**SUPPLEMENTARY MATERIAL**

**Uncertainty in life cycle greenhouse gas emissions of sustainable aviation fuels from vegetable oils**

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# SM1. Fatty acid profile of the vegetable oils for the analyzed feedstocks.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Feedstock | C16:0 | C18:0 | C18:1 | C18:2 | C18:3 | C18:1-OH | C20:0 | C20:1 | C20:2 | C22:0 | C22:1 | 24:1 |
| Camelina[1] | 7.8 | 3.0 | 16.8 | 23.0 | 31.2 | - | - | 12.0 | - | - | 2.8 | - |
| Castor[2] | 1.1 | 1.0 | 3.3 | 4.7 | 0.7 | 87.7 | - | - | - | - | - | - |
| Jatropha[3] | 13.0 | 8.0 | 45.0 | 34.0 | - | - | - | - | - | 1.0 | - | - |
| Palm[4] | 40.8 | 3.7 | 37.2 | 10.1 | - | - | - | - | - | - | - | - |
| Pennycress[5] | 3.1 | 0.5 | 11.1 | 22.4 | 11.8 | - | 0.3 | 8.6 | 1.6 | 0.6 | 32.8 | 2.9 |
| Rapeseed[6] | 3.5 | 0.9 | 64.1 | 22.3 | 8.2 | - | - | - | - | - | - | - |
| Salicornia[3] | 7.0 | 3.0 | 18.0 | 73.0 | - | - | - | - | - | - | - | - |
| Soybean[3] | 11.0 | 4.0 | 22.0 | 53.0 | 8.0 | - | - | - | - | - | - | - |
| E. tobacco[7] | 15.2 | 4.8 | 13.2 | 66.7 | 1 | - | - | - | - | - | - | - |

# SM2. Life cycle inventory for castor-HEFA fuel production

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Parameter* | *Unit* | *Rangea* | *Distribution* | *References/notes* |
| *Cultivation* |  |  |  |  |
| *Castor seed yield* | kg/ha | 1100 | - | [8] |
| *Seed moisture content* | wt % | 3.5 | - | [9] |
| *Seed oil content*  | wt % | [45.5, 47.0, 52.1] | Triangular | [10,11] |
| *Oil extraction efficiency* | % | 96 | - |  |
| *N fertilizer*  | g/kg seeds | [13.5, 32.8, 67.4] | Triangular | [10,12–15] |
| *P fertilizer*  | g/kg seeds | [0. 17.3, 42.1] | Triangular | [10,12–15] |
| *K fertilizer*  | g/kg seeds | [0, 13.7, 33.7] | Triangular | [10,12–15] |
| *Diesel for farming*  | MJ/kg seeds | [1.16, 1.19, 1.22] | Triangular | [12,15] |
|  |  |  |  |  |
| *Oil extractionb* |  |  |  |  |
| *Castor seeds* | kg/kg oil | [1.9, 2.1, 2.2] | - | Calculatedc |
| *Natural gas* | MJ/kg oil | [2.2, 2.4, 2.5] | Triangular |  |
| *Electricity* | MJ/kg oil | [0.38, 0.41, 0.43] | Triangular |  |
| *N-hexane* | kg/kg oil | [0.13, 0.14, 0.15] | Triangular |  |
| *Co-product, meal* | kg/kg oil | [0.9, 1.1, 1.2] | - | Calculatedd |
| *Meal energy content* | MJ/kg meal | 15.2 | - |  |
| *Oil energy content* | MJ/kg oil | 36.2 | - | [11] |
|  |  |  |  |  |
| *HEFA Conversione* |  |  |  |  |
| *Castor oil* | kg | [1.23, 1.25, 1.27] | Triangular | [16] |
| *Natural gas* | MJ | [0.08, 0.14, 0.19] | Triangular | [16] |
| *Electricity* | MJ | [0.005, 0.006, 0.008] | Triangular | [16] |
| *Hydrogen* | MJ | [0.09, 0.05, 0.02] | Triangular | [16] |
| *Jet fuel energy content* | MJ/kg jet | 44.10 | - | [17] |
| *Jet fuel density* | g/L | 757 | - | [17] |

a Range: [min, mean, max] of the collected literature values, b Oil extraction utilities are estimated via the modification of the soybean crushing process model by Sheehan et al. [18], c calculated using the following formula: (1-seed moisture content)/oil content/(1-loss factor), d calculated using the following formula: (1-seed moisture content-oil content)/oil content/(1-loss factor), e HEFA conversion data from CORSIA for the EU and the US have been utilized.

# SM3. Life cycle inventory for jatropha-HEFA fuel production

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Parameter* | *Unit* | *Rangea* | *Distribution* | *References* |
| *Cultivation* |  |  |  |  |
| *Jatropha seed yield* | kg/ha | 2500 | - | [3] |
| *Seed moisture content* | wt % | 5.8 | - | [19] |
| *Seed oil content*  | wt % | [34, 35, 37] | Triangular | [3] |
| *Oil extraction efficiency* | % | 96 | - |  |
| *N fertilizer* | g/kg seeds | [7.0, 27.6, 61.5] | Triangular | [3,20–23] |
| *P fertilizer* | g/kg seeds | [0. 24.5, 63.3] | Triangular | [3,20–23] |
| *K fertilizer* | g/kg seeds | [5.4, 20.1, 50.6] | Triangular | [3,20–23] |
| *Diesel for farming* | MJ/kg seeds | [0.1, 1.1, 1.6] | Triangular | [3,20–23] |
| *Pesticides* | g/kg seeds | [0, 2.9, 9.6] | Triangular | [3,20–23] |
|  |  |  |  |  |
| *Oil extractionb* |  |  |  |  |
| *Jatropha seeds* | kg/kg oil | [2.7, 2.8, 2.9] | - | Calculatedc |
| *Natural gas* | MJ/kg oil | [1.84, 1.80, 1.86] | Triangular |  |
| *Electricity* | MJ/kg oil | [0.61, 0.70, 0.72] | Triangular |  |
| *N-hexane* | kg/kg oil | [0.17, 0.18, 0.18] | Triangular |  |
| *Co-product, meal* | kg/kg oil | [0.69, 0.73, 0.75] | - | Calculatedd |
| *Co-product, electricity* | MJ/kg oil | [8.7, 9.2, 9.5] | - | Calculatedf |
| *Meal energy content* | MJ/kg meal | 18.0 | - | [19] |
| *Oil energy content* | MJ/kg oil | 39.5 | - | [19] |
|  |  |  |  |  |
| *HEFA Conversione* |  |  |  |  |
| *Jatropha oil* | Kg/MJ jet | [1.23, 1.25, 1.27] | Triangular | [16] |
| *Natural gas* | MJ/MJ jet | [0.08, 0.14, 0.19] | Triangular | [16] |
| *Electricity* | MJ/MJ jet | [0.005, 0.006, 0.008] | Triangular | [16] |
| *Hydrogen* | MJ/MJ jet | [0.09, 0.05, 0.02] | Triangular | [16] |
| *Jet fuel energy content* | MJ/kg jet | 44.10 | - | [17] |
| *Jet fuel density* | g/L | 757 | - | [17] |

a Range: [min, mean, max] of the collected literature values, b Oil extraction utilities are estimated via the modification of the soybean crushing process model by Sheehan et al. [18], c calculated using the following formula: (1-seed moisture content)/oil content/(1-loss factor), d calculated using the meal vs seed ratio from Reinhardt et al. 2008, e HEFA conversion data from CORSIA for the EU and the US have been utilized. f Electricity used for extraction (0.7 MJ/kg oil) is subtracted from the total amount of electricity produced.

# SM4. Life cycle inventory for pennycress-HEFA fuel production

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Parameter* | *Unit* | *Rangea* | *Distribution* | *References* |
| *Cultivation* |  |  |  |  |
| *Pennycress seed yield* | kg/ha | 1000 | - | [24,25] |
| *Seed moisture content* | wt % | 12 | - | [26] |
| *Seed oil content*  | wt % | [29, 34, 36] | Triangular | [26,27] |
| *Oil extraction efficiency* | % | 96 | - |  |
| *N fertilizer* | g/kg seeds | [27.8, 63.5, 100.5] | Triangular | [25,26,28–33] |
| *P fertilizer* | g/kg seeds | [0, 31.8, 86.1] | Triangular | [25,26,28–33] |
| *K fertilizer* | g/kg seeds | [0, 18.2, 30.9] | Triangular | [25,26,28–33] |
| *Diesel for farming* | MJ/kg seeds | [0.16, 0.17, 0.174] | Triangular | [26,32] |
|  |  |  |  |  |
| *Oil extractionb* |  |  |  |  |
| *Pennycress seeds* | kg/kg oil | [2.5, 2.7, 3.2] | - | Calculatedc |
| *Natural gas* | MJ/kg oil | [2.9, 3.1, 3.7] | Triangular |  |
| *Electricity* | MJ/kg oil | [0.5,0.53, 0.62] | Triangular |  |
| *N-hexane* | kg/kg oil | [0.17, 0.18, 0.21] | Triangular |  |
| *Co-product, meal* | kg/kg oil | [1.5, 1.65, 2.1] | - | Calculatedd |
| *Meal energy content* | MJ/kg meal | 18.6 | - | [26] |
| *Oil energy content* | MJ/kg oil | 36.6 | - | [26] |
|  |  |  |  |  |
| *HEFA Conversione* |  |  |  |  |
| *Pennycress oil* | kg/MJ jet | [1.23, 1.25, 1.27] | Triangular | [16] |
| *Natural gas* | MJ/MJ jet | [0.08, 0.14, 0.19] | Triangular | [16] |
| *Electricity* | MJ/MJ jet | [0.005, 0.006, 0.008] | Triangular | [16] |
| *Hydrogen* | MJ/MJ jet | [0.02, 0.05, 0.09] | Triangular | [16] |
| *Jet fuel energy content* | MJ/kg jet | 44.10 | - | [17] |
| *Jet fuel density* | g/L | 757 | - | [17] |

a Range: [min, mean, max] of the collected literature values, b Oil extraction utilities are estimated via the modification of the soybean crushing process model by Sheehan et al. [18], c calculated using the following formula: (1-seed moisture content)/oil content/(1-loss factor), d calculated using the following formula: (1-seed moisture content-oil content)/oil content/(1-loss factor), e HEFA conversion data from CORSIA for the EU and the US have been utilized.

# SM5. Life cycle inventory for salicornia-HEFA fuel production

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Parameter* | *Unit* | *Rangea* | *Distribution* | *References* |
| *Cultivation* |  |  |  |  |
| *Salicornia seed yield* | kg/ha | 2000 | - | [34,35] |
| *Seed moisture content* | wt % | 6.4 | - | [36] |
| *Seed oil content*  | wt % | [26, 28.2, 33] | Triangular | [3] |
| *Oil extraction efficiency* | % | 96 | - |  |
| *N fertilizer* | g/kg seeds | [0, 50.6, 133] | Triangular | [3] |
| *Diesel for farming* | MJ/kg seeds | [19.6, 26.7, 36.8] | Triangular | [3] |
|  |  |  |  |  |
| *Oil extractionb* |  |  |  |  |
| *Salicornia seeds* | kg/kg oil | [3.0, 3.5, 3.8] | - | Calculatedc |
| *Natural gas* | MJ/kg oil | [2.5, 4.0, 6.7] | Triangular |  |
| *Electricity* | MJ/kg oil | [0.24, 0.38, 0.63] | Triangular |  |
| *N-hexane* | kg/kg oil | [0.20, 0.23, 0.25] | Triangular |  |
| *Co-product, meal* | kg/kg oil | [1.9, 2.4, 2.7] | - | Calculatedd |
| *Co-product, strawe* | kg/kg seeds | 7.22 | - | [3] |
| *Meal energy content* | MJ/kg meal | 18.0 | - | [3] |
| *Oil energy content* | MJ/kg oil | 38.9 | - | [37] |
| *Straw energy content* | MJ/kg straw | 16.3 | - | [3] |
|  |  |  |  |  |
| *HEFA Conversionf* |  |  |  |  |
| *Salicornia oil* | kg/MJ jet | [1.23, 1.25, 1.27] | Triangular | [16] |
| *Natural gas* | MJ/MJ jet | [0.08, 0.14, 0.19] | Triangular | [16] |
| *Electricity* | MJ/MJ jet | [0.005, 0.006, 0.008] | Triangular | [16] |
| *Hydrogen* | MJ/MJ jet | [0.02, 0.05, 0.09] | Triangular | [16] |
| *Jet fuel energy content* | MJ/kg jet | 44.10 | - | [17] |
| *Jet fuel density* | g/L | 757 | - | [17] |

a Range: [min, mean, max] of the collected literature values, b Oil extraction utilities are estimated via the modification of the soybean crushing process model by Sheehan et al. [18], c calculated using the following formula: (1-seed moisture content)/oil content/(1-loss factor), d calculated using the following formula: (1-seed moisture content-oil content)/oil content/(1-loss factor), e Salicornia straw was assumed to be used for fuel production through FT synthesis, however the emissions were not allocated to these fuels, f HEFA conversion data from CORSIA for the EU and the US have been utilized.

# SM6. Life cycle inventory for energy tobacco-HEFA fuel production

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Parameter* | *Unit* | *Rangea* | *Distribution* | *References* |
| *Cultivation* |  |  |  |  |
| *E. Tobacco seed yield* | kg/ha | 2100 | - | [38] |
| *Seed moisture content* | wt % | 5.0 | - | [39] |
| *Seed oil content*  | wt % | [33, 38, 40] | Triangular | [38,39] |
| *Oil extraction efficiency* | % | 96 | - |  |
| *N fertilizer* | g/kg seeds | [11.8, 56.1, 80.6] | Triangular | [38–40] |
| *P fertilizer* | g/kg seeds | [7.3, 36.8, 60.5] | Triangular | [38–40] |
| *K fertilizer* | g/kg seeds | [0, 31.7, 65.7] | Triangular | [38–40] |
| *Pesticides* | g/kg seeds | 0.33 | - | [40] |
| *Herbicides* | g/kg seeds | 0.41 | - | [40] |
| *Diesel for farming* | MJ/kg seeds | 0.13 | - | [40] |
|  |  |  |  |  |
| *Oil extractionb* |  |  |  |  |
| *E. Tobacco seeds* | kg/kg oil | [2.5, 2.6, 3.3] | - | Calculatedc |
| *Natural gas* | MJ/kg oil | [2.9, 3.0, 3.8] | Triangular |  |
| *Electricity* | MJ/kg oil | [0.48, 0.51, 0.64] | Triangular |  |
| *N-hexane* | kg/kg oil | [0.16, 0.17, 0.22] | Triangular |  |
| *Co-product, meal* | kg/kg oil | [1.4, 1.6, 2.0] | - | Calculatedd |
| *Meal energy content* | MJ/kg meal | 13.4 | - | [41] |
| *Oil energy content* | MJ/kg oil | 39.4 | - | [40] |
|  |  |  |  |  |
| *HEFA Conversione* |  |  |  |  |
| *E. Tobacco oil* | kg/MJ jet | [1.23, 1.25, 1.27] | Triangular | [16] |
| *Natural gas* | MJ/MJ jet | [0.08, 0.14, 0.19] | Triangular | [16] |
| *Electricity* | MJ/MJ jet | [0.005, 0.006, 0.008] | Triangular | [16] |
| *Hydrogen* | MJ/MJ jet | [0.02, 0.05, 0.09] | Triangular | [16] |
| *Jet fuel energy content* | MJ/kg jet | 44.10 | - | [17] |
| *Jet fuel density* | g/L | 757 | - | [17] |

a Range: [min, mean, max] of the collected literature values, b Oil extraction utilities are estimated via the modification of the soybean crushing process model by Sheehan et al. [18], c calculated using the following formula: (1-seed moisture content)/oil content/(1-loss factor), d calculated using the following formula: (1-seed moisture content-oil content)/oil content/(1-loss factor), e HEFA conversion data from CORSIA for EU and US have been utilized.

# SM7. Market prices, energy contents (LHV: Lower heating value) and allocation factors (AF) for the oil extraction step products

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Amount (kg) | LHV (MJ/kg) | Market value ($/kg) | Energy AF (%) | Market AF (%) | Mass AF (%) |
| **Oil extraction process** |  |  |  |  |  |  |
| Castor oil | 1.0 | 36.2 [11] | 1.7 [42] | 68.5 | 90.6 | 47.7 |
| Castor meal | 1.1a | 15.2 | 0.16e | 31.5 | 9.4 | 52.3 |
| Jatropha oil | 1.0 | 39.5 [19] | 0.4 [42] | 64.6 | 65.9 | 57.8 |
| Jatropha meal | 0.73 | 18.0 [19] | 0.05e | 21.4 | 6.0 | 42.2 |
| Jatropha huskb | 0.95 | 15.5 [19] | 0.072f [17] | 14.0 | 28.1 | 0 |
| Jatropha shellb | 1.5 | 19.0 [19] |
| Pennycress oil | 1.0 | 36.6 [26] | 0.81 [42] | 54.3 | 69.0 | 37.7 |
| Pennycress meal | 1.65a | 18.6 [26] | 0.22 [26] | 45.7 | 31.0 | 62.3 |
| Salicornia seedc | 3.5 | 23.8d | 0.2g [43] | 16.9 | 25.0 | 12.0 |
| Salicornia straw | 25.0 | 16.3 [3] | 0.08h [44] | 83.1 | 75.0 | 88.0 |
| Salicornia oil | 1.0 | 38.9 [37] | 0.85 [3] | 47.2 | 57.4 | 29.3 |
| Salicornia meal | 2.4a | 18.0 [3] | 0.26i [17] | 52.8 | 42.6 | 70.7 |
| E. tobacco oil | 1.0 | 40.5 [40] | 1.6 | 66.0 | 79.7 | 39.0 |
| E. tobacco meal | 1.56a | 13.4 [41] | 0.26i [17] | 34.0 | 20.3 | 61.0 |

a Meal amount was calculated using formula: (1-seed oil content-seed moisture content)/seed oil content/ (1-loss factor).

b Jatropha husk and shell were assumed to be combusted for electricity production, net electricity after consumption for the extraction process is 8.5 MJ/kg oil. Biomass conversion efficiency to electricity from GREET 2021 was used (around 22% of overall conversion efficiency, assuming the use of biomass utility boiler and biomass IGCC. Electricity used during oil extraction (0.7 MJ/kg oil) is subtracted from the total amount of electricity produced before allocation.

c For Salicornia the first allocation is applied between the seed and the straw, and the second allocation is applied between the oil and the meal

d LHV of salicornia seed is unknown. Its LHV is approximated to be the total energy of its energy products: salicornia oil:11.2 MJ/kg seeds and salicornia meal:12.6 MJ/kg seeds. Makkawi et al. (2021) reports the seed HHV to be 20.8 MJ/kg

e price at: [www.alibaba.com](http://www.alibaba.com).

f Price of electricity in $/kwh

g Average seed price of similar seeds from ref 43 is used.

h Wheat straw price is used as a proxy for straw from salicornia.

i Price for soybean meal from GREET 2021 is used as a proxy for salicornia and tobacco meals.

# SM8. Formula for the estimation of DLUC emissions

$$DLUC=\frac{\left(∆C\_{AGB}+∆C\_{BGB}+∆C\_{DW}+∆C\_{LI}+∆C\_{SOC}+∆C\_{HWP}\right) }{25}× \frac{44}{12}+F\_{N2O}×265 $$

Where,

$DLUC $= emissions from direct land conversion into feedstock for HEFA production (gCO2e MJ-1)

$∆$CAGB = difference in carbon stocks in aboveground biomass (AGB) before and after land conversion (tC ha-1)

$∆$CBGB = difference in carbon stocks in belowground biomass (BGB) before and after land conversion (tC ha-1)

$∆$CDW = difference in carbon stocks in dead wood before and after land conversion (tC ha-1)

$∆$CLI = carbon stocks in litter before and after land conversion (tC ha-1)

$∆$CSOC = difference in SOC before and after land conversion (tC ha-1)

$∆$CHWP = difference in carbon stocks in harvested wood products before and after land conversion (tC ha-1); assumed to be zero in Tier 1

FN2O = Flows of N2O emissions from mineralized N due to SOC changes (t ha-1)

# SM9. Feedstock-specific yields and carbon sequestration in crop biomass assumed for the estimation of DLUC emissions.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Crop biomass (above- and below-ground) at harvest (t C/ha) | Yields (t seed/ha) | References |
| Oilseed feedstock | Low input | Mediuminput  | Highinput  | Low input | Medium input  | High input  | Crop biomass1 | Yields | Fertilizer effect on yields (crop-biomass) |
| Camelina | 1.8 | 2.0 | 2.2 | 1.9 | 2.3 | 2.7 | [45] | [45,46] | Same assumptions as pennycress[28]  |
| Castor bean | 1.3 | 1.4 | 1.6 | 1.1 | 1.3 | 1.6 | [47] | [8,10] | [11,14,15,48] |
| Jatropha2 | 12.0 | 13.2 | 14.5 | 2.5 | 3.0 | 3.6 | [49,50] | [49–51] | [49] |
| Oil palm3 | 37.5 | 37.5 | 37.5 | 17.1 | 18.0 | 18.9 | [52,53] | Yields from[54], 2015-2019, Malaysia and Indonesia | No effect on crop biomass; yields reflect the range observed in [54] |
| Pennycress | 0.9 | 1.0 | 1.1 | 0.7 | 1.0 | 1.2 | [26,55] | [24,54] | [28] |
| Rapeseed | 1.3 | 1.5 | 1.6 | 3.0 | 3.4 | 4.0 | [46,56] | Yields from [54] 2015-2019, France and Germany | [57]; yields reflect the range observed in [54] |
| Salicornia | 3.8 | 4.2 | 4.6 | 1.5 | 2.0 | 2.5 | [58,59] | [3] | [3] |
| Soybean | 1.2 | 1.4 | 1.5 | 3.0 | 3.2 | 3.5 | [52,60] | Yields from [54] 2015-2019, Brazil and USA | Same assumptions as rapeseed on crop biomass gain; yields reflect the range observed in [54] |
| E. Tobacco | 1.8 | 2.0 | 2.2 | 2.1 | 2.5 | 3.0 | [38] | [38,39] | [61] |

1Based on above-ground biomass data and root-to-shoot ratios

2Carbon sequestration in a 5-year plantation with low yields

3Average carbon sequestration in a 20-year plantation

# SM10. Formula for the estimation of N2O emissions

$$N\_{2}O emissions \left(g\right)=g fertilizer ×1.325 \%×\frac{44 g N\_{2}O}{28 g N}$$

1.325% includes the direct N2O emissions (1%) from fertilizer use as well as volatilization from soil (0.1%), and leaching and runoff (0.225%) of soil nitrogen.

# SM11. Contribution of LCI parameters to the variance in GHG emission results (%)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Nitrogen | Natural gas –HEFA conversion | Diesel | Pesticides | Hydrogen – HEFA conversion | Natural gas – oil extraction |
| Castor-HEFA | 85 | 8.3 | - | - | 4.9 | - |
| Jatropha-HEFA | 80.6 | 6.1 | 4.4 | 3.7 | 3.6 | - |
| Pennycress-HEFA | 90.3 | 5 | - | - | 2.6 | - |
| Salicornia-HEFA | 29.9 | 15.3 | 39.3 | - | 9.1 | 3.8 |
| E. Tobacco-HEFA | 92.9 | 3.2 | - | - | 2.3 | - |

# SM12. Median GHG emission values for oilseed-HEFA pathways in gCO2e/MJ SAF, showing the contribution from each life cycle stage.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Life cycle stage |  | Castor | Jatropha | Pennycress | Salicornia | E. tobacco |
| Cultivation | N fertilizer production | 6.08 | 6.36 | 9.63 | 1.40 | 8.14 |
|  | N2O emissions | 8.80 | 7.65 | 15.48 | 2.03 | 11.78 |
|  | CO2 from urea | 1.45 | 1.52 | 2.30 | 0.33 | 1.94 |
|  | P fertilizer production/use | 0.45 | 0.74 | 0.92 | - | 0.85 |
|  | K fertilizer production/use | 0.28 | 0.64 | 0.25 | - | 0.63 |
|  | Pesticides production/use | - | 2.80 | - | - | 0.18 |
|  | Herbicides production/use | - | - | - | - | 0.23 |
|  | Diesel production/use | 4.20 | 3.74 | 0.60 | 17.41 | 0.54 |
| Feedstock Trans. |  | 0.58 | 0.73 | 0.64 | 0.11 | 0.69 |
| Oil extraction | Hexane production/use | 0.22 | 0.26 | 0.23 | 0.26 | 0.27 |
|  | Natural gas production/use | 2.97 | 2.10 | 3.04 | 3.52 | 3.56 |
|  | Electricity production/use | 0.88 | - | 0.90 | 0.57 | 1.05 |
|  | Biomass combustion | - | 1.34 | - | - | - |
| Fuel production | Hydrogen production/use | 4.02 | 4.02 | 4.02 | 4.02 | 4.02 |
|  | Natural gas production/use | 8.73 | 8.73 | 8.73 | 8.73 | 8.73 |
|  | Electricity production/use | 0.68 | 0.68 | 0.68 | 0.68 | 0.68 |
| Jet fuel T&D |  | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 |

# SM13. Attributional LCA results of oilseed-HEFA pathways in gCO2e/MJ SAF when different allocation methods are used for the oil extraction step*.*

Median values from the stochastic analyses are displayed along with other parameters. Allocation type used for oil extraction and fuel production steps co-products: E/E: energy/energy, M/E: mass/energy, $/E: market/energy

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | 90% Central Range | Median | Coefficient of Variation | Standard Deviation |
| Castor-HEFA | E/E | 31.6 – 47.5  | 39.5 | 0.12 | 4.8 |
|  | M/E | 25.9 – 38.0 | 32.0 | 0.11 | 3.6 |
|  | $/E | 37.4 – 57.7 | 47.4 | 0.13 | 6.1 |
| Jatropha-HEFA | E/E | 31.9 – 50.4 | 41.1 | 0.14 | 5.6 |
|  | M/E | 30.0 – 46.7 | 38.2 | 0.13 | 5.1 |
|  | $/E | 32.3 – 51.0 | 41.7 | 0.14 | 5.6 |
| Pennycress-HEFA | E/E | 37.6 – 58.7 | 48.2 | 0.13 | 6.4 |
|  | M/E | 29.8 – 45.0 | 37.4 | 0.12 | 4.6 |
|  | $/E | 44.3 – 71.1 | 57.6 | 0.14 | 8.1 |
| Salicornia-HEFA | E/E | 35.4 – 48.0 | 41.5 | 0.09 | 3.8 |
|  | M/E | 23.2 – 31.1 | 27.1 | 0.09 | 2.4 |
|  | $/E | 51.0 – 71.1 | 60.6 | 0.10 | 6.1 |
| E. Tobacco-HEFA | E/E | 32.5 – 55.9 | 44.2 | 0.16 | 7.1 |
|  | M/E | 24.4 – 38.8 | 31.6 | 0.14 | 4.4 |
|  | $/E | 36.8 – 64.9 | 50.8 | 0.17 | 8.4 |

# SM14. DLUC factors from different land use change scenarios with scenario details, and median “core-LCA” values from HEFA fuels under different input levels.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Feedstock** | **Crop****management** | **intensity** | **Previous use** | **Continent** | **Total****biomass** | **Crop** **biomass** | **SOC** | **Nitrogen****mineralisation** | **DLUC** **factor** | **Core-LCA** |
| Jatropha | No tillage | Low  | Secondary forest, less than 20 years | Asia (continental) | 216.78 | -32.44 | -11.44 | -0.75 | 172.16 | 28.99 |
| Jatropha | No tillage | Low  | Secondary shrubland, less than 20 years | Asia (continental) | 106.57 | -32.44 | -11.44 | -0.75 | 61.95 | 28.99 |
| Jatropha | No tillage | Low  | Grassland | Asia (continental) | 11.04 | -32.44 | -11.44 | -0.75 | -33.58 | 28.99 |
| Jatropha | No tillage | Low  | Degraded grassland | Asia (continental) | 5.52 | -32.44 | -42.21 | -2.76 | -71.89 | 28.99 |
| Jatropha | No tillage | Low  | Long-term cultivated cropland | Asia (continental) | 7.10 | -32.44 | -54.52 | -3.57 | -83.42 | 28.99 |
| Jatropha | No tillage | Medium  | Secondary forest, less than 20 years | Asia (continental) | 180.65 | -29.73 | -14.53 | -0.95 | 135.43 | 41.14 |
| Jatropha | No tillage | Medium  | Secondary shrubland, less than 20 years | Asia (continental) | 88.81 | -29.73 | -14.53 | -0.95 | 43.59 | 41.14 |
| Jatropha | No tillage | Medium  | Grassland | Asia (continental) | 9.20 | -29.73 | -14.53 | -0.95 | -36.02 | 41.14 |
| Jatropha | No tillage | Medium  | Degraded grassland | Asia (continental) | 4.60 | -29.73 | -40.18 | -2.63 | -67.94 | 41.14 |
| Jatropha | No tillage | Medium  | Long-term cultivated cropland | Asia (continental) | 5.92 | -29.73 | -50.43 | -3.30 | -77.55 | 41.14 |
| Jatropha | No tillage | High  | Secondary forest, less than 20 years | Asia (continental) | 150.54 | -27.26 | -15.44 | -1.01 | 106.83 | 53.20 |
| Jatropha | No tillage | High  | Secondary shrubland, less than 20 years | Asia (continental) | 74.01 | -27.26 | -15.44 | -1.01 | 30.30 | 53.20 |
| Jatropha | No tillage | High  | Grassland | Asia (continental) | 7.67 | -27.26 | -15.44 | -1.01 | -36.04 | 53.20 |
| Jatropha | No tillage | High  | Degraded grassland | Asia (continental) | 3.83 | -27.26 | -36.81 | -2.41 | -62.65 | 53.20 |
| Jatropha | No tillage | High  | Long-term cultivated cropland | Asia (continental) | 4.93 | -27.26 | -45.36 | -2.97 | -70.65 | 53.20 |
| Jatropha | Red. tillage | Low  | Secondary forest, less than 20 years | Asia (continental) | 216.78 | -32.44 | -3.64 | -0.24 | 180.46 | 28.99 |
| Jatropha | Red. tillage | Low  | Secondary shrubland, less than 20 years | Asia (continental) | 106.57 | -32.44 | -3.64 | -0.24 | 70.25 | 28.99 |
| Jatropha | Red. tillage | Low  | Grassland | Asia (continental) | 11.04 | -32.44 | -3.64 | -0.24 | -25.28 | 28.99 |
| Jatropha | Red. tillage | Low  | Degraded grassland | Asia (continental) | 5.52 | -32.44 | -34.41 | -2.25 | -63.58 | 28.99 |
| Jatropha | Red. tillage | Low  | Long-term cultivated cropland | Asia (continental) | 7.10 | -32.44 | -46.72 | -3.06 | -75.11 | 28.99 |
| Jatropha | Red. tillage | Medium  | Secondary forest, less than 20 years | Asia (continental) | 180.65 | -29.73 | -7.69 | -0.50 | 142.72 | 41.14 |
| Jatropha | Red. tillage | Medium  | Secondary shrubland, less than 20 years | Asia (continental) | 88.81 | -29.73 | -7.69 | -0.50 | 50.88 | 41.14 |
| Jatropha | Red. tillage | Medium  | Grassland | Asia (continental) | 9.20 | -29.73 | -7.69 | -0.50 | -28.73 | 41.14 |
| Jatropha | Red. tillage | Medium  | Degraded grassland | Asia (continental) | 4.60 | -29.73 | -33.34 | -2.18 | -60.65 | 41.14 |
| Jatropha | Red. tillage | Medium  | Long-term cultivated cropland | Asia (continental) | 5.92 | -29.73 | -43.59 | -2.85 | -70.26 | 41.14 |
| Jatropha | Red. tillage | High  | Secondary forest, less than 20 years | Asia (continental) | 150.54 | -27.26 | -9.52 | -0.62 | 113.15 | 53.20 |
| Jatropha | Red. tillage | High  | Secondary shrubland, less than 20 years | Asia (continental) | 74.01 | -27.26 | -9.52 | -0.62 | 36.61 | 53.20 |
| Jatropha | Red. tillage | High  | Grassland | Asia (continental) | 7.67 | -27.26 | -9.52 | -0.62 | -29.73 | 53.20 |
| Jatropha | Red. tillage | High  | Degraded grassland | Asia (continental) | 3.83 | -27.26 | -30.89 | -2.02 | -56.33 | 53.20 |
| Jatropha | Red. tillage | High  | Long-term cultivated cropland | Asia (continental) | 4.93 | -27.26 | -39.43 | -2.58 | -64.34 | 53.20 |
| Jatropha | Tillage | Low  | Secondary forest, less than 20 years | Asia (continental) | 216.78 | -32.44 | 5.13 | 0.34 | 189.81 | 28.99 |
| Jatropha | Tillage | Low  | Secondary shrubland, less than 20 years | Asia (continental) | 106.57 | -32.44 | 5.13 | 0.34 | 79.60 | 28.99 |
| Jatropha | Tillage | Low  | Grassland | Asia (continental) | 11.04 | -32.44 | 5.13 | 0.34 | -15.94 | 28.99 |
| Jatropha | Tillage | Low  | Degraded grassland | Asia (continental) | 5.52 | -32.44 | -25.64 | -1.68 | -54.24 | 28.99 |
| Jatropha | Tillage | Low  | Long-term cultivated cropland | Asia (continental) | 7.10 | -32.44 | -37.95 | -2.48 | -65.77 | 28.99 |
| Jatropha | Tillage | Medium  | Secondary forest, less than 20 years | Asia (continental) | 180.65 | -29.73 | 0.00 | 0.00 | 150.92 | 41.14 |
| Jatropha | Tillage | Medium  | Secondary shrubland, less than 20 years | Asia (continental) | 88.81 | -29.73 | 0.00 | 0.00 | 59.07 | 41.14 |
| Jatropha | Tillage | Medium  | Grassland | Asia (continental) | 9.20 | -29.73 | 0.00 | 0.00 | -20.54 | 41.14 |
| Jatropha | Tillage | Medium  | Degraded grassland | Asia (continental) | 4.60 | -29.73 | -25.64 | -1.68 | -52.46 | 41.14 |
| Jatropha | Tillage | Medium  | Long-term cultivated cropland | Asia (continental) | 5.92 | -29.73 | -35.90 | -2.35 | -62.06 | 41.14 |
| Jatropha | Tillage | High  | Secondary forest, less than 20 years | Asia (continental) | 150.54 | -27.26 | -2.85 | -0.19 | 120.25 | 53.20 |
| Jatropha | Tillage | High  | Secondary shrubland, less than 20 years | Asia (continental) | 74.01 | -27.26 | -2.85 | -0.19 | 43.72 | 53.20 |
| Jatropha | Tillage | High  | Grassland | Asia (continental) | 7.67 | -27.26 | -2.85 | -0.19 | -22.63 | 53.20 |
| Jatropha | Tillage | High  | Degraded grassland | Asia (continental) | 3.83 | -27.26 | -24.22 | -1.58 | -49.23 | 53.20 |
| Jatropha | Tillage | High  | Long-term cultivated cropland | Asia (continental) | 4.93 | -27.26 | -32.77 | -2.14 | -57.23 | 53.20 |
| Tobacco | No tillage | Low  | Secondary forest, less than 20 years | Asia (continental) | 395.62 | -6.69 | 80.15 | 5.24 | 474.32 | 27.73 |
| Tobacco | No tillage | Low  | Secondary shrubland, less than 20 years | Asia (continental) | 145.97 | -6.69 | 80.15 | 5.24 | 224.67 | 27.73 |
| Tobacco | No tillage | Low  | Grassland | Asia (continental) | 27.98 | -6.69 | 80.15 | 5.24 | 106.68 | 27.73 |
| Tobacco | No tillage | Low  | Degraded grassland | Asia (continental) | 13.99 | -6.69 | 28.02 | 1.83 | 37.15 | 27.73 |
| Tobacco | No tillage | Low  | Long-term cultivated cropland | Asia (continental) | 9.73 | -6.69 | -10.21 | -0.67 | -7.83 | 27.73 |
| Tobacco | No tillage | Medium  | Secondary forest, less than 20 years | Asia (continental) | 329.68 | -6.19 | 60.01 | 3.93 | 387.42 | 44.17 |
| Tobacco | No tillage | Medium  | Secondary shrubland, less than 20 years | Asia (continental) | 121.64 | -6.19 | 60.01 | 3.93 | 179.38 | 44.17 |
| Tobacco | No tillage | Medium  | Grassland | Asia (continental) | 23.31 | -6.19 | 60.01 | 3.93 | 81.06 | 44.17 |
| Tobacco | No tillage | Medium  | Degraded grassland | Asia (continental) | 11.66 | -6.19 | 16.57 | 1.08 | 23.12 | 44.17 |
| Tobacco | No tillage | Medium  | Long-term cultivated cropland | Asia (continental) | 8.11 | -6.19 | -15.29 | -1.00 | -14.37 | 44.17 |
| Tobacco | No tillage | High  | Secondary forest, less than 20 years | Asia (continental) | 274.73 | -5.68 | 42.23 | 2.76 | 314.05 | 60.68 |
| Tobacco | No tillage | High  | Secondary shrubland, less than 20 years | Asia (continental) | 101.37 | -5.68 | 42.23 | 2.76 | 140.69 | 60.68 |
| Tobacco | No tillage | High  | Grassland | Asia (continental) | 19.43 | -5.68 | 42.23 | 2.76 | 58.75 | 60.68 |
| Tobacco | No tillage | High  | Degraded grassland | Asia (continental) | 9.71 | -5.68 | 6.03 | 0.39 | 10.46 | 60.68 |
| Tobacco | No tillage | High  | Long-term cultivated cropland | Asia (continental) | 6.76 | -5.68 | -78.44 | -5.13 | -82.49 | 60.68 |
| Tobacco | Red. tillage | Low  | Secondary forest, less than 20 years | Asia (continental) | 395.62 | -6.69 | 85.52 | 5.59 | 480.05 | 27.73 |
| Tobacco | Red. tillage | Low  | Secondary shrubland, less than 20 years | Asia (continental) | 145.97 | -6.69 | 85.52 | 5.59 | 230.40 | 27.73 |
| Tobacco | Red. tillage | Low  | Grassland | Asia (continental) | 27.98 | -6.69 | 85.52 | 5.59 | 112.41 | 27.73 |
| Tobacco | Red. tillage | Low  | Degraded grassland | Asia (continental) | 13.99 | -6.69 | 33.39 | 2.18 | 42.88 | 27.73 |
| Tobacco | Red. tillage | Low  | Long-term cultivated cropland | Asia (continental) | 9.73 | -6.69 | -4.84 | -0.32 | -2.11 | 27.73 |
| Tobacco | Red. tillage | Medium  | Secondary forest, less than 20 years | Asia (continental) | 329.68 | -6.19 | 64.87 | 4.24 | 392.61 | 44.17 |
| Tobacco | Red. tillage | Medium  | Secondary shrubland, less than 20 years | Asia (continental) | 121.64 | -6.19 | 64.87 | 4.24 | 184.56 | 44.17 |
| Tobacco | Red. tillage | Medium  | Grassland | Asia (continental) | 23.31 | -6.19 | 64.87 | 4.24 | 86.24 | 44.17 |
| Tobacco | Red. tillage | Medium  | Degraded grassland | Asia (continental) | 11.66 | -6.19 | 21.43 | 1.40 | 28.30 | 44.17 |
| Tobacco | Red. tillage | Medium  | Long-term cultivated cropland | Asia (continental) | 8.11 | -6.19 | -10.43 | -0.68 | -9.19 | 44.17 |
| Tobacco | Red. tillage | High  | Secondary forest, less than 20 years | Asia (continental) | 274.73 | -5.68 | 46.73 | 3.06 | 318.85 | 60.68 |
| Tobacco | Red. tillage | High  | Secondary shrubland, less than 20 years | Asia (continental) | 101.37 | -5.68 | 46.73 | 3.06 | 145.48 | 60.68 |
| Tobacco | Red. tillage | High  | Grassland | Asia (continental) | 19.43 | -5.68 | 46.73 | 3.06 | 63.54 | 60.68 |
| Tobacco | Red. tillage | High  | Degraded grassland | Asia (continental) | 9.71 | -5.68 | 10.53 | 0.69 | 15.26 | 60.68 |
| Tobacco | Red. tillage | High  | Long-term cultivated cropland | Asia (continental) | 6.76 | -5.68 | -16.02 | -1.05 | -15.98 | 60.68 |
| Tobacco | Tillage | Low  | Secondary forest, less than 20 years | Asia (continental) | 395.62 | -6.69 | 97.03 | 6.35 | 492.31 | 27.73 |
| Tobacco | Tillage | Low  | Secondary shrubland, less than 20 years | Asia (continental) | 145.97 | -6.69 | 97.03 | 6.35 | 242.66 | 27.73 |
| Tobacco | Tillage | Low  | Grassland | Asia (continental) | 27.98 | -6.69 | 97.03 | 6.35 | 124.67 | 27.73 |
| Tobacco | Tillage | Low  | Degraded grassland | Asia (continental) | 13.99 | -6.69 | 44.90 | 2.94 | 55.14 | 27.73 |
| Tobacco | Tillage | Low  | Long-term cultivated cropland | Asia (continental) | 9.73 | -6.69 | 6.67 | 0.44 | 10.15 | 27.73 |
| Tobacco | Tillage | Medium  | Secondary forest, less than 20 years | Asia (continental) | 329.68 | -6.19 | 75.30 | 4.93 | 403.71 | 44.17 |
| Tobacco | Tillage | Medium  | Secondary shrubland, less than 20 years | Asia (continental) | 121.64 | -6.19 | 75.30 | 4.93 | 195.67 | 44.17 |
| Tobacco | Tillage | Medium  | Grassland | Asia (continental) | 23.31 | -6.19 | 75.30 | 4.93 | 97.35 | 44.17 |
| Tobacco | Tillage | Medium  | Degraded grassland | Asia (continental) | 11.66 | -6.19 | 31.86 | 2.08 | 39.41 | 44.17 |
| Tobacco | Tillage | Medium  | Long-term cultivated cropland | Asia (continental) | 8.11 | -6.19 | 0.00 | 0.00 | 1.92 | 44.17 |
| Tobacco | Tillage | High  | Secondary forest, less than 20 years | Asia (continental) | 274.73 | -5.68 | 56.38 | 3.69 | 329.12 | 60.68 |
| Tobacco | Tillage | High  | Secondary shrubland, less than 20 years | Asia (continental) | 101.37 | -5.68 | 56.38 | 3.69 | 155.76 | 60.68 |
| Tobacco | Tillage | High  | Grassland | Asia (continental) | 19.43 | -5.68 | 56.38 | 3.69 | 73.82 | 60.68 |
| Tobacco | Tillage | High  | Degraded grassland | Asia (continental) | 9.71 | -5.68 | 20.18 | 1.32 | 25.53 | 60.68 |
| Tobacco | Tillage | High  | Long-term cultivated cropland | Asia (continental) | 6.76 | -5.68 | -6.37 | -0.42 | -5.71 | 60.68 |
| Castor bean | No tillage | Low  | Secondary forest, less than 20 years | Asia (continental) | 554.31 | -6.69 | 112.30 | 7.35 | 667.26 | 28.75 |
| Castor bean | No tillage | Low  | Secondary shrubland, less than 20 years | Asia (continental) | 204.52 | -6.69 | 112.30 | 7.35 | 317.47 | 28.75 |
| Castor bean | No tillage | Low  | Grassland | Asia (continental) | 39.20 | -6.69 | 112.30 | 7.35 | 152.16 | 28.75 |
| Castor bean | No tillage | Low  | Degraded grassland | Asia (continental) | 19.60 | -6.69 | 39.26 | 2.57 | 54.74 | 28.75 |
| Castor bean | No tillage | Low  | Long-term cultivated cropland | Asia (continental) | 13.63 | -6.69 | -14.30 | -0.94 | -8.30 | 28.75 |
| Castor bean | No tillage | Medium  | Secondary forest, less than 20 years | Asia (continental) | 461.92 | -6.13 | 84.08 | 5.50 | 545.37 | 39.49 |
| Castor bean | No tillage | Medium  | Secondary shrubland, less than 20 years | Asia (continental) | 170.43 | -6.13 | 84.08 | 5.50 | 253.88 | 39.49 |
| Castor bean | No tillage | Medium  | Grassland | Asia (continental) | 32.67 | -6.13 | 84.08 | 5.50 | 116.11 | 39.49 |
| Castor bean | No tillage | Medium  | Degraded grassland | Asia (continental) | 16.33 | -6.13 | 23.21 | 1.52 | 34.93 | 39.49 |
| Castor bean | No tillage | Medium  | Long-term cultivated cropland | Asia (continental) | 11.36 | -6.13 | -21.43 | -1.40 | -17.60 | 39.49 |
| Castor bean | No tillage | High  | Secondary forest, less than 20 years | Asia (continental) | 384.94 | -5.62 | 59.17 | 3.87 | 442.36 | 50.31 |
| Castor bean | No tillage | High  | Secondary shrubland, less than 20 years | Asia (continental) | 142.03 | -5.62 | 59.17 | 3.87 | 199.45 | 50.31 |
| Castor bean | No tillage | High  | Grassland | Asia (continental) | 27.22 | -5.62 | 59.17 | 3.87 | 84.64 | 50.31 |
| Castor bean | No tillage | High  | Degraded grassland | Asia (continental) | 13.61 | -5.62 | 8.45 | 0.55 | 16.99 | 50.31 |
| Castor bean | No tillage | High  | Long-term cultivated cropland | Asia (continental) | 9.47 | -5.62 | -28.75 | -1.88 | -26.78 | 50.31 |
| Castor bean | Red. tillage | Low  | Secondary forest, less than 20 years | Asia (continental) | 554.31 | -6.69 | 119.83 | 7.84 | 675.28 | 28.75 |
| Castor bean | Red. tillage | Low  | Secondary shrubland, less than 20 years | Asia (continental) | 204.52 | -6.69 | 119.83 | 7.84 | 325.49 | 28.75 |
| Castor bean | Red. tillage | Low  | Grassland | Asia (continental) | 39.20 | -6.69 | 119.83 | 7.84 | 160.17 | 28.75 |
| Castor bean | Red. tillage | Low  | Degraded grassland | Asia (continental) | 19.60 | -6.69 | 46.79 | 3.06 | 62.75 | 28.75 |
| Castor bean | Red. tillage | Low  | Long-term cultivated cropland | Asia (continental) | 13.63 | -6.69 | -6.78 | -0.44 | -0.28 | 28.75 |
| Castor bean | Red. tillage | Medium  | Secondary forest, less than 20 years | Asia (continental) | 461.92 | -6.13 | 90.90 | 5.95 | 552.63 | 39.49 |
| Castor bean | Red. tillage | Medium  | Secondary shrubland, less than 20 years | Asia (continental) | 170.43 | -6.13 | 90.90 | 5.95 | 261.14 | 39.49 |
| Castor bean | Red. tillage | Medium  | Grassland | Asia (continental) | 32.67 | -6.13 | 90.90 | 5.95 | 123.37 | 39.49 |
| Castor bean | Red. tillage | Medium  | Degraded grassland | Asia (continental) | 16.33 | -6.13 | 30.03 | 1.96 | 42.19 | 39.49 |
| Castor bean | Red. tillage | Medium  | Long-term cultivated cropland | Asia (continental) | 11.36 | -6.13 | -14.61 | -0.96 | -10.34 | 39.49 |
| Castor bean | Red. tillage | High  | Secondary forest, less than 20 years | Asia (continental) | 384.94 | -5.62 | 65.48 | 4.28 | 449.08 | 50.31 |
| Castor bean | Red. tillage | High  | Secondary shrubland, less than 20 years | Asia (continental) | 142.03 | -5.62 | 65.48 | 4.28 | 206.17 | 50.31 |
| Castor bean | Red. tillage | High  | Grassland | Asia (continental) | 27.22 | -5.62 | 65.48 | 4.28 | 91.36 | 50.31 |
| Castor bean | Red. tillage | High  | Degraded grassland | Asia (continental) | 13.61 | -5.62 | 14.76 | 0.97 | 23.71 | 50.31 |
| Castor bean | Red. tillage | High  | Long-term cultivated cropland | Asia (continental) | 9.47 | -5.62 | -22.44 | -1.47 | -20.06 | 50.31 |
| Castor bean | Tillage | Low  | Secondary forest, less than 20 years | Asia (continental) | 554.31 | -6.69 | 135.95 | 8.89 | 692.46 | 28.75 |
| Castor bean | Tillage | Low  | Secondary shrubland, less than 20 years | Asia (continental) | 204.52 | -6.69 | 135.95 | 8.89 | 342.67 | 28.75 |
| Castor bean | Tillage | Low  | Grassland | Asia (continental) | 39.20 | -6.69 | 135.95 | 8.89 | 177.36 | 28.75 |
| Castor bean | Tillage | Low  | Degraded grassland | Asia (continental) | 19.60 | -6.69 | 62.91 | 4.12 | 79.94 | 28.75 |
| Castor bean | Tillage | Low  | Long-term cultivated cropland | Asia (continental) | 13.63 | -6.69 | 9.35 | 0.61 | 16.90 | 28.75 |
| Castor bean | Tillage | Medium  | Secondary forest, less than 20 years | Asia (continental) | 461.92 | -6.13 | 105.50 | 6.90 | 568.20 | 39.49 |
| Castor bean | Tillage | Medium  | Secondary shrubland, less than 20 years | Asia (continental) | 170.43 | -6.13 | 105.50 | 6.90 | 276.70 | 39.49 |
| Castor bean | Tillage | Medium  | Grassland | Asia (continental) | 32.67 | -6.13 | 105.50 | 6.90 | 138.94 | 39.49 |
| Castor bean | Tillage | Medium  | Degraded grassland | Asia (continental) | 16.33 | -6.13 | 44.64 | 2.92 | 57.76 | 39.49 |
| Castor bean | Tillage | Medium  | Long-term cultivated cropland | Asia (continental) | 11.36 | -6.13 | 0.00 | 0.00 | 5.23 | 39.49 |
| Castor bean | Tillage | High  | Secondary forest, less than 20 years | Asia (continental) | 384.94 | -5.62 | 78.99 | 5.17 | 463.47 | 50.31 |
| Castor bean | Tillage | High  | Secondary shrubland, less than 20 years | Asia (continental) | 142.03 | -5.62 | 78.99 | 5.17 | 220.56 | 50.31 |
| Castor bean | Tillage | High  | Grassland | Asia (continental) | 27.22 | -5.62 | 78.99 | 5.17 | 105.76 | 50.31 |
| Castor bean | Tillage | High  | Degraded grassland | Asia (continental) | 13.61 | -5.62 | 28.27 | 1.85 | 38.11 | 50.31 |
| Castor bean | Tillage | High  | Long-term cultivated cropland | Asia (continental) | 9.47 | -5.62 | -8.93 | -0.58 | -5.67 | 50.31 |
| Pennycress | No tillage | Low  | Secondary forest, less than 20 years | North America | 110.57 | -1.57 | 29.09 | 1.90 | 139.99 | 33.29 |
| Pennycress | No tillage | Low  | Improved grassland | North America | 10.85 | -1.57 | 44.17 | 2.89 | 56.34 | 33.29 |
| Pennycress | No tillage | Low  | Grassland | North America | 10.85 | -1.57 | 29.09 | 1.90 | 40.27 | 33.29 |
| Pennycress | No tillage | Low  | Degraded grassland | North America | 5.43 | -1.57 | -3.23 | -0.21 | 0.41 | 33.29 |
| Pennycress | No tillage | Low  | Long-term cultivated cropland | North America | 4.50 | -1.57 | -78.65 | -5.14 | -80.86 | 33.29 |
| Pennycress | No tillage | Medium  | Secondary forest, less than 20 years | North America | 82.93 | -1.31 | 16.69 | 1.09 | 99.40 | 48.16 |
| Pennycress | No tillage | Medium  | Improved grassland | North America | 8.14 | -1.31 | 28.00 | 1.83 | 36.66 | 48.16 |
| Pennycress | No tillage | Medium  | Grassland | North America | 8.14 | -1.31 | 16.69 | 1.09 | 24.60 | 48.16 |
| Pennycress | No tillage | Medium  | Degraded grassland | North America | 4.07 | -1.31 | -7.55 | -0.49 | -5.29 | 48.16 |
| Pennycress | No tillage | Medium  | Long-term cultivated cropland | North America | 3.38 | -1.31 | -8.36 | -0.55 | -6.84 | 48.16 |
| Pennycress | No tillage | High  | Secondary forest, less than 20 years | North America | 66.34 | -1.15 | 7.71 | 0.50 | 73.40 | 62.82 |
| Pennycress | No tillage | High  | Improved grassland | North America | 6.51 | -1.15 | 16.76 | 1.10 | 23.21 | 62.82 |
| Pennycress | No tillage | High  | Grassland | North America | 6.51 | -1.15 | 7.71 | 0.50 | 13.57 | 62.82 |
| Pennycress | No tillage | High  | Degraded grassland | North America | 3.26 | -1.15 | -11.69 | -0.76 | -10.35 | 62.82 |
| Pennycress | No tillage | High  | Long-term cultivated cropland | North America | 2.70 | -1.15 | -12.33 | -0.81 | -11.59 | 62.82 |
| Pennycress | Red. tillage | Low  | Secondary forest, less than 20 years | North America | 110.57 | -1.57 | 33.87 | 2.22 | 145.09 | 33.29 |
| Pennycress | Red. tillage | Low  | Improved grassland | North America | 10.85 | -1.57 | 48.96 | 3.20 | 61.44 | 33.29 |
| Pennycress | Red. tillage | Low  | Grassland | North America | 10.85 | -1.57 | 33.87 | 2.22 | 45.37 | 33.29 |
| Pennycress | Red. tillage | Low  | Degraded grassland | North America | 5.43 | -1.57 | 1.55 | 0.10 | 5.51 | 33.29 |
| Pennycress | Red. tillage | Low  | Long-term cultivated cropland | North America | 4.50 | -1.57 | 0.48 | 0.03 | 3.44 | 33.29 |
| Pennycress | Red. tillage | Medium  | Secondary forest, less than 20 years | North America | 82.93 | -1.31 | 20.59 | 1.35 | 103.55 | 48.16 |
| Pennycress | Red. tillage | Medium  | Improved grassland | North America | 8.14 | -1.31 | 31.90 | 2.09 | 40.82 | 48.16 |
| Pennycress | Red. tillage | Medium  | Grassland | North America | 8.14 | -1.31 | 20.59 | 1.35 | 28.76 | 48.16 |
| Pennycress | Red. tillage | Medium  | Degraded grassland | North America | 4.07 | -1.31 | -3.65 | -0.24 | -1.13 | 48.16 |
| Pennycress | Red. tillage | Medium  | Long-term cultivated cropland | North America | 3.38 | -1.31 | -4.46 | -0.29 | -2.69 | 48.16 |
| Pennycress | Red. tillage | High  | Secondary forest, less than 20 years | North America | 66.34 | -1.15 | 11.17 | 0.73 | 77.09 | 62.82 |
| Pennycress | Red. tillage | High  | Improved grassland | North America | 6.51 | -1.15 | 20.22 | 1.32 | 26.90 | 62.82 |
| Pennycress | Red. tillage | High  | Grassland | North America | 6.51 | -1.15 | 11.17 | 0.73 | 17.26 | 62.82 |
| Pennycress | Red. tillage | High  | Degraded grassland | North America | 3.26 | -1.15 | -8.22 | -0.54 | -6.66 | 62.82 |
| Pennycress | Red. tillage | High  | Long-term cultivated cropland | North America | 2.70 | -1.15 | -8.87 | -0.58 | -7.90 | 62.82 |
| Pennycress | Tillage | Low  | Secondary forest, less than 20 years | North America | 110.57 | -1.57 | 39.34 | 2.57 | 150.92 | 33.29 |
| Pennycress | Tillage | Low  | Improved grassland | North America | 10.85 | -1.57 | 54.43 | 3.56 | 67.27 | 33.29 |
| Pennycress | Tillage | Low  | Grassland | North America | 10.85 | -1.57 | 39.34 | 2.57 | 51.20 | 33.29 |
| Pennycress | Tillage | Low  | Degraded grassland | North America | 5.43 | -1.57 | 7.02 | 0.46 | 11.34 | 33.29 |
| Pennycress | Tillage | Low  | Long-term cultivated cropland | North America | 4.50 | -1.57 | 5.95 | 0.39 | 9.27 | 33.29 |
| Pennycress | Tillage | Medium  | Secondary forest, less than 20 years | North America | 82.93 | -1.31 | 25.05 | 1.64 | 108.31 | 48.16 |
| Pennycress | Tillage | Medium  | Improved grassland | North America | 8.14 | -1.31 | 36.36 | 2.38 | 45.57 | 48.16 |
| Pennycress | Tillage | Medium  | Grassland | North America | 8.14 | -1.31 | 25.05 | 1.64 | 33.51 | 48.16 |
| Pennycress | Tillage | Medium  | Degraded grassland | North America | 4.07 | -1.31 | 0.81 | 0.05 | 3.62 | 48.16 |
| Pennycress | Tillage | Medium  | Long-term cultivated cropland | North America | 3.38 | -1.31 | 0.00 | 0.00 | 2.07 | 48.16 |
| Pennycress | Tillage | High  | Secondary forest, less than 20 years | North America | 66.34 | -1.15 | 15.13 | 0.99 | 81.31 | 62.82 |
| Pennycress | Tillage | High  | Improved grassland | North America | 6.51 | -1.15 | 24.18 | 1.58 | 31.12 | 62.82 |
| Pennycress | Tillage | High  | Grassland | North America | 6.51 | -1.15 | 15.13 | 0.99 | 21.48 | 62.82 |
| Pennycress | Tillage | High  | Degraded grassland | North America | 3.26 | -1.15 | -4.26 | -0.28 | -2.44 | 62.82 |
| Pennycress | Tillage | High  | Long-term cultivated cropland | North America | 2.70 | -1.15 | -4.91 | -0.32 | -3.68 | 62.82 |
| Salicornia | No tillage | Low  | Secondary steppe, less than 20 years | North America | 36.63 | -2.79 | 9.96 | 0.65 | 44.45 | 36.95 |
| Salicornia | No tillage | Low  | Improved grassland | North America | 3.02 | -2.79 | 13.89 | 0.91 | 15.03 | 36.95 |
| Salicornia | No tillage | Low  | Grassland | North America | 3.02 | -2.79 | 9.96 | 0.65 | 10.84 | 36.95 |
| Salicornia | No tillage | Low  | Degraded grassland | North America | 1.51 | -2.79 | 1.55 | 0.10 | 0.37 | 36.95 |
| Salicornia | No tillage | Low  | Long-term cultivated cropland | North America | 1.94 | -2.79 | -1.81 | -0.12 | -2.78 | 36.95 |
| Salicornia | No tillage | Medium  | Secondary steppe, less than 20 years | North America | 27.47 | -2.32 | 6.76 | 0.44 | 32.35 | 41.54 |
| Salicornia | No tillage | Medium  | Improved grassland | North America | 2.26 | -2.32 | 9.70 | 0.63 | 10.28 | 41.54 |
| Salicornia | No tillage | Medium  | Grassland | North America | 2.26 | -2.32 | 6.76 | 0.44 | 7.14 | 41.54 |
| Salicornia | No tillage | Medium  | Degraded grassland | North America | 1.13 | -2.32 | 0.45 | 0.03 | -0.71 | 41.54 |
| Salicornia | No tillage | Medium  | Long-term cultivated cropland | North America | 1.46 | -2.32 | -2.07 | -0.14 | -3.08 | 41.54 |
| Salicornia | No tillage | High  | Secondary steppe, less than 20 years | North America | 21.98 | -2.05 | 4.95 | 0.32 | 25.21 | 46.96 |
| Salicornia | No tillage | High  | Improved grassland | North America | 1.81 | -2.05 | 7.31 | 0.48 | 7.55 | 46.96 |
| Salicornia | No tillage | High  | Grassland | North America | 1.81 | -2.05 | 4.95 | 0.32 | 5.04 | 46.96 |
| Salicornia | No tillage | High  | Degraded grassland | North America | 0.91 | -2.05 | -0.10 | -0.01 | -1.24 | 46.96 |
| Salicornia | No tillage | High  | Long-term cultivated cropland | North America | 1.17 | -2.05 | -2.12 | -0.14 | -3.13 | 46.96 |
| Salicornia | Red. tillage | Low  | Secondary steppe, less than 20 years | North America | 36.63 | -2.79 | 11.20 | 0.73 | 45.77 | 36.95 |
| Salicornia | Red. tillage | Low  | Improved grassland | North America | 3.02 | -2.79 | 15.13 | 0.99 | 16.34 | 36.95 |
| Salicornia | Red. tillage | Low  | Grassland | North America | 3.02 | -2.79 | 11.20 | 0.73 | 12.16 | 36.95 |
| Salicornia | Red. tillage | Low  | Degraded grassland | North America | 1.51 | -2.79 | 2.79 | 0.18 | 1.69 | 36.95 |
| Salicornia | Red. tillage | Low  | Long-term cultivated cropland | North America | 1.94 | -2.79 | -0.58 | -0.04 | -1.46 | 36.95 |
| Salicornia | Red. tillage | Medium  | Secondary steppe, less than 20 years | North America | 27.47 | -2.32 | 7.74 | 0.51 | 33.39 | 41.54 |
| Salicornia | Red. tillage | Medium  | Improved grassland | North America | 2.26 | -2.32 | 10.68 | 0.70 | 11.32 | 41.54 |
| Salicornia | Red. tillage | Medium  | Grassland | North America | 2.26 | -2.32 | 7.74 | 0.51 | 8.18 | 41.54 |
| Salicornia | Red. tillage | Medium  | Degraded grassland | North America | 1.13 | -2.32 | 1.43 | 0.09 | 0.33 | 41.54 |
| Salicornia | Red. tillage | Medium  | Long-term cultivated cropland | North America | 1.46 | -2.32 | -1.10 | -0.07 | -2.04 | 41.54 |
| Salicornia | Red. tillage | High  | Secondary steppe, less than 20 years | North America | 21.98 | -2.05 | 5.76 | 0.38 | 26.07 | 46.96 |
| Salicornia | Red. tillage | High  | Improved grassland | North America | 1.81 | -2.05 | 8.12 | 0.53 | 8.41 | 46.96 |
| Salicornia | Red. tillage | High  | Grassland | North America | 1.81 | -2.05 | 5.76 | 0.38 | 5.90 | 46.96 |
| Salicornia | Red. tillage | High  | Degraded grassland | North America | 0.91 | -2.05 | 0.72 | 0.05 | -0.38 | 46.96 |
| Salicornia | Red. tillage | High  | Long-term cultivated cropland | North America | 1.17 | -2.05 | -1.30 | -0.09 | -2.27 | 46.96 |
| Salicornia | Tillage | Low  | Secondary steppe, less than 20 years | North America | 36.63 | -2.79 | 12.59 | 0.82 | 47.25 | 36.95 |
| Salicornia | Tillage | Low  | Improved grassland | North America | 3.02 | -2.79 | 16.52 | 1.08 | 17.83 | 36.95 |
| Salicornia | Tillage | Low  | Grassland | North America | 3.02 | -2.79 | 12.59 | 0.82 | 13.64 | 36.95 |
| Salicornia | Tillage | Low  | Degraded grassland | North America | 1.51 | -2.79 | 4.18 | 0.27 | 3.17 | 36.95 |
| Salicornia | Tillage | Low  | Long-term cultivated cropland | North America | 1.94 | -2.79 | 0.81 | 0.05 | 0.02 | 36.95 |
| Salicornia | Tillage | Medium  | Secondary steppe, less than 20 years | North America | 27.47 | -2.32 | 8.83 | 0.58 | 34.56 | 41.54 |
| Salicornia | Tillage | Medium  | Improved grassland | North America | 2.26 | -2.32 | 11.78 | 0.77 | 12.49 | 41.54 |
| Salicornia | Tillage | Medium  | Grassland | North America | 2.26 | -2.32 | 8.83 | 0.58 | 9.35 | 41.54 |
| Salicornia | Tillage | Medium  | Degraded grassland | North America | 1.13 | -2.32 | 2.52 | 0.17 | 1.50 | 41.54 |
| Salicornia | Tillage | Medium  | Long-term cultivated cropland | North America | 1.46 | -2.32 | 0.00 | 0.00 | -0.87 | 41.54 |
| Salicornia | Tillage | High  | Secondary steppe, less than 20 years | North America | 21.98 | -2.05 | 6.68 | 0.44 | 27.04 | 46.96 |
| Salicornia | Tillage | High  | Improved grassland | North America | 1.81 | -2.05 | 9.03 | 0.59 | 9.39 | 46.96 |
| Salicornia | Tillage | High  | Grassland | North America | 1.81 | -2.05 | 6.68 | 0.44 | 6.88 | 46.96 |
| Salicornia | Tillage | High  | Degraded grassland | North America | 0.91 | -2.05 | 1.63 | 0.11 | 0.59 | 46.96 |
| Salicornia | Tillage | High  | Long-term cultivated cropland | North America | 1.17 | -2.05 | -0.39 | -0.03 | -1.30 | 46.96 |
| Oil palm | No tillage | Low  | Secondary forest, less than 20 years | Asia (insular) | 159.66 | -32.90 | -6.82 | -0.45 | 119.49 | 60.00 |
| Oil palm | No tillage | Low  | Secondary shrubland, less than 20 years | Asia (insular) | 42.80 | -32.90 | -6.82 | -0.45 | 2.64 | 60.00 |
| Oil palm | No tillage | Low  | Grassland | Asia (insular) | 7.03 | -32.90 | -6.82 | -0.45 | -33.14 | 60.00 |
| Oil palm | No tillage | Low  | Degraded grassland | Asia (insular) | 3.52 | -32.90 | -23.55 | -1.54 | -54.47 | 60.00 |
| Oil palm | No tillage | Low  | Long-term cultivated cropland | Asia (insular) | 2.45 | -32.90 | -35.82 | -2.34 | -68.61 | 60.00 |
| Oil palm | No tillage | Medium  | Secondary forest, less than 20 years | Asia (insular) | 151.68 | -31.25 | -11.65 | -0.76 | 108.01 | 60.00 |
| Oil palm | No tillage | Medium  | Secondary shrubland, less than 20 years | Asia (insular) | 40.66 | -31.25 | -11.65 | -0.76 | -3.00 | 60.00 |
| Oil palm | No tillage | Medium  | Grassland | Asia (insular) | 6.68 | -31.25 | -11.65 | -0.76 | -36.99 | 60.00 |
| Oil palm | No tillage | Medium  | Degraded grassland | Asia (insular) | 3.34 | -31.25 | -27.54 | -1.80 | -57.26 | 60.00 |
| Oil palm | No tillage | Medium  | Long-term cultivated cropland | Asia (insular) | 2.32 | -31.25 | -39.20 | -2.56 | -70.69 | 60.00 |
| Oil palm | No tillage | High  | Secondary forest, less than 20 years | Asia (insular) | 144.46 | -29.76 | -17.87 | -1.17 | 95.66 | 60.00 |
| Oil palm | No tillage | High  | Secondary shrubland, less than 20 years | Asia (insular) | 38.73 | -29.76 | -17.87 | -1.17 | -10.07 | 60.00 |
| Oil palm | No tillage | High  | Grassland | Asia (insular) | 6.36 | -29.76 | -17.87 | -1.17 | -42.44 | 60.00 |
| Oil palm | No tillage | High  | Degraded grassland | Asia (insular) | 3.18 | -29.76 | -33.00 | -2.16 | -61.74 | 60.00 |
| Oil palm | No tillage | High  | Long-term cultivated cropland | Asia (insular) | 2.21 | -29.76 | -44.10 | -2.88 | -74.54 | 60.00 |
| Oil palm | Red. tillage | Low  | Secondary forest, less than 20 years | Asia (insular) | 159.66 | -32.90 | -3.23 | -0.21 | 123.32 | 60.00 |
| Oil palm | Red. tillage | Low  | Secondary shrubland, less than 20 years | Asia (insular) | 42.80 | -32.90 | -3.23 | -0.21 | 6.46 | 60.00 |
| Oil palm | Red. tillage | Low  | Grassland | Asia (insular) | 7.03 | -32.90 | -3.23 | -0.21 | -29.31 | 60.00 |
| Oil palm | Red. tillage | Low  | Degraded grassland | Asia (insular) | 3.52 | -32.90 | -19.96 | -1.31 | -50.65 | 60.00 |
| Oil palm | Red. tillage | Low  | Long-term cultivated cropland | Asia (insular) | 2.45 | -32.90 | -32.23 | -2.11 | -64.79 | 60.00 |
| Oil palm | Red. tillage | Medium  | Secondary forest, less than 20 years | Asia (insular) | 151.68 | -31.25 | -7.95 | -0.52 | 111.96 | 60.00 |
| Oil palm | Red. tillage | Medium  | Secondary shrubland, less than 20 years | Asia (insular) | 40.66 | -31.25 | -7.95 | -0.52 | 0.95 | 60.00 |
| Oil palm | Red. tillage | Medium  | Grassland | Asia (insular) | 6.68 | -31.25 | -7.95 | -0.52 | -33.04 | 60.00 |
| Oil palm | Red. tillage | Medium  | Degraded grassland | Asia (insular) | 3.34 | -31.25 | -23.84 | -1.56 | -53.31 | 60.00 |
| Oil palm | Red. tillage | Medium  | Long-term cultivated cropland | Asia (insular) | 2.32 | -31.25 | -35.49 | -2.32 | -66.74 | 60.00 |
| Oil palm | Red. tillage | High  | Secondary forest, less than 20 years | Asia (insular) | 144.46 | -29.76 | -13.95 | -0.91 | 99.83 | 60.00 |
| Oil palm | Red. tillage | High  | Secondary shrubland, less than 20 years | Asia (insular) | 38.73 | -29.76 | -13.95 | -0.91 | -5.90 | 60.00 |
| Oil palm | Red. tillage | High  | Grassland | Asia (insular) | 6.36 | -29.76 | -13.95 | -0.91 | -38.26 | 60.00 |
| Oil palm | Red. tillage | High  | Degraded grassland | Asia (insular) | 3.18 | -29.76 | -29.08 | -1.90 | -57.57 | 60.00 |
| Oil palm | Red. tillage | High  | Long-term cultivated cropland | Asia (insular) | 2.21 | -29.76 | -40.18 | -2.63 | -70.36 | 60.00 |
| Oil palm | Tillage | Low  | Secondary forest, less than 20 years | Asia (insular) | 159.66 | -32.90 | 4.46 | 0.29 | 131.52 | 60.00 |
| Oil palm | Tillage | Low  | Secondary shrubland, less than 20 years | Asia (insular) | 42.80 | -32.90 | 4.46 | 0.29 | 14.66 | 60.00 |
| Oil palm | Tillage | Low  | Grassland | Asia (insular) | 7.03 | -32.90 | 4.46 | 0.29 | -21.11 | 60.00 |
| Oil palm | Tillage | Low  | Degraded grassland | Asia (insular) | 3.52 | -32.90 | -12.27 | -0.80 | -42.45 | 60.00 |
| Oil palm | Tillage | Low  | Long-term cultivated cropland | Asia (insular) | 2.45 | -32.90 | -24.53 | -1.60 | -56.59 | 60.00 |
| Oil palm | Tillage | Medium  | Secondary forest, less than 20 years | Asia (insular) | 151.68 | -31.25 | 0.00 | 0.00 | 120.43 | 60.00 |
| Oil palm | Tillage | Medium  | Secondary shrubland, less than 20 years | Asia (insular) | 40.66 | -31.25 | 0.00 | 0.00 | 9.41 | 60.00 |
| Oil palm | Tillage | Medium  | Grassland | Asia (insular) | 6.68 | -31.25 | 0.00 | 0.00 | -24.57 | 60.00 |
| Oil palm | Tillage | Medium  | Degraded grassland | Asia (insular) | 3.34 | -31.25 | -15.89 | -1.04 | -44.84 | 60.00 |
| Oil palm | Tillage | Medium  | Long-term cultivated cropland | Asia (insular) | 2.32 | -31.25 | -27.54 | -1.80 | -58.27 | 60.00 |
| Oil palm | Tillage | High  | Secondary forest, less than 20 years | Asia (insular) | 144.46 | -29.76 | -5.55 | -0.36 | 108.78 | 60.00 |
| Oil palm | Tillage | High  | Secondary shrubland, less than 20 years | Asia (insular) | 38.73 | -29.76 | -5.55 | -0.36 | 3.05 | 60.00 |
| Oil palm | Tillage | High  | Grassland | Asia (insular) | 6.36 | -29.76 | -5.55 | -0.36 | -29.31 | 60.00 |
| Oil palm | Tillage | High  | Degraded grassland | Asia (insular) | 3.18 | -29.76 | -20.68 | -1.35 | -48.62 | 60.00 |
| Oil palm | Tillage | High  | Long-term cultivated cropland | Asia (insular) | 2.21 | -29.76 | -31.78 | -2.08 | -61.41 | 60.00 |
| Rapeseed | No tillage | Low  | Secondary forest, less than 20 years | Europe | 85.46 | -2.81 | 54.50 | 3.57 | 140.72 | 47.40 |
| Rapeseed | No tillage | Low  | Improved grassland | Europe | 13.58 | -2.81 | 82.76 | 5.41 | 98.95 | 47.40 |
| Rapeseed | No tillage | Low  | Grassland | Europe | 13.58 | -2.81 | 54.50 | 3.57 | 68.84 | 47.40 |
| Rapeseed | No tillage | Low  | Degraded grassland | Europe | 6.79 | -2.81 | -6.06 | -0.40 | -2.47 | 47.40 |
| Rapeseed | No tillage | Low  | Long-term cultivated cropland | Europe | 5.59 | -2.81 | -8.08 | -0.53 | -5.82 | 47.40 |
| Rapeseed | No tillage | Medium  | Secondary forest, less than 20 years | Europe | 76.92 | -2.81 | 37.52 | 2.45 | 114.08 | 47.40 |
| Rapeseed | No tillage | Medium  | Improved grassland | Europe | 12.22 | -2.81 | 62.95 | 4.12 | 76.49 | 47.40 |
| Rapeseed | No tillage | Medium  | Grassland | Europe | 12.22 | -2.81 | 37.52 | 2.45 | 49.39 | 47.40 |
| Rapeseed | No tillage | Medium  | Degraded grassland | Europe | 6.11 | -2.81 | -16.99 | -1.11 | -14.80 | 47.40 |
| Rapeseed | No tillage | Medium  | Long-term cultivated cropland | Europe | 5.03 | -2.81 | -18.80 | -1.23 | -17.81 | 47.40 |
| Rapeseed | No tillage | High  | Secondary forest, less than 20 years | Europe | 64.10 | -2.57 | 18.05 | 1.18 | 80.75 | 47.40 |
| Rapeseed | No tillage | High  | Improved grassland | Europe | 10.19 | -2.57 | 39.25 | 2.57 | 49.43 | 47.40 |
| Rapeseed | No tillage | High  | Grassland | Europe | 10.19 | -2.57 | 18.05 | 1.18 | 26.84 | 47.40 |
| Rapeseed | No tillage | High  | Degraded grassland | Europe | 5.09 | -2.57 | -27.37 | -1.79 | -26.64 | 47.40 |
| Rapeseed | No tillage | High  | Long-term cultivated cropland | Europe | 4.19 | -2.57 | -28.89 | -1.89 | -29.15 | 47.40 |
| Rapeseed | Red. tillage | Low  | Secondary forest, less than 20 years | Europe | 85.46 | -2.81 | 63.47 | 4.15 | 150.28 | 47.40 |
| Rapeseed | Red. tillage | Low  | Improved grassland | Europe | 13.58 | -2.81 | 91.73 | 6.00 | 108.51 | 47.40 |
| Rapeseed | Red. tillage | Low  | Grassland | Europe | 13.58 | -2.81 | 63.47 | 4.15 | 78.40 | 47.40 |
| Rapeseed | Red. tillage | Low  | Degraded grassland | Europe | 6.79 | -2.81 | 2.91 | 0.19 | 7.08 | 47.40 |
| Rapeseed | Red. tillage | Low  | Long-term cultivated cropland | Europe | 5.59 | -2.81 | 0.89 | 0.06 | 3.73 | 47.40 |
| Rapeseed | Red. tillage | Medium  | Secondary forest, less than 20 years | Europe | 76.92 | -2.81 | 46.29 | 3.03 | 123.43 | 47.40 |
| Rapeseed | Red. tillage | Medium  | Improved grassland | Europe | 12.22 | -2.81 | 71.73 | 4.69 | 85.84 | 47.40 |
| Rapeseed | Red. tillage | Medium  | Grassland | Europe | 12.22 | -2.81 | 46.29 | 3.03 | 58.74 | 47.40 |
| Rapeseed | Red. tillage | Medium  | Degraded grassland | Europe | 6.11 | -2.81 | -8.21 | -0.54 | -5.45 | 47.40 |
| Rapeseed | Red. tillage | Medium  | Long-term cultivated cropland | Europe | 5.03 | -2.81 | -10.03 | -0.66 | -8.46 | 47.40 |
| Rapeseed | Red. tillage | High  | Secondary forest, less than 20 years | Europe | 64.10 | -2.57 | 26.17 | 1.71 | 89.40 | 47.40 |
| Rapeseed | Red. tillage | High  | Improved grassland | Europe | 10.19 | -2.57 | 47.36 | 3.10 | 58.07 | 47.40 |
| Rapeseed | Red. tillage | High  | Grassland | Europe | 10.19 | -2.57 | 26.17 | 1.71 | 35.49 | 47.40 |
| Rapeseed | Red. tillage | High  | Degraded grassland | Europe | 5.09 | -2.57 | -19.25 | -1.26 | -17.99 | 47.40 |
| Rapeseed | Red. tillage | High  | Long-term cultivated cropland | Europe | 4.19 | -2.57 | -20.77 | -1.36 | -20.51 | 47.40 |
| Rapeseed | Tillage | Low  | Secondary forest, less than 20 years | Europe | 85.46 | -2.81 | 73.72 | 4.82 | 161.20 | 47.40 |
| Rapeseed | Tillage | Low  | Improved grassland | Europe | 13.58 | -2.81 | 101.98 | 6.67 | 119.43 | 47.40 |
| Rapeseed | Tillage | Low  | Grassland | Europe | 13.58 | -2.81 | 73.72 | 4.82 | 89.32 | 47.40 |
| Rapeseed | Tillage | Low  | Degraded grassland | Europe | 6.79 | -2.81 | 13.16 | 0.86 | 18.01 | 47.40 |
| Rapeseed | Tillage | Low  | Long-term cultivated cropland | Europe | 5.59 | -2.81 | 11.14 | 0.73 | 14.66 | 47.40 |
| Rapeseed | Tillage | Medium  | Secondary forest, less than 20 years | Europe | 76.92 | -2.81 | 56.32 | 3.68 | 134.12 | 47.40 |
| Rapeseed | Tillage | Medium  | Improved grassland | Europe | 12.22 | -2.81 | 81.76 | 5.35 | 96.52 | 47.40 |
| Rapeseed | Tillage | Medium  | Grassland | Europe | 12.22 | -2.81 | 56.32 | 3.68 | 69.42 | 47.40 |
| Rapeseed | Tillage | Medium  | Degraded grassland | Europe | 6.11 | -2.81 | 1.82 | 0.12 | 5.24 | 47.40 |
| Rapeseed | Tillage | Medium  | Long-term cultivated cropland | Europe | 5.03 | -2.81 | 0.00 | 0.00 | 2.22 | 47.40 |
| Rapeseed | Tillage | High  | Secondary forest, less than 20 years | Europe | 64.10 | -2.57 | 35.44 | 2.32 | 99.29 | 47.40 |
| Rapeseed | Tillage | High  | Improved grassland | Europe | 10.19 | -2.57 | 56.64 | 3.71 | 67.96 | 47.40 |
| Rapeseed | Tillage | High  | Grassland | Europe | 10.19 | -2.57 | 35.44 | 2.32 | 45.37 | 47.40 |
| Rapeseed | Tillage | High  | Degraded grassland | Europe | 5.09 | -2.57 | -9.98 | -0.65 | -8.11 | 47.40 |
| Rapeseed | Tillage | High  | Long-term cultivated cropland | Europe | 4.19 | -2.57 | -11.49 | -0.75 | -10.62 | 47.40 |
| Soybean | No tillage | Low  | Secondary forest, less than 20 years | South America | 383.52 | -3.64 | 63.80 | 4.17 | 447.85 | 39.10 |
| Soybean | No tillage | Low  | Secondary shrubland, less than 20 years | South America | 110.66 | -3.64 | 63.80 | 4.17 | 174.99 | 40.40 |
| Soybean | No tillage | Low  | Grassland | South America | 22.27 | -3.64 | 63.80 | 4.17 | 86.60 | 40.40 |
| Soybean | No tillage | Low  | Degraded grassland | South America | 11.13 | -3.64 | 22.30 | 1.46 | 31.26 | 40.40 |
| Soybean | No tillage | Low  | Long-term cultivated cropland | South America | 7.75 | -3.64 | -8.13 | -0.53 | -4.55 | 40.40 |
| Soybean | No tillage | Medium  | Secondary forest, less than 20 years | South America | 364.34 | -3.84 | 54.45 | 3.56 | 418.51 | 40.40 |
| Soybean | No tillage | Medium  | Secondary shrubland, less than 20 years | South America | 105.12 | -3.84 | 54.45 | 3.56 | 159.29 | 40.40 |
| Soybean | No tillage | Medium  | Grassland | South America | 21.16 | -3.84 | 54.45 | 3.56 | 75.33 | 40.40 |
| Soybean | No tillage | Medium  | Degraded grassland | South America | 10.58 | -3.84 | 15.03 | 0.98 | 22.75 | 40.40 |
| Soybean | No tillage | Medium  | Long-term cultivated cropland | South America | 7.36 | -3.84 | -13.88 | -0.91 | -11.27 | 40.40 |
| Soybean | No tillage | High  | Secondary forest, less than 20 years | South America | 331.22 | -3.84 | 41.81 | 2.73 | 371.92 | 40.40 |
| Soybean | No tillage | High  | Secondary shrubland, less than 20 years | South America | 95.57 | -3.84 | 41.81 | 2.73 | 136.27 | 40.40 |
| Soybean | No tillage | High  | Grassland | South America | 19.23 | -3.84 | 41.81 | 2.73 | 59.93 | 40.40 |
| Soybean | No tillage | High  | Degraded grassland | South America | 9.62 | -3.84 | 5.97 | 0.39 | 12.13 | 40.40 |
| Soybean | No tillage | High  | Long-term cultivated cropland | South America | 6.69 | -3.84 | -20.31 | -1.33 | -18.79 | 40.40 |
| Soybean | Red. tillage | Low  | Secondary forest, less than 20 years | South America | 383.52 | -3.64 | 68.08 | 4.45 | 452.40 | 40.40 |
| Soybean | Red. tillage | Low  | Secondary shrubland, less than 20 years | South America | 110.66 | -3.64 | 68.08 | 4.45 | 179.54 | 40.40 |
| Soybean | Red. tillage | Low  | Grassland | South America | 22.27 | -3.64 | 68.08 | 4.45 | 91.16 | 40.40 |
| Soybean | Red. tillage | Low  | Degraded grassland | South America | 11.13 | -3.64 | 26.58 | 1.74 | 35.81 | 40.40 |
| Soybean | Red. tillage | Low  | Long-term cultivated cropland | South America | 7.75 | -3.64 | -3.85 | -0.25 | 0.00 | 40.40 |
| Soybean | Red. tillage | Medium  | Secondary forest, less than 20 years | South America | 364.34 | -3.84 | 58.87 | 3.85 | 423.22 | 40.40 |
| Soybean | Red. tillage | Medium  | Secondary shrubland, less than 20 years | South America | 105.12 | -3.84 | 58.87 | 3.85 | 164.00 | 40.40 |
| Soybean | Red. tillage | Medium  | Grassland | South America | 21.16 | -3.84 | 58.87 | 3.85 | 80.03 | 40.40 |
| Soybean | Red. tillage | Medium  | Degraded grassland | South America | 10.58 | -3.84 | 19.45 | 1.27 | 27.45 | 40.40 |
| Soybean | Red. tillage | Medium  | Long-term cultivated cropland | South America | 7.36 | -3.84 | -9.46 | -0.62 | -6.56 | 40.40 |
| Soybean | Red. tillage | High  | Secondary forest, less than 20 years | South America | 331.22 | -3.84 | 46.26 | 3.03 | 376.66 | 40.40 |
| Soybean | Red. tillage | High  | Secondary shrubland, less than 20 years | South America | 95.57 | -3.84 | 46.26 | 3.03 | 141.01 | 40.40 |
| Soybean | Red. tillage | High  | Grassland | South America | 19.23 | -3.84 | 46.26 | 3.03 | 64.68 | 40.40 |
| Soybean | Red. tillage | High  | Degraded grassland | South America | 9.62 | -3.84 | 10.43 | 0.68 | 16.88 | 40.40 |
| Soybean | Red. tillage | High  | Long-term cultivated cropland | South America | 6.69 | -3.84 | -15.85 | -1.04 | -14.05 | 40.40 |
| Soybean | Tillage | Low  | Secondary forest, less than 20 years | South America | 383.52 | -3.64 | 77.24 | 5.05 | 462.16 | 40.40 |
| Soybean | Tillage | Low  | Secondary shrubland, less than 20 years | South America | 110.66 | -3.64 | 77.24 | 5.05 | 189.30 | 40.40 |
| Soybean | Tillage | Low  | Grassland | South America | 22.27 | -3.64 | 77.24 | 5.05 | 100.92 | 40.40 |
| Soybean | Tillage | Low  | Degraded grassland | South America | 11.13 | -3.64 | 35.74 | 2.34 | 45.57 | 40.40 |
| Soybean | Tillage | Low  | Long-term cultivated cropland | South America | 7.75 | -3.64 | 5.31 | 0.35 | 9.76 | 40.40 |
| Soybean | Tillage | Medium  | Secondary forest, less than 20 years | South America | 364.34 | -3.84 | 68.33 | 4.47 | 433.30 | 40.40 |
| Soybean | Tillage | Medium  | Secondary shrubland, less than 20 years | South America | 105.12 | -3.84 | 68.33 | 4.47 | 174.08 | 40.40 |
| Soybean | Tillage | Medium  | Grassland | South America | 21.16 | -3.84 | 68.33 | 4.47 | 90.11 | 40.40 |
| Soybean | Tillage | Medium  | Degraded grassland | South America | 10.58 | -3.84 | 28.91 | 1.89 | 37.53 | 40.40 |
| Soybean | Tillage | Medium  | Long-term cultivated cropland | South America | 7.36 | -3.84 | 0.00 | 0.00 | 3.52 | 40.40 |
| Soybean | Tillage | High  | Secondary forest, less than 20 years | South America | 331.22 | -3.84 | 55.81 | 3.65 | 386.84 | 40.40 |
| Soybean | Tillage | High  | Secondary shrubland, less than 20 years | South America | 95.57 | -3.84 | 55.81 | 3.65 | 151.18 | 40.40 |
| Soybean | Tillage | High  | Grassland | South America | 19.23 | -3.84 | 55.81 | 3.65 | 74.85 | 40.40 |
| Soybean | Tillage | High  | Degraded grassland | South America | 9.62 | -3.84 | 19.97 | 1.31 | 27.05 | 40.40 |
| Soybean | Tillage | High  | Long-term cultivated cropland | South America | 6.69 | -3.84 | -6.31 | -0.41 | -3.87 | 40.40 |
| Camelina | No tillage | Low  | Secondary forest, less than 20 years | North America | 83.16 | -2.30 | 29.51 | 1.93 | 112.30 | 42.00 |
| Camelina | No tillage | Low  | Improved grassland | North America | 8.22 | -2.30 | 44.82 | 2.93 | 53.67 | 42.00 |
| Camelina | No tillage | Low  | Grassland | North America | 8.22 | -2.30 | 29.51 | 1.93 | 37.37 | 42.00 |
| Camelina | No tillage | Low  | Degraded grassland | North America | 4.11 | -2.30 | -3.28 | -0.21 | -1.68 | 42.00 |
| Camelina | No tillage | Low  | Long-term cultivated cropland | North America | 3.38 | -2.30 | -4.37 | -0.29 | -3.57 | 42.00 |
| Camelina | No tillage | Medium  | Secondary forest, less than 20 years | North America | 69.30 | -2.11 | 18.81 | 1.23 | 87.23 | 42.00 |
| Camelina | No tillage | Medium  | Improved grassland | North America | 6.85 | -2.11 | 31.57 | 2.06 | 38.37 | 42.00 |
| Camelina | No tillage | Medium  | Grassland | North America | 6.85 | -2.11 | 18.81 | 1.23 | 24.79 | 42.00 |
| Camelina | No tillage | Medium  | Degraded grassland | North America | 3.43 | -2.11 | -8.52 | -0.56 | -7.76 | 42.00 |
| Camelina | No tillage | Medium  | Long-term cultivated cropland | North America | 2.82 | -2.11 | -9.43 | -0.62 | -9.33 | 42.00 |
| Camelina | No tillage | High  | Secondary forest, less than 20 years | North America | 57.75 | -1.93 | 9.05 | 0.59 | 65.46 | 42.00 |
| Camelina | No tillage | High  | Improved grassland | North America | 5.71 | -1.93 | 19.68 | 1.29 | 24.74 | 42.00 |
| Camelina | No tillage | High  | Grassland | North America | 5.71 | -1.93 | 9.05 | 0.59 | 13.42 | 42.00 |
| Camelina | No tillage | High  | Degraded grassland | North America | 2.85 | -1.93 | -13.72 | -0.90 | -13.70 | 42.00 |
| Camelina | No tillage | High  | Long-term cultivated cropland | North America | 2.35 | -1.93 | -14.48 | -0.95 | -15.01 | 42.00 |
| Camelina | Red. tillage | Low  | Secondary forest, less than 20 years | North America | 83.16 | -2.30 | 34.37 | 2.25 | 117.48 | 42.00 |
| Camelina | Red. tillage | Low  | Improved grassland | North America | 8.22 | -2.30 | 49.68 | 3.25 | 58.85 | 42.00 |
| Camelina | Red. tillage | Low  | Grassland | North America | 8.22 | -2.30 | 34.37 | 2.25 | 42.54 | 42.00 |
| Camelina | Red. tillage | Low  | Degraded grassland | North America | 4.11 | -2.30 | 1.58 | 0.10 | 3.49 | 42.00 |
| Camelina | Red. tillage | Low  | Long-term cultivated cropland | North America | 3.38 | -2.30 | 0.48 | 0.03 | 1.60 | 42.00 |
| Camelina | Red. tillage | Medium  | Secondary forest, less than 20 years | North America | 69.30 | -2.11 | 23.21 | 1.52 | 91.92 | 42.00 |
| Camelina | Red. tillage | Medium  | Improved grassland | North America | 6.85 | -2.11 | 35.97 | 2.35 | 43.06 | 42.00 |
| Camelina | Red. tillage | Medium  | Grassland | North America | 6.85 | -2.11 | 23.21 | 1.52 | 29.47 | 42.00 |
| Camelina | Red. tillage | Medium  | Degraded grassland | North America | 3.43 | -2.11 | -4.12 | -0.27 | -3.07 | 42.00 |
| Camelina | Red. tillage | Medium  | Long-term cultivated cropland | North America | 2.82 | -2.11 | -5.03 | -0.33 | -4.64 | 42.00 |
| Camelina | Red. tillage | High  | Secondary forest, less than 20 years | North America | 57.75 | -1.93 | 13.12 | 0.86 | 69.80 | 42.00 |
| Camelina | Red. tillage | High  | Improved grassland | North America | 5.71 | -1.93 | 23.75 | 1.55 | 29.08 | 42.00 |
| Camelina | Red. tillage | High  | Grassland | North America | 5.71 | -1.93 | 13.12 | 0.86 | 17.76 | 42.00 |
| Camelina | Red. tillage | High  | Degraded grassland | North America | 2.85 | -1.93 | -9.65 | -0.63 | -9.36 | 42.00 |
| Camelina | Red. tillage | High  | Long-term cultivated cropland | North America | 2.35 | -1.93 | -10.41 | -0.68 | -10.68 | 42.00 |
| Camelina | Tillage | Low  | Secondary forest, less than 20 years | North America | 83.16 | -2.30 | 39.92 | 2.61 | 123.39 | 42.00 |
| Camelina | Tillage | Low  | Improved grassland | North America | 8.22 | -2.30 | 55.23 | 3.61 | 64.76 | 42.00 |
| Camelina | Tillage | Low  | Grassland | North America | 8.22 | -2.30 | 39.92 | 2.61 | 48.46 | 42.00 |
| Camelina | Tillage | Low  | Degraded grassland | North America | 4.11 | -2.30 | 7.13 | 0.47 | 9.41 | 42.00 |
| Camelina | Tillage | Low  | Long-term cultivated cropland | North America | 3.38 | -2.30 | 6.03 | 0.39 | 7.52 | 42.00 |
| Camelina | Tillage | Medium  | Secondary forest, less than 20 years | North America | 69.30 | -2.11 | 28.24 | 1.85 | 97.28 | 42.00 |
| Camelina | Tillage | Medium  | Improved grassland | North America | 6.85 | -2.11 | 40.99 | 2.68 | 48.42 | 42.00 |
| Camelina | Tillage | Medium  | Grassland | North America | 6.85 | -2.11 | 28.24 | 1.85 | 34.83 | 42.00 |
| Camelina | Tillage | Medium  | Degraded grassland | North America | 3.43 | -2.11 | 0.91 | 0.06 | 2.29 | 42.00 |
| Camelina | Tillage | Medium  | Long-term cultivated cropland | North America | 2.82 | -2.11 | 0.00 | 0.00 | 0.71 | 42.00 |
| Camelina | Tillage | High  | Secondary forest, less than 20 years | North America | 57.75 | -1.93 | 17.77 | 1.16 | 74.75 | 42.00 |
| Camelina | Tillage | High  | Improved grassland | North America | 5.71 | -1.93 | 28.40 | 1.86 | 34.03 | 42.00 |
| Camelina | Tillage | High  | Grassland | North America | 5.71 | -1.93 | 17.77 | 1.16 | 22.71 | 42.00 |
| Camelina | Tillage | High  | Degraded grassland | North America | 2.85 | -1.93 | -5.00 | -0.33 | -4.41 | 42.00 |
| Camelina | Tillage | High  | Long-term cultivated cropland | North America | 2.35 | -1.93 | -5.76 | -0.38 | -5.72 | 42.00 |

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