Measuring impact of products on biodiversity: The Biodiversity Footprint Calculator

Planbureau voor de Leefomgeving
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By Wilbert van Rooij
Plansup
Plansup.consult@gmail.com

Biodiversity footprint approach

- Developed under the Platform Biodiversity Ecosystems and Economy and applied to assess the biodiversity footprint of 8 companies from different sectors in the Netherlands.
- Also applied to the dairy sector in the Netherlands and nature restoration.
- Based on the **GLOBIO3**, global biodiversity assessment model of the PBL Netherlands Environmental Assessment Agency
- Internationally implemented at global, regional and sub-national scale

Biodiversity footprint assessments company level

Companies cases:

- DESSO (carpets)
- DSM Chemical industry
- Foreco (timber)
- Moyee (coffee)
- Natural plastics
- Better Future Factory (Recycled PET products)
- Tony's Chocolonely (chocolate)
- Schut paper (paper with tomato residue)

Sector case:

- Milk sector Netherlands

Calculating current and future footprint:
Measure effectiviness of company measures to reduce biodiversity footprint

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Main goals of assessment for companies

- Insight in impact contribution main pressure factors
- Determination which part of the chain or process has the largest impact
- Testing effectiveness of assumed biodiversity friendly measures
- Determination of footprint difference between:
  - Different products
  - Current and desired (future) situation
  - Use of different raw materials / energy consumption / transport systems, etc

GLOBIO: From global to national to footprint company level

- **GLOBIO3 method**:
  Global, national and sub-national. Incl 5 terrestrial pressures

- **Biodiversity Footprint method**:
  Company / product level, impact assessed per part of the chain.
  - Incl 2 terrestrial pressures from GLOBIO3: **Landuse**, **GHG Emissions**,
  - 1 pressure from GLOBIO-aquatic: **N&P Emissions to water**,
  - and for the Netherlands 1 new pressure: **Water extraction**

  These 4 pressures are the most relevant pressure factors on biodiversity and cover also the majority of impacts caused by businesses.
  Note: This can be different for individual companies!

- **Biodiversity Footprint calculator**:
  Web based calculation tool
  Company / product level, impact assessed for 2 parts of the chain (raw materials/supplier + production)
  - Incl 2 terrestrial pressures from GLOBIO3: **Landuse**, **GHG Emissions**

Biodiversity footprint approach

The model uses the **MSA** indicator:
Mean Species Abundance of original species,
relative to their abundance in primary ecosystems

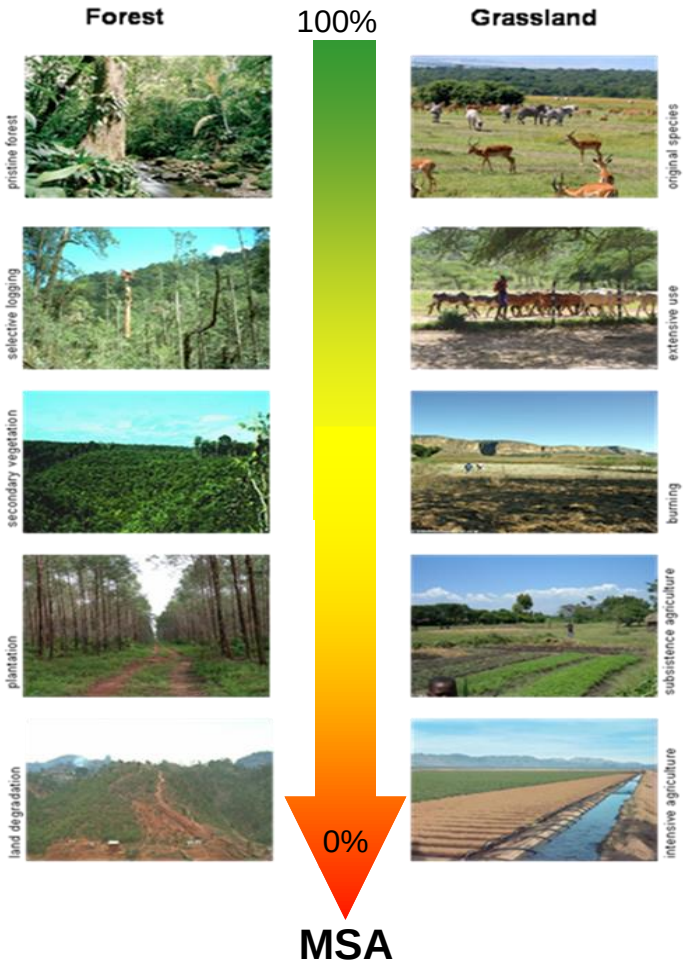
x

Quality * Quantity

- Indicates the 'naturalness' or 'intactness' of an area / ecosystem
- Combines ecosystem quality (species abundance) and quantity (extent)
- The MSA can be calculated to determine past, present or future state
- Similar to the Biodiversity Integrity Index, the Biodiversity Intactness Index (BII) and the Living Planet Index (LPI), but
  - every hectare is given equal weight in MSA, whereas BII gives more weight to species rich areas.
  - The main difference with LPI is that MSA takes the pristine situation as a baseline, whereas LPI compares to the situation in 1970.

Land-use impact

- Naturalness compared to original situation
- In agricultural systems the **productivity** (yield per ha) is an important component for assessing the impact as it determines the area needed to produce a certain amount of product
- The **intensity** of production determines the impact per unit of area used
- Trade-offs between productivity and intensity of production can be assessed
- Degradation of original ecosystem will lead to a reduced MSA



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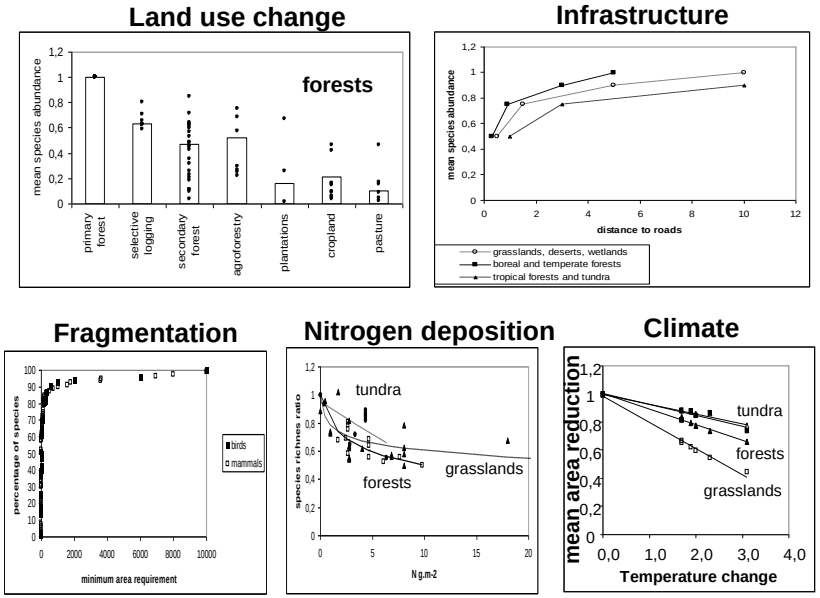
Pressure factors in GLOBIO3

- **Land-use change** (agriculture expansion, forestry) (management; e.g. harvest system, rotation, etc.)
- Infrastructure & settlement
- Fragmentation
- **Climate change**
- N-deposition

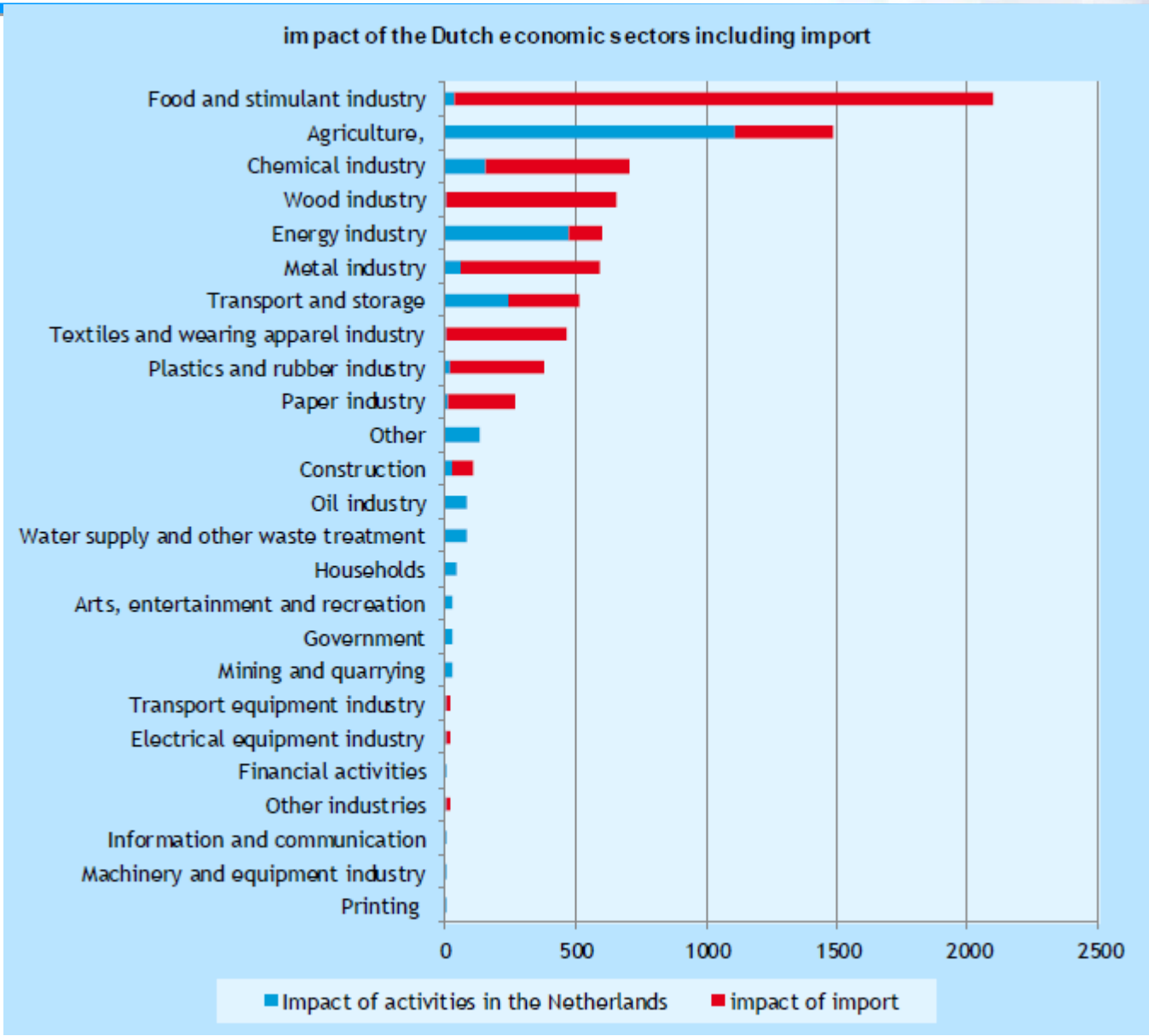
→ MSA

Cause-Effect relations for each pressure based on literature research in terms of quantity and quality



Impact companies on biodiversity

PBL and



Dutch consumption only: Based on LCA analysis (ReCiPe):

Climate: 49%

Landuse: 40%

So, land use and climate change cover by far the largest impact

Biodiversity Footprint Calculator includes these two pressures

Source:
Benchmark Biodiversiteit, CE report 2014

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GLOBIO: From global to national to footprint company level

Biodiversity Footprint is expressed in loss off MSA within the area that is used for the production of the product: → **MSA.ha**

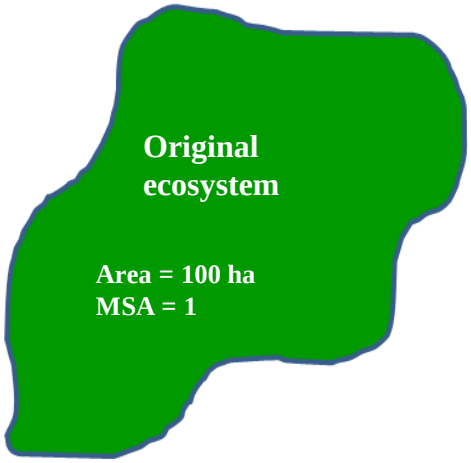
Biodiversity Footprint = Reduction of MSA * Impacted area

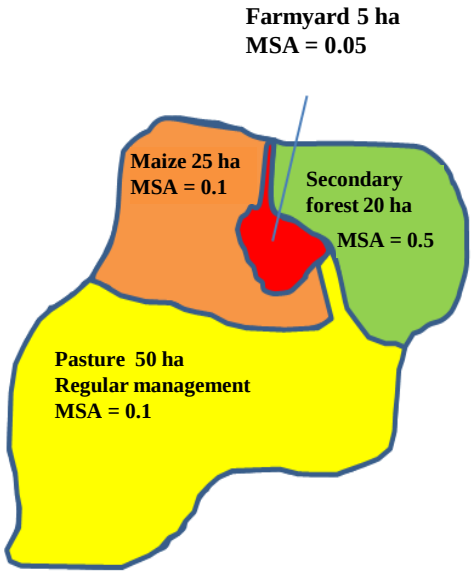
= [1 – MSA_impact area product] (MSA) *** Impact area product** (ha)

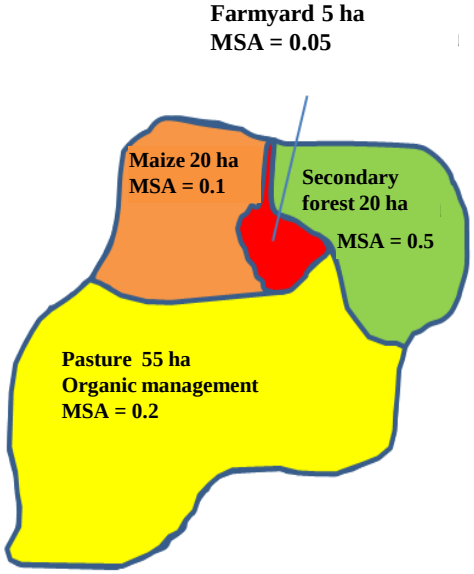
- A higher MSA.ha means a larger footprint. E.g. because loss of natural reference-species per hectare is large, and/or loss extends over a larger area
- In case of multiple use of land, an **economic allocation correction** of the footprint is applied. Only the share is used for which the company is responsible.

Biodiversity footprint calculation: Land use

Calculation biodiversity footprint land use





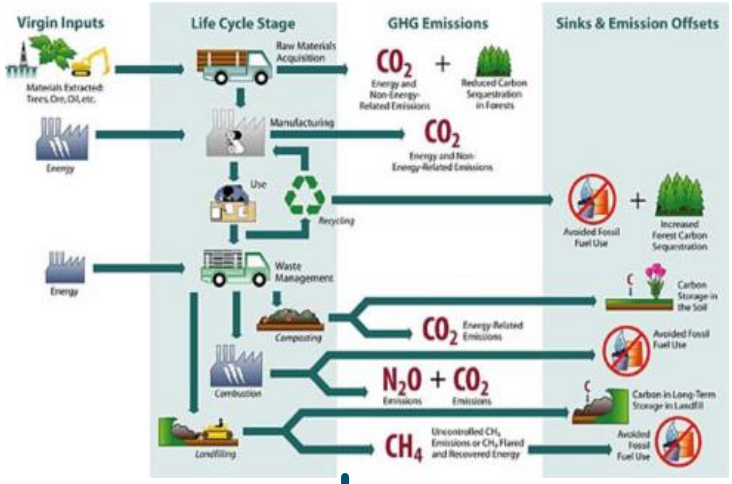


Biodiversity footprint landuse 1900
=∑ ha landuse * (1- MSA landuse)
= 100 * (1-1) = **0 MSA.ha**

Biodiversity footprint baseline (2010)
=∑ ha landuse * (1- MSA landuse)
= (25*0.9)+(5*0.95)+ (20*0.5)+(50*0.9)
= **82.85 MSA.ha**

Biodiversity footprint 2020
=∑ ha landuse * (1- MSA landuse)
= (20*0.9)+(5*0.95)+ (20*0.5)+(55*0.8)
= **74.5 MSA.ha**

Biodiversity footprint calculation: Climate change



CO_2 eq. emissions

Delta GMT per kg CO_2

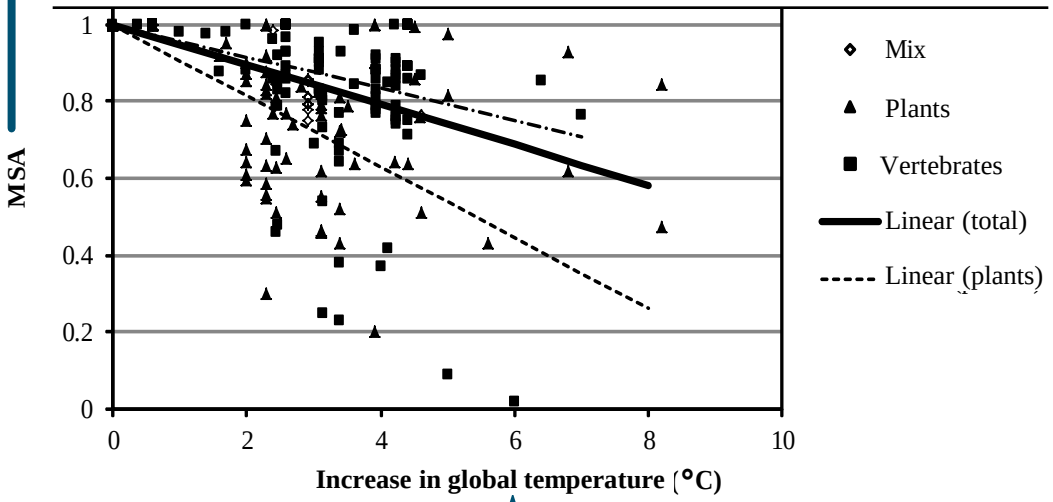
Temperature factors

20	100	infinit
8.5E-15	4.2E-14	5.9E-13

(1-MSA) * global area Natural ecosystems → MSA.ha

MSA.ha per ton CO2

	Time horizon		
	20	100	infinit
natural	6.07238E-05	0.0002956	0.004167
natural and semi natural	6.62E-05	0.0003288	0.004633



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Summary basic calculation

Common indicator: MSA.ha.
Measured per pressure for entire product chain

- **Land use**
  Land use change: (Σ ha landuse * [1-MSA_ landuse]) → … MSA.ha

- **GHG Emissions**
  CO_2, CH_4 en N_2O emissions: CO2 equivalents →
  Global Mean Temperature increase: $4{,}2 \cdot 10^{-14}$ °C yr /kg CO_2 for 100 year →
  $3{,}29 \cdot 10^{-5}$ msa.ha.yr per kg CO2 * X kg CO2/yr → … MSA.ha

Total terrestrial footprint = MSA.ha_land use + MSA.ha_climate

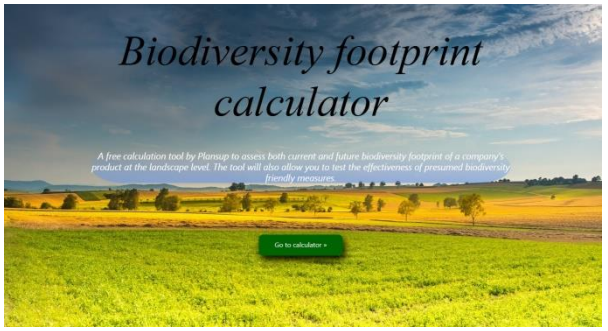
Webtool: Biodiversity Footprint Calculator

Web application for companies to calculate biodiversity footprint by themselves

- Simple method so that companies can use it without background knowledge.
- Included pressures: Land use, GHG.
- Not entire chain included. First tool focuses on resources and production process
- Calculator has been developed by Plansup in collaboration with Saxion
  A start for a similar tool is made by Wageningen Environmental Research with possibility to add emission to water and water extraction, but financial support needed.

Biodiversity Footprint Calculator

Reason using only two pressures:



- First version.
  Focus on the main pressure factors.
  Keeping method simple.

- Not all pressures can directly be related to a company as there are more companies/people involved
  (e.g. Infrastructure, Fragmentation and Nitrogen deposition to land)

- Local desiccation, pesticides, toxic waste and eutrophying emissions are implicitly included via land use.

Access to tool: http://biodiversity-footprint.herokuapp.com/#/home

Follow up version:

- N and P to water?
- Water extraction?

Data requirements Biodiversity Footprint Calculator

For each product that needs to be assessed:

- **Extent and management intensity of land use**
  - Supply chain
  - Production process
- **GHG emitters, type and amount**
  - Supply chain
  - Production process
- **Info on Transport emission**
  - Supply chain
  - Production process
- **Info on Economic allocation**
  - Multiple use of: land, production facility and transport

Info on Land use type and area

Info on GHG type and amount

Info on Transport emission

Info on Economic allocation

Scenario name

Enter scenario title here

Product description

Enter the amount of product unit eg 1kg cookies/year

Supply chain Production process Transport All

Supply chain

Name, type and extent of supply chain factors that can be related to land use and emission of GHG.

Enter name | Land use | Intensive ag | Enter quantity (ha) | Economic alocation

Add item

If you are not sure which type is appropriate for you, press this link and look at the corresponding table with descriptions of each type.

Add scenario

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Description table

Land use

MSA	Type	Description
1	Primary forests	Forests with minimal disturbance where flora and fauna species abundance is near pristine. Not present in the Netherlands.
0.2	Forest plantations, single species	Planted forest, often with exotic species. Plantations with only exotic species have the lowest value (0.2). Plantations with several local species have a higher biodiversity. Plantations with short rotations have a lower value than those with long rotations.
0.3	Forest plantations, mixed species	Forest plantations, mixed species
0.5	Secondary forests	Areas originally covered with forest or woodlands, where vegetation has been removed, forest is re-growing or has a different cover and is no longer in use
0.7	Light used primary forest (limited selective logging of semi-natural forest)	Forests with extractive use and associated disturbance like hunting and selective logging, where timber extraction is followed by a long period of re-growth with naturally occurring tree species. Reduced Impact Logging.
0.8	Light used forest (limited selective logging of semi-natural forest with Reduced Impact Logging management)	
0.5	Agro-forestry	Agricultural production intercropped with (native) trees. Trees are kept for shade or as wind shelter
0.3	Extensive agriculture / low input farming	Subsistence and traditional farming, farming, and low external input agriculture
0.05	Irrigated intensive agriculture	High external input irrigation-based agriculture, conventional agriculture, mostly with a degree of regional specialization, , drainage-based agriculture
0.1	Intensive agriculture	High external input agriculture, conventional agriculture, mostly with a degree of regional specialization, drainage-based agriculture
0.2	Perennial crops & woody bio fules	Cultivated perennial crops, including bio fuel crops

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		specialization, drainage-based agriculture
0.2	Perennial crops & woody bio fules	Cultivated perennial crops, including bio fuel crops
0.1	Intensive managed man made pastures	Forests, woodlands and natural grasslands that have been converted to grasslands for livestock grazing.
1	Natural grass & shrub lands	Grassland or scbuildrubland-dominated vegetation (incl natural wetlands) with minimal disturbance where flora and fauna species abundance is near pristine. (E.g. undisturbed steppe, tundra, or savannah)
0.05	Urban area, industrial area	Areas with more than 80% build up and other artificial surfaces
0.05	Mining area	Areas predominantly excavated land for miningMSA value estimated; no cause-effect relation yet
1	Natural bare, rock and snow	Areas permanently covered with snow or ice considered as undisturbed areas
1	Natural rangelands	Rangeland ecosystems determined by climatic and geographical circumstances and grazed by wildlife or domestic animals at rates similar to those of free-roaming wildlife
0.7	Extensively used or recent abandoned rangelands	Rangelands with low stocking rates or original grasslands no longer in use, lacking wildlife grazing and no forests developed
0.6	Moderately used rangelands	Rangelands with higher stocking rates: grazing has different seasonal patterns or vegetation structure is different compared with natural rangelands
0.5	Intensively used rangelands	Rangelands with very high stocking rates: grazing has different seasonal patterns and vegetation structure is different compared with natural rangelands
0.3	Extensive managed man-made grasslands	Man made rangeland with extensive/organic management, including converted forests
0.1	Intensive managed man-made grasslands	Man made rangeland with intensive management

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Description table

Green house gas

CO2 eq	Type	Description
1	CO2 (m3)	Carbon dioxide. Colorless gas
25	CH4 (m3)	Methane. Colorless, flammable, nontoxic gas with a sweet, oil type odor
298	N2O (m3)	Nitrous oxide / laughing gas
0.65	Petrol (liter)	Gasoline
0.01	Hard coal briquettes (kg)	Compressed block of coal dust or other combustible biomass material such as charcoal, sawdust, wood chips, peat, or paper used for fuel and kindling to start a fire.
0.53	Diesel (liter)	Liquid fuel used in diesel engines, whose fuel ignition takes place, without any spark, as a result of compression of the inlet air mixture and then injection of fuel.
0.53	Electricity - NL (kWh)	Electricity
0.14	Natural gas (m3)	Naturally occurring hydrocarbon gas mixture consisting primarily of methane, but commonly including varying amounts of other higher alkanes, and sometimes a small percentage of carbon dioxide, nitrogen, hydrogen sulfide, or helium
0	Electricity from wind, sun and water power (kWh)	Electricity from wind, sun and water power (kWh)
0.19	Electricity from biomass (kWh)	Biomass is an industry term for getting energy by burning wood, and other organic matter
0	Other	Any other type

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Description table

Transport

CO2 eq per ton/km	Type
1.95	light commercial vehicle (Van)
0.085	Lorry (>32 metric ton)
0.17	Lorry (16-32 metric ton)
0.22	Lorry (7.5-16 metric ton)
0.525	Lorry (3.5-7.5 metric ton)
0.05	Freight train (electric)
0.03	Freight train (diesel)
0.05	Barge tanker
0.05	Barge
0.01	transoceanic tanker
0.01	transoceanic ship
1.7	Aircraft (intracontinental)
1.1	Aircraft (intercontinental)

Scenario name

Production 2017

Product description

Woolen sweaters and carpets

○ Supply chain ○ Production process ○ Transport ◉ All

Supply chain

Name, type and extent of supply chain factors that can be related to land use and emission of GHG.

Pasture for wool	Land use	Intensive m	1196	0.25	X
Storage house w	Land use	Urban area	0.5	Economic alocation	X
Wool emission	Green hous	CO2 (kg)	2508000	Economic alocation	X

Add item

If you are not sure which type is appropriate for you, press this link and look at the corresponding table with descriptions of each type.

Production process

Name, type and extent of production process and site factors that can be related to land use and emission of GHG.

Factory	Land use	Urban area	2	Economic alocation	X
Storage house p	Land use	Urban area	1	Economic alocation	X
GHG carpet proc	Green hous	CO2 (kg)	2825158	Economic alocation	X
GHG sweater pro	Green hous	CO2 (kg)	99900	Economic alocation	X

Plansup Van Rooij 2018

Transport

Name, type and extent of transport process that can be related to emission of GHG.

Transport wool	Lorry (16-32 me	400	6	Share of cost	X
nsport sweaters En	light commercia	11000	7.5	Share of cost	X
ansport carpets En	Lorry (16-32 me	3000	4	Share of cost	X

Add item

Scenario name

Production 2020

Product description

Woolen sweaters and carpets

○ Supply chain ○ Production process ○ Transport ◉ All

Supply chain

Name, type and extent of supply chain factors that can be related to land use and emission of GHG.

Pasture for wool	Land use	Organic ma	1500	0.25	X
Storage house w	Land use	Urban area	0.5	Economic alocation	X
Wool emission	Green hous	CO2 (kg)	2508000	Economic alocation	X

Add item

Plansup Van Rooij 2018

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GHG carpet proc	Green hous	CO2 (kg)	2025158	Economic alocation		X
GHG sweater prc	Green hous	CO2 (kg)	50900	Economic alocation		X
GHG storage	Green hous	CO2 (kg)	5000	Economic alocation		X

Add item

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Transport wool	Lorry (>32 metr	400	6	Share of cost		X
Transport sweaters	Lorry (3.5-7.5 m	5500	7.5	Share of cost		X
Transport carpets I	Lorry (16-32 me	3000	4	Share of cost		X

Add item

Add scenario

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Scenario name

Production 2017

Product description

Woolen sweaters and carpets

○ Supply chain ○ Production process ○ Transport ◉ All

Copy input fields scenario so that you do not have to fill in many fields for 2nd scenario, only the title and fields that change

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Add item

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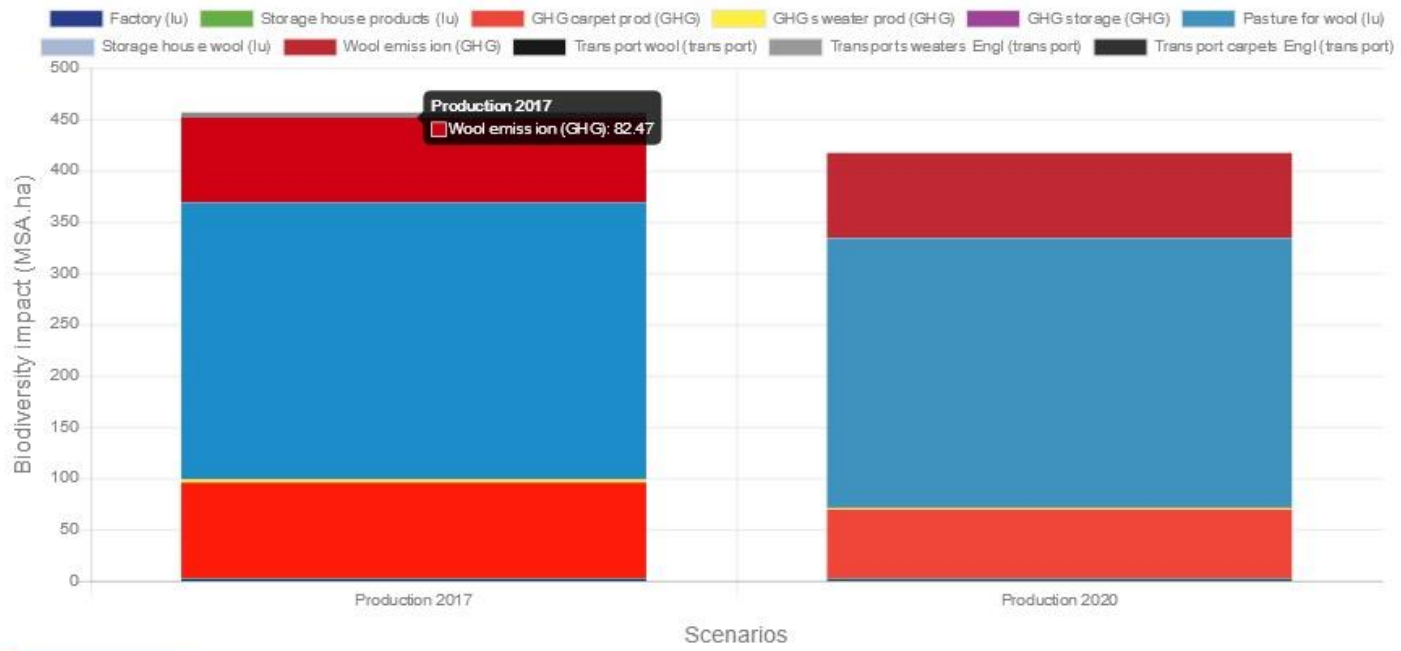
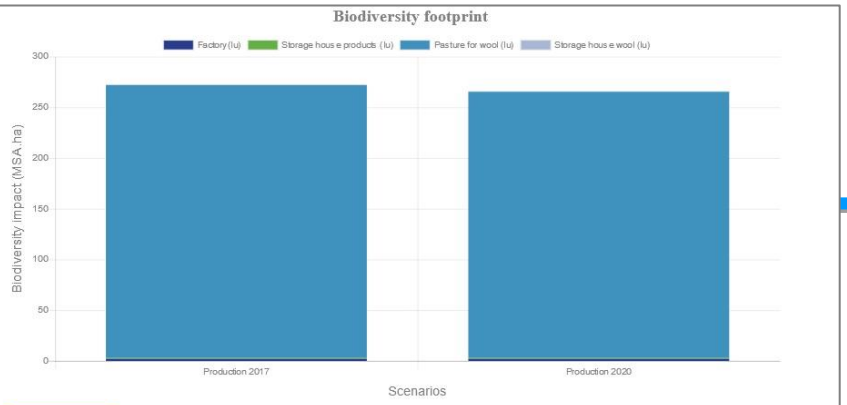
Biodiversity footprint



Export Graph

Land use Filter results to show only biodiversity impact caused by land use. Filter results	**Greenhouse gases** Filter results to show only biodiversity impact caused by greenhouse gasses. Filter results	**Supply chain** Filter results to show biodiversity impact of the supply chain only. Filter results
Production process Filter results to show biodiversity impact of the production process only. Filter results	**Transport** Filter results to show biodiversity impact of transport only. Filter results	**Reset filters** Reset the results filters to show biodiversity impact caused by all factors. Filter results

Tables



Export Graph

Land use

Land use	Greenhouse gases	Supply chain
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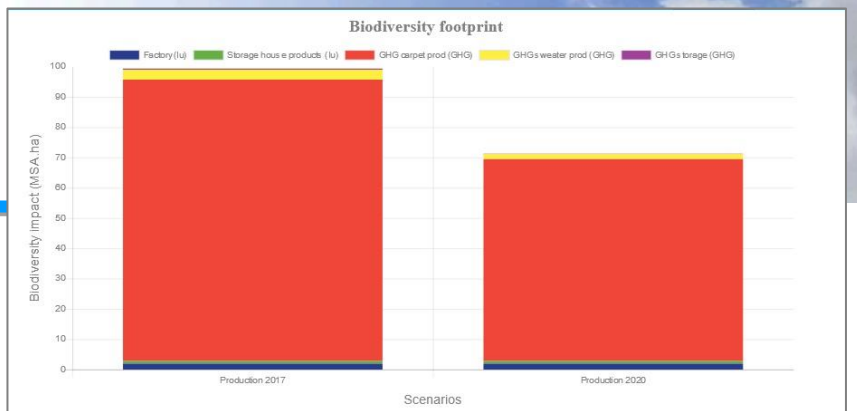

Export Graph

Production process

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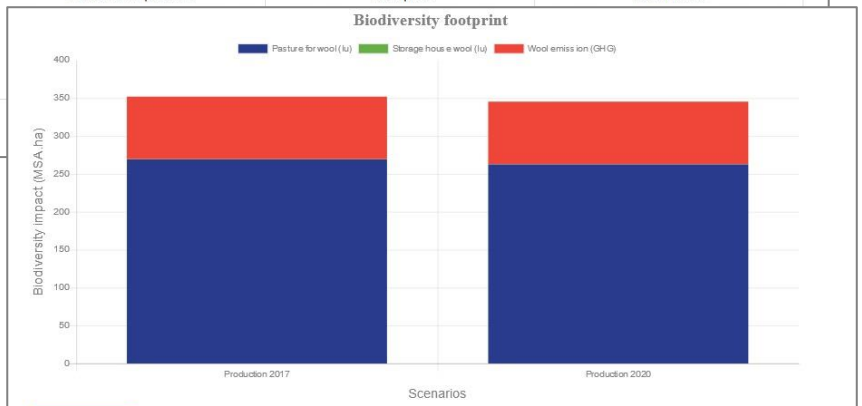

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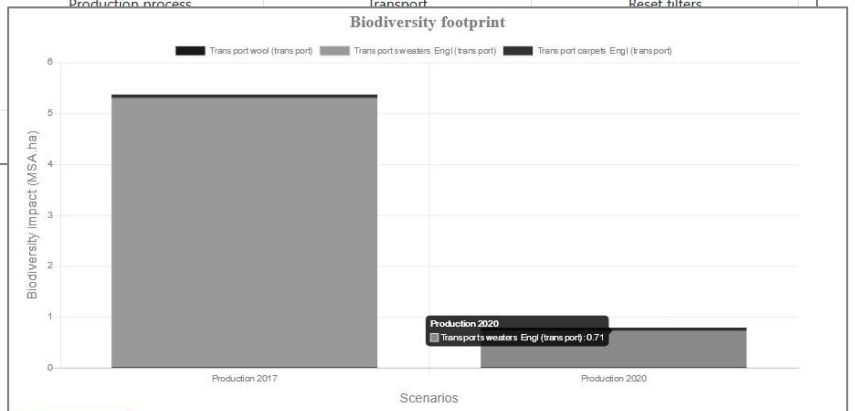

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Tables


Thank you for your attention!
Time for Questions