ECOINVENT LCI CALCULATION TOOL FOR CROP PRODUCTION – GUIDANCE FOR THE INTEGRATION OF NEW CROPS

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For: ecoinvent

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PROJECT INFORMATION	
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1. Introduction

The ECOINVENT LCI CALCULATION TOOL FOR CROP PRODUCTION allows creating inventories and emissions for crop production. The tool uses models to calculate the exchanges based on the user's entries. The models integrated in the tool include internal parameters which are partly specific for the various crops. In case of integration of a new crop, the values for these parameters have to be submitted to ecoinvent. This document explains which parameters are needed and gives indication of where to find the values.

Once collected, please submit the values using the email address support@ecoinvent.org

Table 1: Summary of the parameters needed in the various models, their units and the chapter where the guidance can be found.

Parameter	Unit	Model	Chapter
Rooting depth (per crop)	m	Nitrate emission	2.1.1
Nitrogen uptake	kg N / (ha*crop cycle)	Nitrate/N2O emissions	2.1.2
N from crop residues (per crop)	kg N / (ha*crop cycle)	Nitrate/N2O emissions	2.1.3
Crop factor (per crop)	-	Erosion	2.1.4
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Land use category	type	P-emissions	2.1.6
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Seeds/seedlings	type	Inventory modelling	2.1.8
Seed dry matter	kg DM/kg seed	Heavy metal emissions	2.1.9
Heavy metal seed content	mg / kg DM	Heavy metal emissions	2.1.10
Crop carbon content	ratio	Resource from nature	2.1.11
Energy gross calorific value	kgC/kgDM	Resource from nature	2.1.12

2. Guidance for the sampling of crop parameters

2.1. Guidance for the sampling of crop parameters

For the modelling of agricultural emissions, some parameters are needed in the ECOINVENT LCI CALCULATION TOOL FOR CROP PRODUCTION. Such parameters are stored in the data base and used every time the specific crop is used.

The values for the parameters should be taken from the FAO database (http://ecocrop.fao.org/ecocrop/) or from reviewed literature and should as far as possible represent an average.

Needed data are for the calculations are:

- Root depth
- Nitrogen uptake
- Nitrogen in crop residues
- Cultivation time

Furthermore, such parameters are needed for calculation of the Swiss regulation (phosphate emissions):

- crop factor
- average leaching
- average runoff

2.1.1. Rooting depth

The data should indicate the average root depth. Values can be found in the FAO database ecocrop (FAO) or in literature.

The root depth should be expressed in meters.

2.1.2. Nitrogen uptake

The regression equation used for calculating nitrate emissions needs the quantity of nitrogen that is taken up by the *whole plant*. The yield in the ecoinvent tool however refers to 1 hectare. The nitrogen uptake of the whole plant have to thus to be expressed per one hectare. Values can be found in the FAO database crop water management (FAO) or in literature.

The nitrogen uptake should be expressed in kg per hectare.

2.1.3. Nitrogen in crop residues

Nitrogen in crop residues refers to the quantity of nitrogen contained in crop residues left on fields. Values can be found in the FAO database crop water management (FAO) or in literature.

The nitrogen in crop residues should be expressed in kg per hectare.

2.1.4. Crop factor

The original USLE method combines the crop and the tillage factors in a single factor. Because the original factor does not cover all crops and regions, the procedure of the Ontario Ministry of Agriculture, Food and Rural Affairs[1] was followed, which provides a simple, comprehensive and concise dataset.

Table 2: Crop type factor

Crop type	**Factor**
Grain corn	0.40
Silage corn, beans and canola	0.50
Cereals (spring and winter)	0.35
Seasonal horticultural crops	0.50
Fruit trees	0.10
Hay and pasture	0.02

Source: http://www.omafra.gov.on.ca/english/engineer/facts/12-051.htm, Table 4A

Further data can be found in the FAO webpage (http://www.fao.org/docrep/007/y2413e/y2413e09.htm). The value should be between 0 and 1 (typically between 0.1 and 0.5) and has no unit

[1] http://www.omafra.gov.on.ca/english/engineer/facts/00-001.htm#tab4b

Table 3: C-values for various land uses an dcrops calculated by the Universal Soil Loss Equation, as reported by four sources in the literature. Source: FAO

Vegetative Cover/Crop	C-value			
	1)	2)	3)	4)
Forest				
Primary forest (with dense undergrowth)	0.001	0.001		
Second-growth forest with good undergrowth and high mulch cover	0.003			
Second-growth forest with patches of shrubs and plantation crops of five years or more	0.006			
Industrial Tree Plantations				
Benguet pine with high mulch cover	0.007			
Mahogany, Narra, eight years or more with good undergrowth	0.01-0.05			
Mixed stand of industrial tree plantation species, eight years or more	0.07			
Agroforesty Tree Species				
Mixed stand of agroforestry species, five years or more with good cover	0.15			
Coconuts, with annual crops as intercrop	0.1-0.3			
Leucaena leucocephala, newly cut for leaf meal or charcoal	0.3			
Cashew, mango and jackfruit, less than three years, without intercrop and with ring weeding	0.25			
Oil palm, coffee, cacao with cover crops		0.1-0.3		
Grasslands				
Imperata or thermeda grassland, well established and undisturbed, with shrub	0.007			
Shrubs with patches or open, disturbed grasslands	0.15			
Well-managed rangeland, cover of fast development, ungrazed two years or more	0.01-0.05			
Savanah or pasture without grazing		0.01		
Grassland, moderately grazed, burned occasionally	0.2-0.4			
Overgrazed grasslands, burned regularly	0.4-0.9			
Guinea grass (*Panicum maximum*)			0.01	
Covercrops/green manures				
Rapidly growing cover crop		0.1		
Velvet bean (*Mucuna sp*)			0.05	
Annual Cash Crops				
Maize, sorghum	0.3-0.6	0.3-0.9	0.05	
Rice	0.1-0.2	0.1-0.2		
Peanut, mungbean, soybean	0.3-0.5	0.4-0.8		
Cotton, tobacco	0.4-0.6	0.5	0.14	
Pineapple	0.2-0.5			
Bananas	0.1-0.3			
Diversified crops	0.2-0.4			
New kaingin areas, diversified crops	0.3			
Old kaingin areas, diversified crops	0.8			
Cassava monoculture		*0.2-0.8*	*0.18*	
Cassava with well-established leguminous ground cover				*0.01-0.02*
Crops with thick layer of mulch		0.001		
Other				
Built-up rural areas, with home gardens	0.2			
Bare soil	1.0	1.0	1.0	1.0

Sources:
[1)]Data from David, 1987, for watersheds in the Philippines.
[2)]Data from Roose, 1977.
[3)]Data from Margolis and Campos Filho, 1981, for Pernambuco, Brazil.

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2.1.5. Land use category – heavy metal emissions

The type of crop should be indicated. There are three possibilities:

- permanent_grassland
- arable_land
- horticultural_crops

2.1.6. Land use category – P-emissions

The type of crop should be indicated. There are seven possibilities:

- arable_land
- fruit_trees
- grassland_intensive
- grassland_extensive
- summer_alpine_pastures
- vegetables
- viticulture

2.1.7. Crop type

The crop type is used for the modelling of land use change. The crop type should be chosen between “annual” and “perennial”.

The value for this parameter is “annual” or “perennial”.

2.1.8. Seeds/seedlings

For the inventory modelling, it is necessary to indicate if the crop uses seeds, seedlings or trees.

The value for this parameter is “seeds”, “seedlings” or “trees”.

2.1.9. Seed dry matter

Seed dry matter is needed to calculate the input of heavy metal with seeds. This value can be found in literature. For seeds, the value is typically between 0.70 and 0.9. For potato or beet, it is around 0.2.

The value is given in kg DM per kg.

2.1.10. Heavy metal seed content

Heavy metal seed content is needed to calculate the input of heavy metal with seeds. Values can be found in literature, e.g. in the SALCA model description (Freiermuth 2006).

The value is given in mg / kg seed DM.

2.1.11. Crop carbon content

The crop carbon content is needed for the inventory exchange “Carbon dioxide, in air”, which is a resource (exchange from nature).

The carbon content can be found in literature or approximated based on the composition of the crop. The carbon content is usually around 40-45% (kg C/kg).

2.1.12. Energy gross calorific value

The energy gross calorific value is needed for the inventory exchange “Energy, gross calorific value, in biomass“, which is a resource (exchange from nature). The energy content on the crop can be approximated based on the carbon content of the crop with following formula:

Energy content (MJ/kg) = carbon content (kg C/kg) *44/12 (kg CO_2/kg C)*11.5 (MJ/kg CO_2)

3. References

FAO Ecocrop. http://ecocrop.fao.org/ecocrop/srv/en/cropFindForm.

FAO Crop Water Information. http://www.fao.org/land-water/databases-and-software/crop-information/en/.

Freiermuth R (2006) Modell zur Berechnung der Schwermetallflüsse in der landwirtschaftlichen Ökobilanz. SALCA-Schwermetall. Agroscope FAL Zürich-Reckenholz, Zürich-Reckenholz