Measuring the Environmental Footprint among agro-food supply chain: new frontiers and opportunities for the Fertilizer Industry

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ILSA The green evolution

ABSTRACT

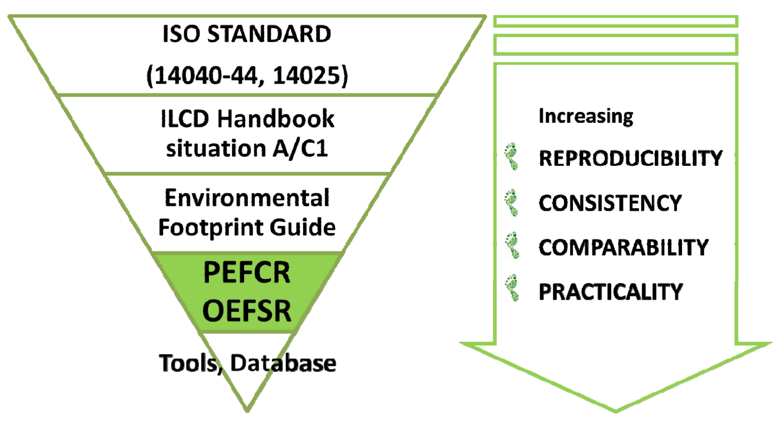
Ilsa is an Italian company producing solid and liquid organic and organo-mineral fertilizers and plant biostimulants of animal and plant origin. Aware that world nutrition and food security are today the cornerstones that modern and sustainable agriculture must focused on, since many years Ilsa has oriented its production towards biorefinery processes and the use of renewable and vegetal raw materials. In 2014 Ilsa decided to perform a study of the Organization Environmental Footprint (OEF) and Product Environmental Footprint (PEF) in accordance with Recommendation 2013/179/EU. This Recommendation involves the use of harmonized methodologies at European level to measure and communicate the environmental performance of production process and products during their entire life cycle, including the final agronomical use of products. The aim of the study was to obtain a precise indication of the environmental performances related to production process and products by analyzing all the 14 categories of environmental footprint required by the EU Recommendation. The results obtained provide the company with a robust tool for knowledge of its environmental performance, possible pathways of improvement and reduction of its environmental footprint, and a way of strengthening its position in the Green Marketing. The study of PEF focused in particular on the two ILSA organic matrices Agrogel® and Gelamin®, updating the 14 environmental impacts required by EU recommendations with experimental datas obtained from various agronomical tests of both these to organic matrices.

INTRODUCTION

The European Commission has the final objective of overcoming the fragmentation of the internal market as regards different available methods for measuring environmental performance.

The Product Environmental Footprint (PEF) project was initiated with the aim of developing a harmonised European methodology for Environmental Footprint (EF) studies that can accommodate a broader suite of relevant environmental performance criteria in order to enable Member States and the private sector to assess, display and benchmark the environmental performance of products, services and companies based on a comprehensive assessment of environmental impacts over the life cycle.

A life-cycle approach (ISO STANDARD 14040-44) refers to taking into consideration the spectrum of resource flows and environmental interventions associated with a product or organisation from a supply chain perspective. It includes all stages from raw material acquisition through processing, distribution, use, and end-of-life processes, and all relevant related environmental impacts, health effects, resource-related threats and burdens to society. This approach is also essential for exposing any potential trade-offs between different types of environmental impacts associated with specific policy and management decisions.



PRODUCT ENVIRONMENTAL FOOTPRINT

The Product Environmental Footprint (PEF) is a multi-criteria measure of the environmental performance of a good or service throughout its life cycle, produced for the overarching purpose of seeking to reduce the environmental impacts of goods and services taking into account all the supply chain activities (from extraction of raw materials, through production and use, to final waste management).

The present study has been developed adhering to the analytical principles of relevance, completeness, consistency, accuracy and transparency in order to produce consistent, robust and reproducible results. These principles provide overarching guidance in the application of the PEF method. They have been considered with respect to each phase of PEF study, from the definition of study goals and the scope of the research, through data collection, impact assessment, reporting and verification of study outcomes. The phases that have been taken into account are represented in Figure 1.

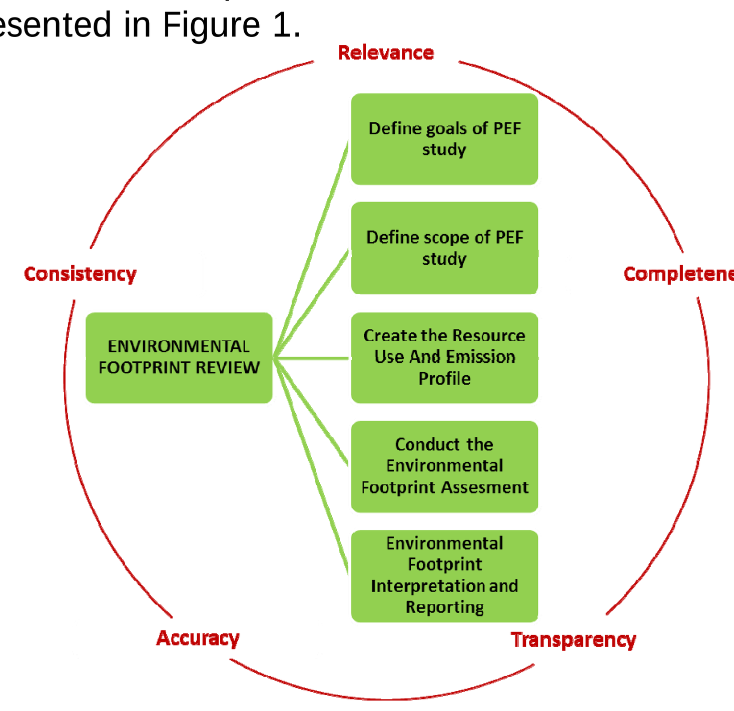
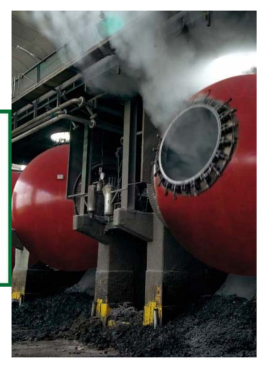


Figure 1: Phases of PEF study

UNIT OF ANALYSIS

The PEF studies of ILSA organic matrices Agrogel® and Gelamin® were developed in the context of a global analysis of the environmental performances related to production process and products of the organization (OEF Study). In order to obtain comparable results the unit of analysis was selected as **kg of N** (Nitrogen), the distinguish fertilizing unit of the two products cosidered.



Potential fields of application for the PEF method and ILSA application	
1	Optimization of processes along the life cycle of a product
	Comparison between different disposal scenarios: valorization of leather scraps as fertilizer or energy recovery by incineration.
2	Support of product design minimizing environmental impacts along the life cycle;.
	• "Cradle-to-gate" Study in order to compare Ilsa organic fertilizers and Urea • "Cradle-to-grave" Study of the use and end-life stages of Ilsa fertilizer
3	Communication of life cycle environmental performance information on products and schemes related to environmental claims, in particular ensuring sufficient robustness and completeness
	Communication of life cycle environmental performance results to private and public stake-holders in the market of fertilizers to meet the demand to monitor and increase the sustai-nability of fertilizers life-cycle.
4	Reputational schemes giving visibility to products that calculate their life cycle environ-mental performance
	• Marketing Strategy 3.0 • Product Stewardship 2014 (Federchimica)
5	Identification of significant environmental impacts in view of setting criteria for ecolabels
	Data Quality Analysis and Estimation of Uncertainty to supports iterative improvement of PEF studies

Table 1: Potential fields of application for the PEF method

GOAL, SCOPE AND INDICATORS DEFINITION

The boundaries of the study have been selected in order to be in line with the defined goals, established analyzing the potential application for the PEF method, listed in Table 1.

As represented in Figure 2, firstly a "Cradle-to-gate" PEF study has been performed to evaluate all the 14 environmental impact of Ilsa fertilizers production, taking into account all the upstream processes and site-level processes.

Secondly, the study has been extended to involve the use and the end-life phases of Ilsa products such as field distribution, soil storage, plant uptake, disposal and eventual recycling stages by mean of experimental data obtained by Horta, a spin-off company of the Università Cattolica del Sacro Cuore.

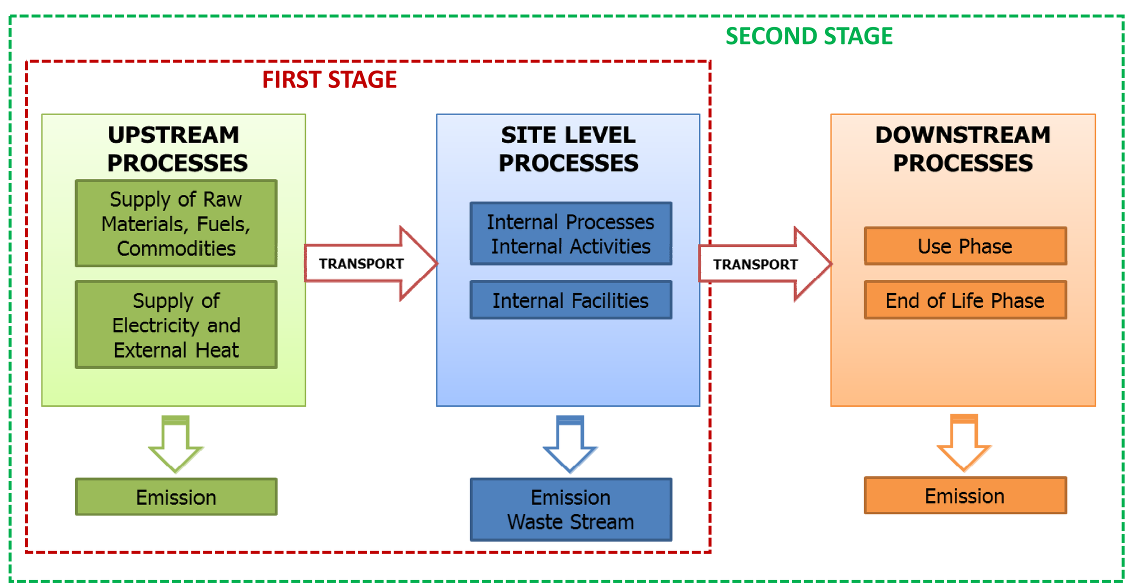


Figure 2: System Boundaries

#	EF IMPACT CATEGORY	EF IMPACT INDICATOR	EF IMPACT ASSESSMENT MODEL
1	CLIMATE CHANGE	Kg CO_2 eq	Bern model – GWP100
2	OZONE DEPLETION	Kg CFC-11 eq	EDIP model
3	HUMAN TOXICITY – CANCER EFFECTS	CTUh	USEtox Model
4	HUMAN TOXICITY – NON CANCER EFFECTS	CTUh	USEtox Model
5	PARTICULATE MATTER/RESPIRATORY INORGANICS	kg $PM_{2.5}$ eq	RiskPoll Model
6	IONIZING RADIATION HH	CTUe	Human Health effect model
7	IONIZING RADIATION E	CTUe	Human Health effect model
8	PHOTOCHEMICAL OZONE FORMATION	Kg NMVOC	LOTOS-EUROS Model
9	ACIDIFICATION	Mol H^+eq	Accumulated Exceedance model
10	TERRESTRIAL EUTROPHICATION	Mol N eq	Accumulated Exceedance model
11	FRESH WATER EUTROPHICATION	Kg P eq	EUTREND Model
12	MARINE EUTROPHICATION	Kg N eq	EUTREND Model
13	FRESHWATER ECOTOXICITY	CTUe	USEtox Model
14	LAND USE	Kg C deficit	Soil Organic Matter (SOM) model
15	WATER RESOURCE DEPLETION	m^3 water eq	Swiss Ecoscarcity model
16	MINERAL, FOSSIL & REN RESOURCE DEPLETION	Kg Sb eq	CML 2002 Model
17*	GER – Gross Energy Requirement	MJ	Cumulative Energy Demand

** Additional Impact Category*

Table 2: Environmental Impact Category

RESULTS

The environmental impact associated to the production of organic matrices Agrogel® and Gelamin® (*first stage*) are reported in Table 3. The attention is focused on the Climate change indicator, represented in the Figure 3, allocated in the different phases of the production process.

In Table 4 is reported the GWP100 impact of the downstream processes (*second stage*) allocated in transports to the costumers, field distribution and respons of the soil to the fertilizer use .

Unit of analysis: kg of Nitrogen (N)			
EF Impact Category	EF Indicator	AGROGEL	GELAMIN
GER	MJ	51,85	182,22
Climate change	kg CO_2 eq	2,91	11,05
Ozone depletion	kg CFC-11 eq	4,99e^{-7}	1,67e^{-6}
Human toxicity, cancer effects	CTUh	6,09e^{-7}	9,30e^{-7}
Human toxicity, non-cancer effects	CTUh	2,18e^{-7}	5,36e^{-7}
Particulate matter	kg $PM_{2.5}$ eq	0,000671	0,002682
Ionizing radiation HH	kBq U235 eq	0,154497	0,838017
Ionizing radiation E (interim)	CTUe	4,12e^{-7}	2,01e^{-6}
Photochemical ozone formation	kg NMVOC eq	0,005061	0,017741
Acidification	molc H^+ eq	0,008606	0,036798
Terrestrial eutrophication	molc N eq	0,014322	0,052433
Freshwater eutrophication	kg P eq	0,000198	0,000901
Marine eutrophication	kg N eq	0,006385	0,029979
Freshwater ecotoxicity	CTUe	10,17	22,43
Land use	kg C deficit	3,08	10,71
Water resource depletion	m^3 water eq	0,007071	0,066733
Mineral, fossil & ren resource depletion	kg Sb eq	1,73e^{-5}	4,10e^{-5}

Table 3: First Stage Results- Environmental Impact of of organic matrices Agrogel® and Gelamin® production

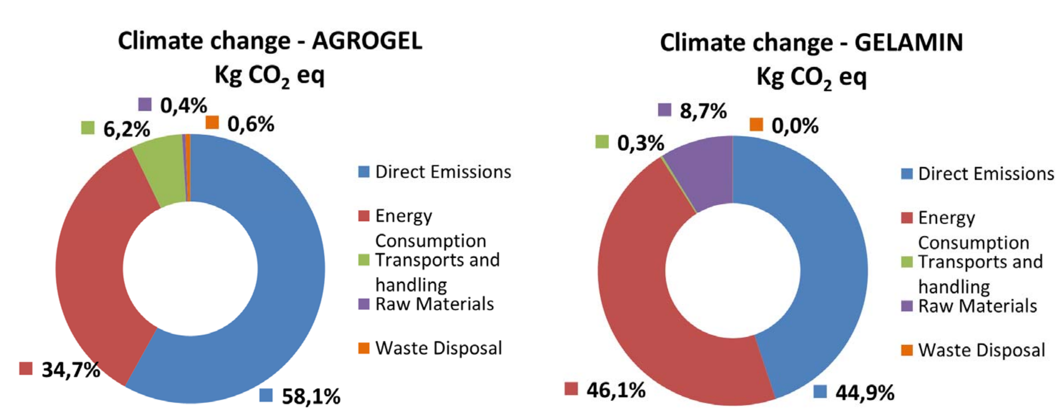


Figure 3: GWP100 of organic matrices Agrogel® and Gelamin® allocated in the different phases of the production process

GWP100 – kg CO_2 eq / kg of N						
Product	Fertilizer production at plant gate	Transports to the costumers	Field distribution	Fertilizer use – Soil Effect*		
				Direct N_2O from use	CO_2 from UREA hydrolysis	Indirect N_2O
AGROGEL®	2,91	0,35	0,16	3,27	0	1,73
GELAMIN®	11,05	0,22	0,17	3,75	0	1,99

**Horta Srl*

Table 4: Second Stage Results - GWP100 Impact of of organic matrices Agrogel® and Gelamin®

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