
Chile	3×10^{-3}%	6.22	2.07×10^{-2}
Pakistan	3×10^{-3}%	15.84	4.68×10^{-2}
Ethiopia	2×10^{-3}%	9.70	2.29×10^{-2}
Switzerland	1×10^{-3}%	12.09	1.23×10^{-2}
Turkey	1×10^{-3}%	8.05	7.13×10^{-3}
Paraguay	9×10^{-4}%	0.27	4.43×10^{-5}
Norway	7×10^{-4}%	2.95	8.71×10^{-5}
Japan	2×10^{-4}%	14.00	2.07×10^{-4}
		$\Sigma = 7.04$	

Compliance with Environmental Standards

In the following it is shown how the results for the category compliance with environmental standards are determined according to Equation (16) (in the main part of the article) (see Tables S28 and S29). The compliance with environmental standards sums up to 11.04 for soy beans and to 11.17 for rapeseed.

Table S28. Data for determination of the compliance with environmental standards of soy bean producing countries: countries, global production share and Environmental Performance Indicators (EPI).

Soy Bean Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	EPI Indicators Based on Yale Center for Environmental Law & Policy (2014)	Global Production Share × EPI
USA	33.5%	8.80	2.95
Brazil	31.3%	9.77	3.06
Argentina	17.9%	13.96	2.49
China	3.8%	9.25	3.48×10^{-1}
Paraguay	2.8%	25.53	7.04×10^{-1}
India	2.5%	16.19	4.06×10^{-1}
Canada	2.0%	10.67	2.09×10^{-1}
Ukraine	1.2%	18.36	2.19×10^{-1}
Uruguay	1.0%	21.55	2.10×10^{-1}
Bolivia	1.0%	15.00	1.46×10^{-1}
Russia	0.9%	13.58	1.21×10^{-1}
South Africa	0.3%	7.12	1.99×10^{-2}
Nigeria	0.2%	12.36	2.52×10^{-2}
Indonesia	0.2%	5.90	1.15×10^{-2}
Serbia	0.2%	18.72	3.11×10^{-2}
Mexico	0.1%	10.21	1.15×10^{-2}
Japan	0.1%	8.18	5.64×10^{-3}
Myanmar	0.1%	20.31	1.27×10^{-2}
Iran	0.1%	17.58	1.07×10^{-2}
Uganda	0.1%	9.82	5.85×10^{-3}
Vietnam	0.1%	14.19	7.79×10^{-3}
Korea, Dem. Rep.	4.7×10^{-4}%	28.67	1.35×10^{-2}
Korea, Rep.	3.8×10^{-4}%	17.18	6.46×10^{-3}
Turkey	2.8×10^{-4}%	17.02	4.80×10^{-3}
Venezuela	2.4×10^{-4}%	1.50	3.53×10^{-4}
Colombia	2.3×10^{-4}%	4.83	1.11×10^{-3}
Ecuador	2.2×10^{-4}%	1.85	4.06×10^{-4}
Australia	1.9×10^{-4}%	2.59	4.86×10^{-4}
Thailand	1.6×10^{-4}%	14.00	2.19×10^{-3}
Guatemala	1.1×10^{-4}%	12.34	1.39×10^{-3}
Egypt	6.3×10^{-5}%	14.28	8.95×10^{-4}
Bosnia	2.2×10^{-5}%	28.42	6.24×10^{-4}
Nicaragua	2.2×10^{-5}%	10.32	2.26×10^{-4}
Taiwan	1.9×10^{-5}%	14.02	2.64×10^{-4}
Peru	9.4×10^{-6}%	8.11	7.63×10^{-5}
Switzerland	9.4×10^{-6}%	18.67	1.76×10^{-4}
Pakistan	6.3×10^{-6}%	17.57	1.10×10^{-4}
Syrian Arab.Rep.	6.3×10^{-6}%	21.99	1.38×10^{-4}
Philippines	3.1×10^{-6}%	9.80	3.07×10^{-5}
		$\Sigma = 11.04$	

Table S29. Data for determination of environmental compliance of rapeseed producing countries: countries, global production share and Environmental Performance Indicators (EPI).

Rapeseed Producing Countries	Global Production Share (gps) Based on Barrientos and Soria (2016)	EPI Based on Yale Center for Environmental Law & Policy (2014)	Global Production Share × EPI
Canada	32%	8.42	2.71
China	25%	7.59	1.93
India	21%	6.89	1.43
Australia	9%	1.34	1.18×10^{-1}
France	8.07%	15.26	1.23
Germany	7.12%	8.67	6.17×10^{-1}
Ukraine	5%	10.07	4.61×10^{-1}
UK	3.79%	10.62	4.02×10^{-1}
USA	3%	6.75	1.70×10^{-1}
Poland	2.74%	11.14	3.05×10^{-1}
Russia	2%	11.70	2.26×10^{-1}
Belarus	2%	6.54	1.09×10^{-1}
Czech Rep.	1.64%	18.83	3.08×10^{-1}
Lithuania	0.93%	9.89	9.25×10^{-2}
Denmark	0.72%	15.82	1.13×10^{-1}
Hungary	0.59%	25.71	1.52×10^{-1}
Sweden	0.48%	14.83	7.08×10^{-2}
Latvia	0.45%	28.41	1.28×10^{-1}
Bulgaria	0.40%	18.01	7.21×10^{-2}
Slovakia	0.31%	19.89	6.26×10^{-2}
Estonia	0.24%	8.67	2.09×10^{-2}
Romania	0.24%	14.18	3.33×10^{-2}
Austria	0.22%	19.64	4.32×10^{-2}
Finland	0.11%	15.14	1.63×10^{-2}
Spain	0.08%	16.52	1.27×10^{-2}
Belgium	0.07%	20.03	1.42×10^{-2}
Italy	0.04%	3.05	1.13×10^{-3}
Ireland	0.04%	24.08	9.96×10^{-3}
Slovenia	0.03%	18.67	4.69×10^{-3}
Luxembourg	0.02%	18.67	4.13×10^{-3}
Netherlands	0.01%	28.67	2.96×10^{-3}
Greece	0.01%	11.66	8.61×10^{-4}
Bangladesh	4×10^{-3}%	14.45	6.40×10^{-2}
Kazakhstan	3×10^{-3}%	26.40	8.97×10^{-2}
Chile	3×10^{-3}%	8.89	2.95×10^{-2}
Pakistan	3×10^{-3}%	14.06	4.15×10^{-2}
Ethiopia	2×10^{-3}%	6.38	1.51×10^{-2}
Switzerland	1×10^{-3}%	16.10	1.90×10^{-2}
Turkey	1×10^{-3}%	14.80	1.51×10^{-2}
Paraguay	9×10^{-4}%	19.58	1.73×10^{-2}
Norway	7×10^{-4}%	3.56	2.42×10^{-3}
Japan	2×10^{-4}%	1.49	2.42×10^{-4}
Korea, Rep.	3×10^{-5}%	8.59	2.54×10^{-4}
Morocco	1×10^{-5}%	20.93	3.09×10^{-4}
		$\Sigma = 11.17$	

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