UNIT 4
Sustainability of animal productions

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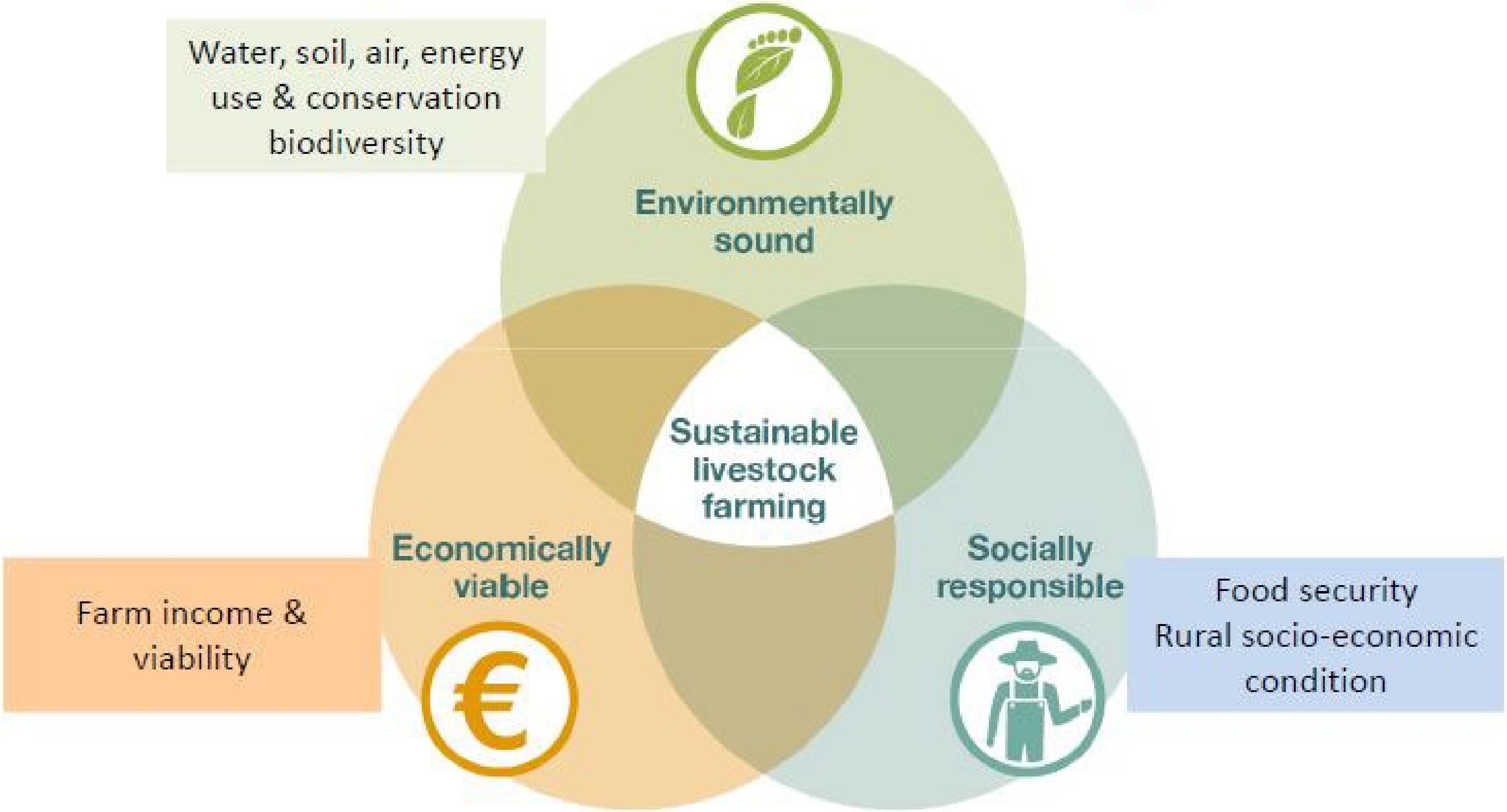
Sustainable livestock farming refers to a system based on three pillars



https://www.elancoeurope.com/pdfs/sustainable_livestock_a4_aw_290915_dps.pdf

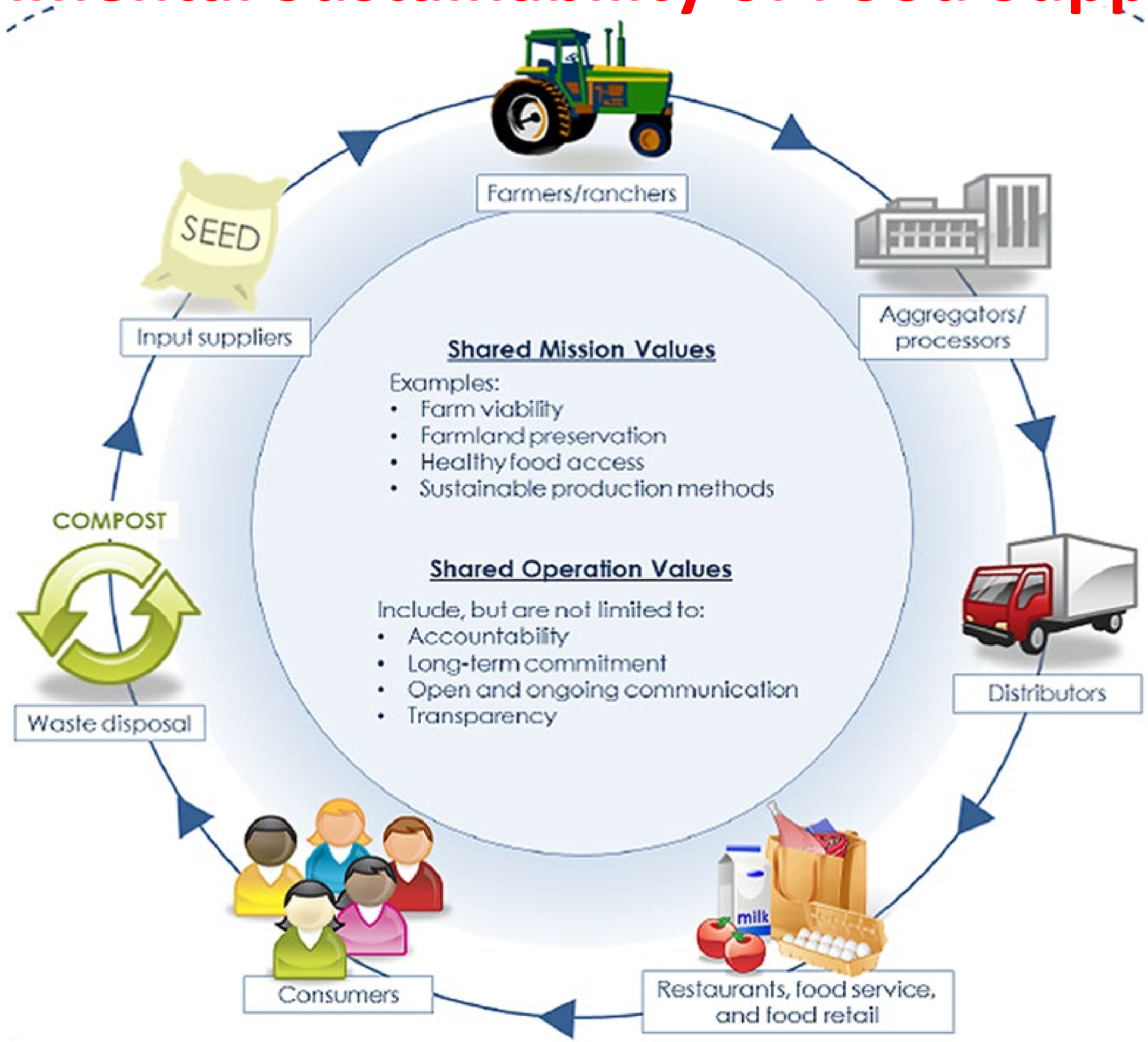
The most workable definition is…

Something is sustainable if it can simultaneously achieve economic feasibility, social justice and environment quality

What is sustainable livestock farming?

The efficient production of safe, high quality agricultural products, in a way that protects and improves the natural environment, the social and economic conditions of farmers, their employees and local communities, and safeguards the health and welfare of all farmed species

Environmental Sustainability of Food Supply Chain



Social responsibility

The social responsibility component of sustainability in livestock production includes elements such as:

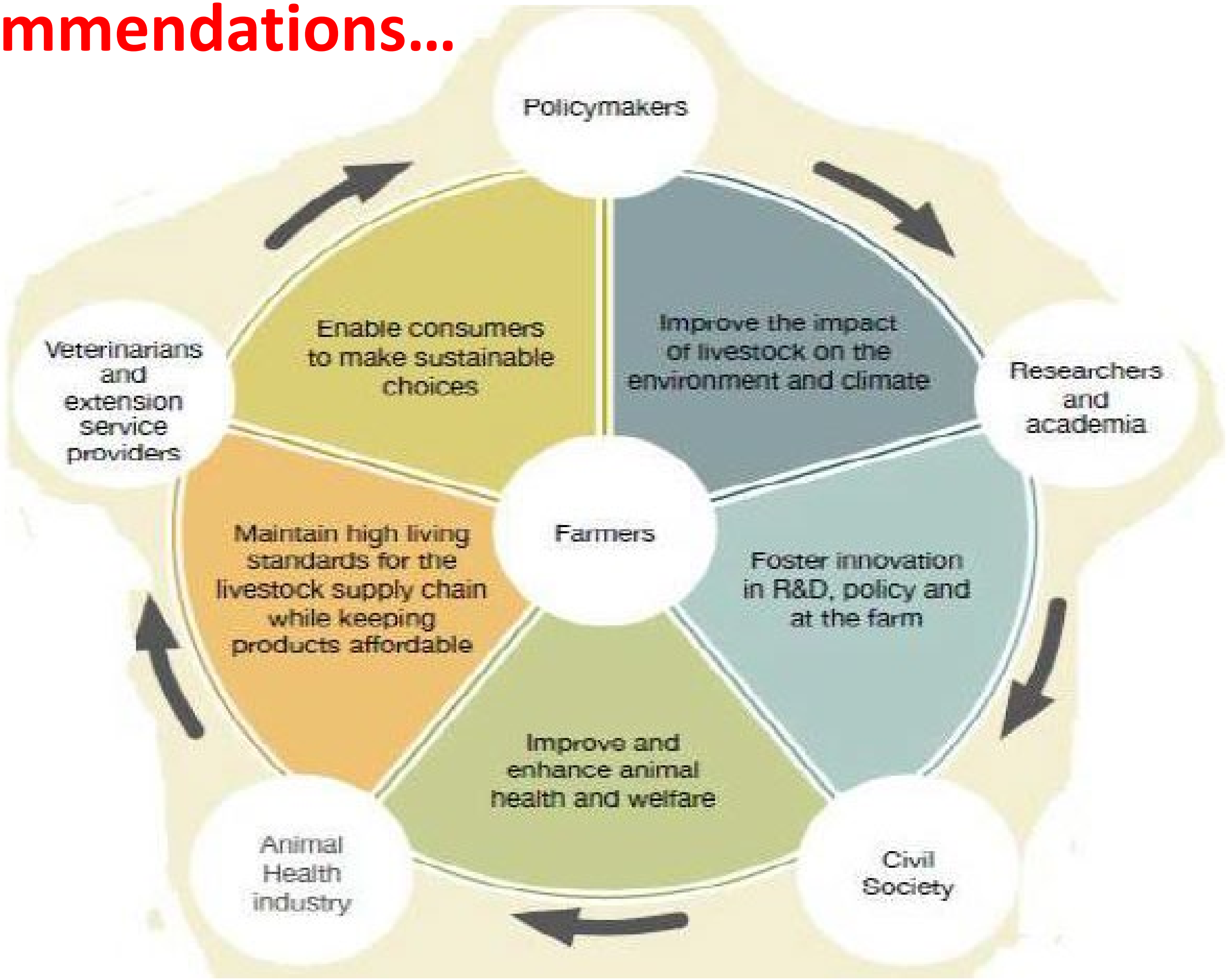
- ✓ Improving and maintaining the societies and communities where livestock food products are produced.
- ✓ Safeguarding the health, well-being, and social rights of workers, farm managers, and their families. Good working and social conditions are valid regardless of gender, age, religion, nationality, ethnicity, personal preferences, or conviction.
- ✓ Guaranteeing food safety and public health.
- ✓ Improving and safeguarding animal health and welfare.

Economic viability

From an economic standpoint, sustainable livestock farming systems are therefore characterised by elements such as:

- ✓ Enabling economically viable food production along the food chain, while accomplishing social and ecological goals.
- ✓ Ensuring that farm operations obtain a fair share of the profits achieved in the food chain.
- ✓ Supporting the ability of livestock producers to invest in sustainability improvements.
- ✓ Adopting innovation and approaches that help farmers deal with market volatility and hence the prices of products and inputs.

Recommendations…



Sustainability as a wicked problem

- It cannot be solved
- It can be only managed

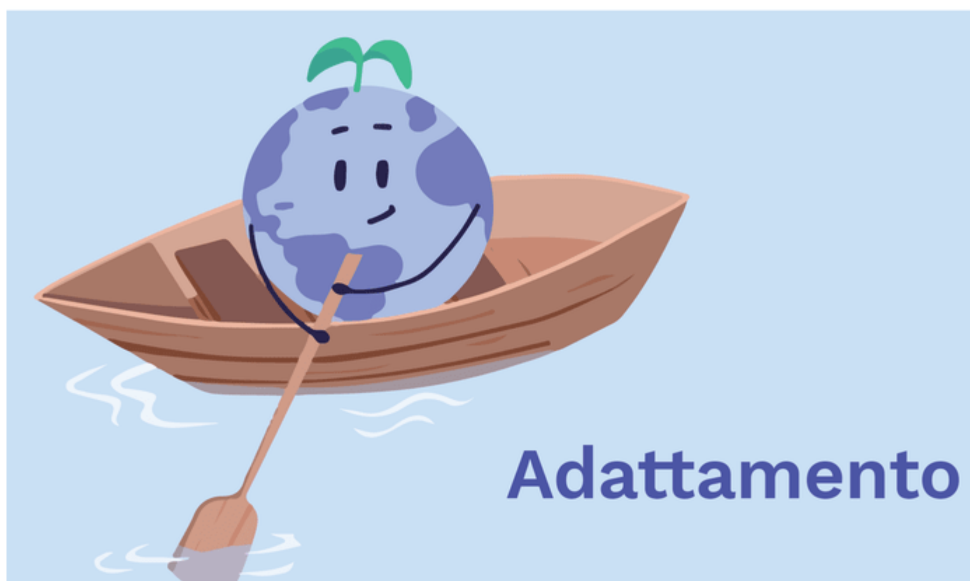
The problem with wicked problems is:

- No definitive formulation of the problem exists
- Its solution is not true or false, but rather better or worse
- Stakeholders have radically different frames of reference concerning the problem
- The underlining cause and effect relationships related to the problem are complex, systemic and either unknown or highly uncertain

Global warming

- **Mitigation:** Actions to limit, block or reverse climate change (reduction of greenhouse gas emissions)
- **Adaptation**: Actions that seek to reduce the vulnerability of biological systems to the effects of climate change (ventilators counteract heat stress)


Mitigazione


Adattamento

Mitigation GHG from food of animal origin

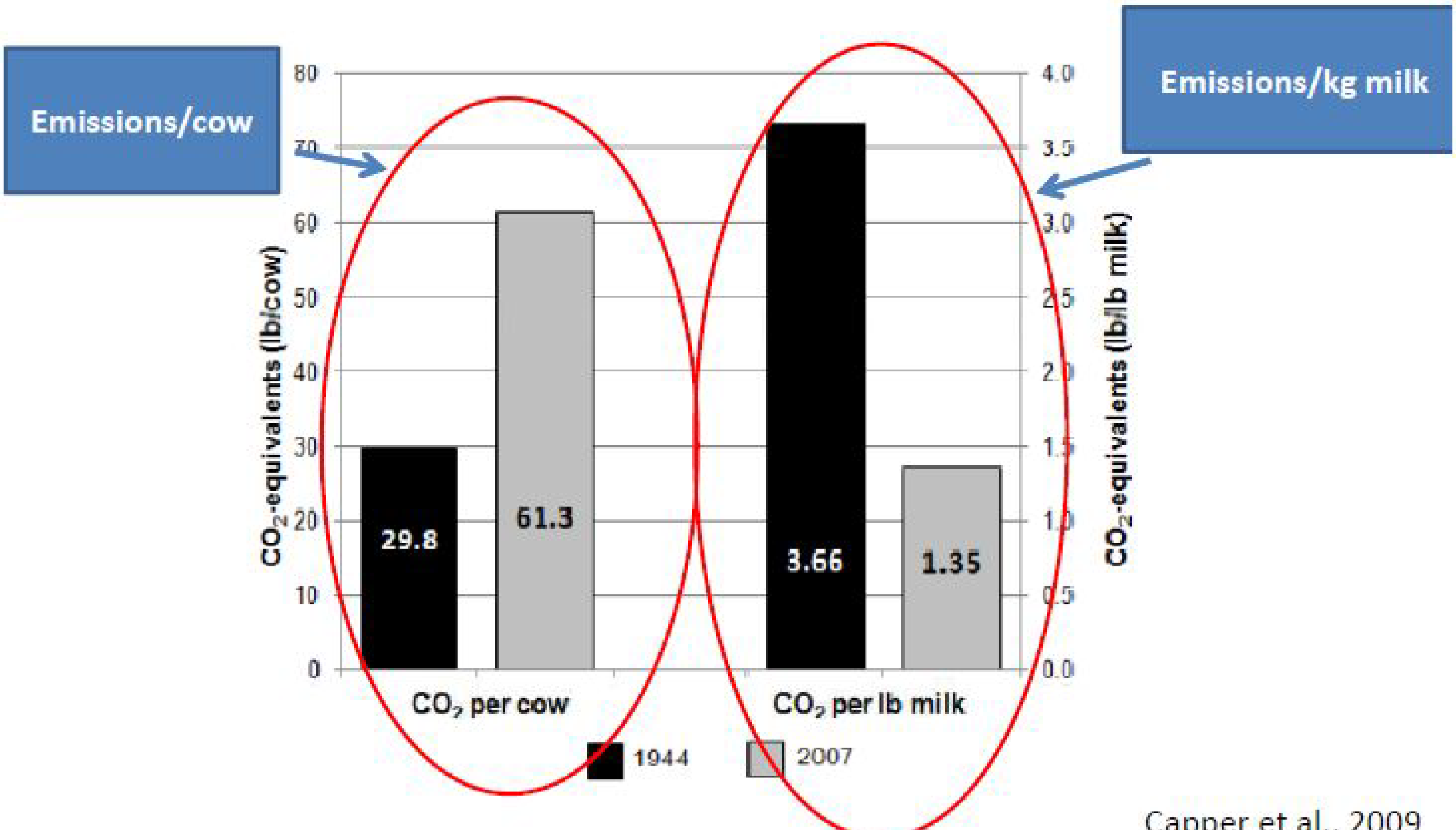
At Farm

- Production efficiency
- Nutritional management
- Manure management
- Animal welfare and healthy
- Energy efficiency

At home

- Consume less meat preferring high quality meat and reducing the consumption of low quality meat
- Reduce waste
- Improve consumer habits (shopping, storage and cooking of food)

Production efficiency



Capper et al., 2009

Fats

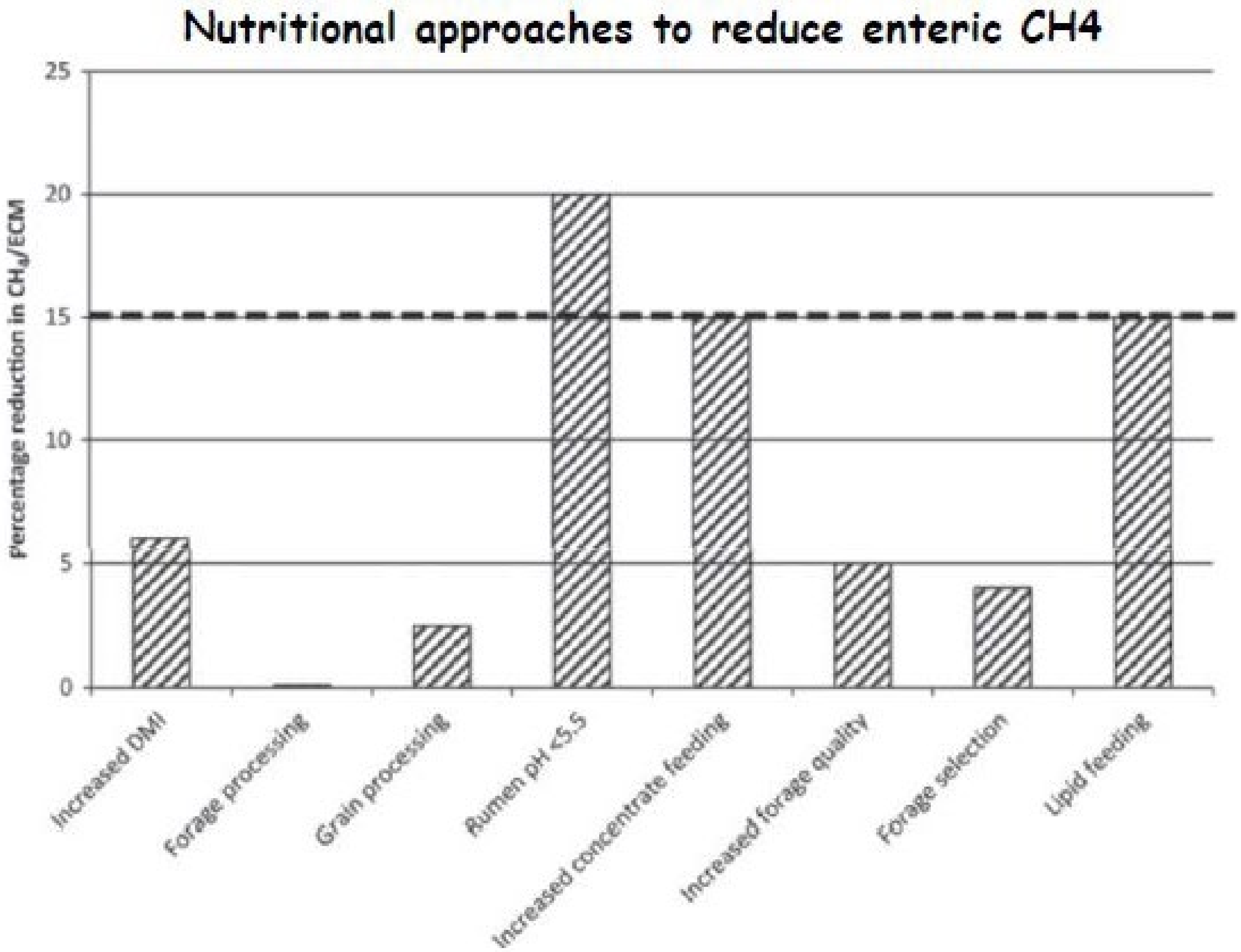
- The use of fats (unsaturated) reduce CH_4 by biohydrogenation done from bacteria where they saturate double bond by using H_2. They act as competitor for H_2 required for methanogenesis
- The effectiveness is related to fat source and concentration
- Maximum 5-6% of fat on DMI basis. More may negatively affect rumen fermentation (trade-off with animal welfare)
- Cost of fats may limit they use (trade-off with economic sustainability)

A recent Australian in vitro study showed a reduction of enteric CH4 of **99%** using concentration of 5 and 10% of red seaweed (Kinley et al., 2016)

Asparagopsis taxiformis

In vivo studies on sheep showed a drop of enteric CH4 emission of 60, 70 and 80 % using concentration of Asparagopsis of 1, 2 and 3% respectively.

http://www.abc.net.au/news/rural/2017-04-21/seaweed-fed-cows-could-solve-livestock-methane-problems/8460512



https://www.sciencedirect.com/science/article/pii/S0022030214002896

Mitigation of CH4 by different approaches

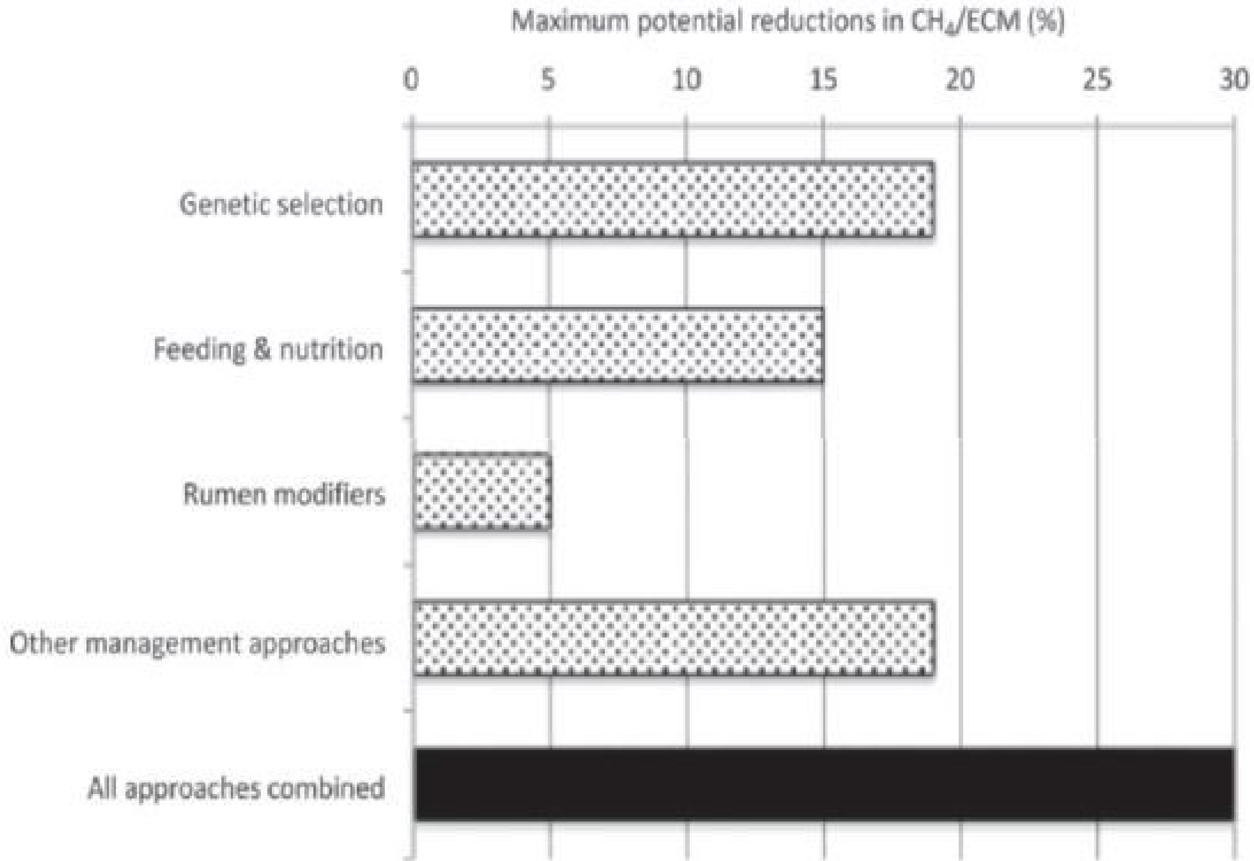


Figure 7. Estimated maximum impact of various approaches to mitigating CH_4 in intensive dairy production that have been demonstrated to be effective on an in vivo basis. Approaches are not expected to be fully additive; lower additivity would reduce impacts in each category. Detailed information on the estimates for each category is provided in the respective sections of the text.

Use of ozone for sanitizing the livestock premises and milking equipment

- ✓ Ozone is an oxidizing agent with antibacterial and antifungal activity
- ✓ Following use, it rapidly decomposes without releasing toxic compounds into the environment

Nitrate Directive 91/676/CEE

Laws n. 152/1999 and n. 152/2006

Each region identified vulnerable and non-vulnerable areas and established the criteria for proper agronomic use of livestock effluents and nitrogen fertilizers.

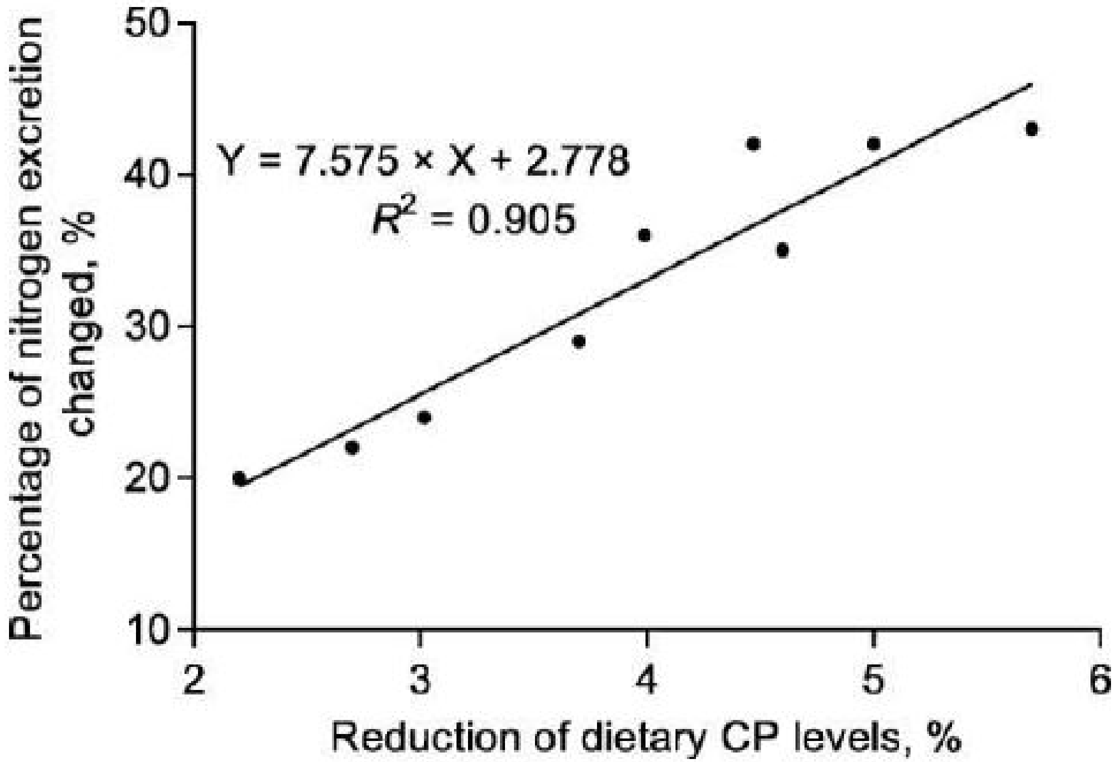
http://ec.europa.eu/environment/water/water-nitrates/index_en.html#Direttiva nitrati

The reduction of N has an effect on eutrophication, Global warming and acidification potential

Mitigation of eutrophication and acidification

- Reduce nitrogen content of animal effluents (diet, treatments)
- Rationalization/reduction of transports (corporate sales)
- Constitution of bushes and/or shrubs, able to intercept and reduce the contribution of nutrients entering the surface water
- Increase the efficiency of organic fertilization by using high nitrogen absorption cultures and modifying the time and mode of distribution of effluents

Percent reduction in nitrogen excretion as a result of reduced protein content in the diet



Wang et al., 2018

Mitigation of eutrophication and acidification
DIET

Percent reduction in nitrogen excretion as a result of reduced protein content in the diet of one percentage point	
Category	Reduction %
Hens	10%
Other poultry	5-10%
pigs	10%

Zavatti *et al.*, 2007.

Mitigation of eutrophication and acidification
DIET

Reduction of excreted phosphorus as a result of the reduction of 0.1% in the ration and increase of the digestibility of vegetal phosphorus following the addition of phytase		
Category	Reduction of phosphours (%)	Increase of digestibility
Pigletts	30-40%	20-30%
Fattening pigs	25-35%	15-20%
Sows	20-30%	15-20%
poultry	20%	20-30%

Zavatti *et al.*, 2007.

Water saving

- Choice of cultivation systems and techniques of arid culture (sunflower or sorghum vs. corn; or alfa alfa vs graminaceae)
- Choice of timing and irrigation volume (water balance culture)
- Choice of typology and correct use of irrigation systems (prefer pressure systems such as aspersion or drops vs. sliding systems)
- Recovery and reuse of water.
- Replacement a part of the fodders in the diet with by-products of the agro-food industry (sausage, vinegar, etc.)

The Hydroponic System

Structure, cleaning and seeding 2.2 kg of barley each dish

Growing 7/8 days

Harvesting

Feeding

Some data of HYDROPONIC SYSTEM

- 1 kg of seeds produces 6 kg of fresh fodder
- Production is independent by climate conditions
- Easy modulable
- Homogeneity of production during the year and between years
- High palatability
- Rich in vitamins
- Reduce soil use
- Reduce water use

Hydroponic System

https://www.youtube.com/watch?v=b2XYLEliMhQ

Dietary supplements with natural additives to reduces antibiotic use

Phytotherapics

- Phytotherapics are a secondary natural plant compounds and their use in animal feed is growing rapidly as a result of the positive effects on animal production and animal health.
- The interest in these organic plant compounds has developed after the interdiction of the use of antibiotics as growth promoters.
- Scientific studies have shown that the use of these extracts in livestock feeding causes improvements in production yields, feed conversion, metabolism, plasma antioxidant capacity, ruminal activity, and enzymatic activity of the intestine.

Some examples…

- Solanacee (tomatoes, tobaccos, potatoes, eggplant and pepperoni) are rich in Solanesol (isoprenoides)
- Several studies have pointed out a positive action against: bacteria, virus and mold. E.g., Chen (2007) reported inhibition activity on *Escherichia coli*, *Staphyloccoccus areus* and *Pseudomonas aeruginosa*
- Anti inflammatory and antioxidant properties was also reported

Some examples…

- Olive leaves (*Olea europea*) is rich in oleuropeina and dimetiloleuropeina
- These substances have anti bacteria and antioxidant activity
- They are active against bacteria gram+ such as (*B. cereus*, *S. aureus*), gram – such as (*E. Coli*, *Pseudomonas aeruginosa*) and molds (*C. albicans*, *C. neoformans*)
- In vitro studies shower their positive action against *Pseudomonas and Klebsiella*, two bacteria that may generate anti-biotic resistance issues

animals

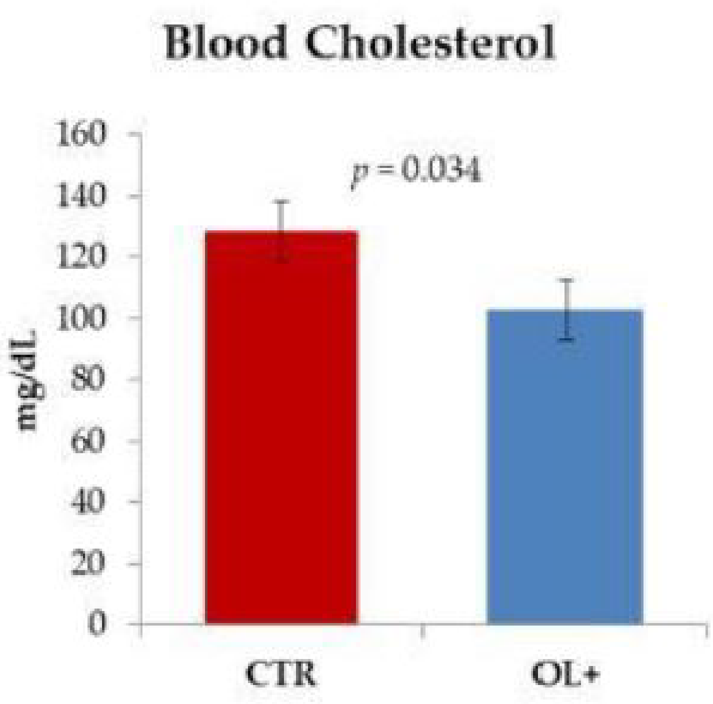
MDPI

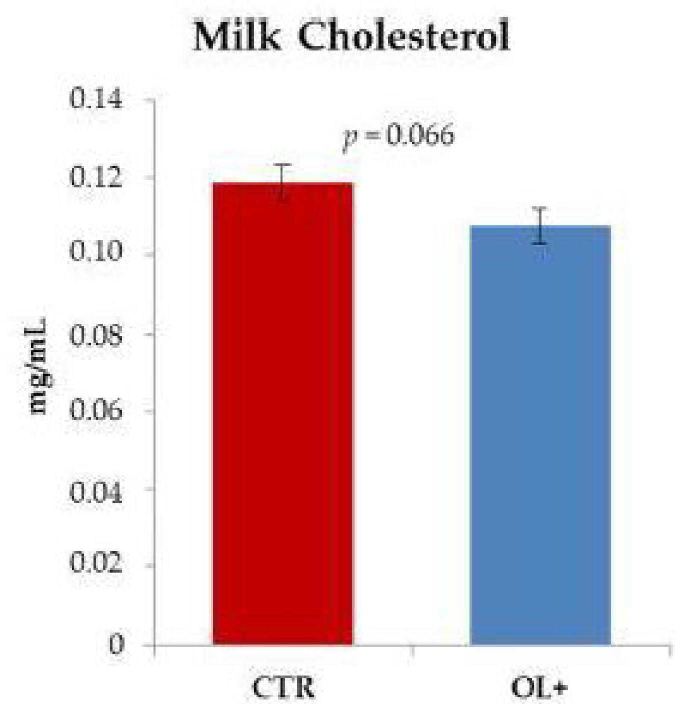
Article

Whole Blood Transcriptome Profiling Reveals Positive Effects of Olive Leaves-Supplemented Diet on Cholesterol in Goats

Andrea Ianni [1], Francesca Bennato [1], Camillo Martino [2], Martina Colapietro [1] and Giuseppe Martino [1,*]

Apolipoprotein B mRNA editing enzyme catalytic subunit 2 (APOBEC2) showed downregulated in goats that received the dietary supplementation





animals MDPI

Article

Nutrigenomic Effects of Long-Term Grape Pomace Supplementation in Dairy Cows

Marianna Pauletto [1,†], Ramy Elgendy [1,2,†], Andrea Ianni [3], Elettra Marone [3], Mery Giantin [1], Lisa Grotta [3], Solange Ramazzotti [3], Francesca Bennato [3], Mauro Dacasto [1,*] and Giuseppe Martino [3]

The gene set enrichment analysis evidenced the positive enrichment of IFN-α and IFN-γ response', IL6-JAK-STAT3 signaling and genes of the complement system

Grape pomace induced an immunomodulatory effect

animals

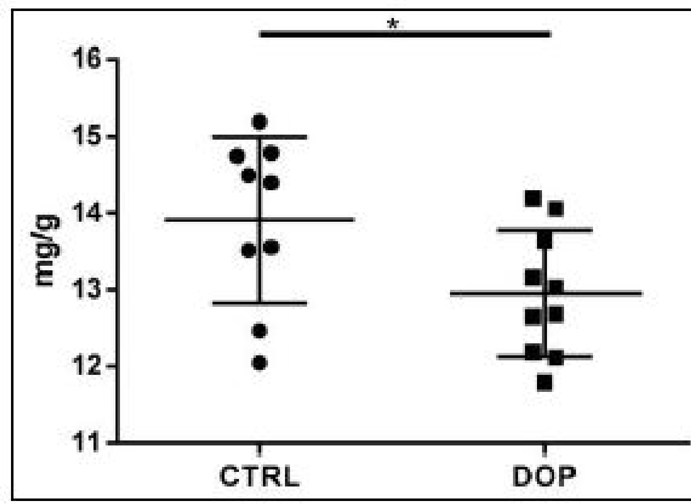
MDPI

Article

Whole Blood Transcriptome Analysis Reveals Positive Effects of Dried Olive Pomace-Supplemented Diet on Inflammation and Cholesterol in Laying Hens

Marco Iannaccone [1,†], Andrea Ianni [1,†], Solange Ramazzotti [1], Lisa Grotta [1], Elettra Marone [1], Angelo Cichelli [2] and Giuseppe Martino [1,*]

Olive pomace improved laying hens health status by influencing cholesterol biosynthesis and immune response (interferon-gamma signaling pathway, interleukin signaling pathway, and JAK/STAT signaling pathway)



Significant decrease in egg yolk cholesterol!

Organic acids with anti microbial activity

- Formic acid is natural present in Pine needles, lavender and bergamot essences, grape, tamarind and nettle leaves
- Studies in chickens that have analyzed the effect of integration with dietary formic acid report an antibacterial action against a reduction in Salmonella, coliform bacteria and Escherichiacoli in the small intestine, in the blind and in the faeces (Ricke, 2003)
- In pigs, it stimulates digestion of amino acids and lipids, improves performance and growth rate

Organic acids with anti microbial activity

- Lauric acid is present in many products of plant and animal origin. Coconut oil and palm kernel oil are the most generous sources Lower concentrations are found in milk fat (2-3%).
- It is converted into monolaurine, a monoglyceride with antiviral, antimicrobial, antiprotozoal and antifungal properties.
- Lauric acid is a strong inhibitor of *Clostridium perfringens*, a ubiquitous bacterium responsible for necrotic enteritis, very common in intensive poultry farming (Timbermont et al., 2010).
- In addition, lauric acid and other medium chain fatty acids are indicated to be effective inhibitors of salmonella (Van Immerseel et al., 2006).

Probiotics

- They are microorganisms that, when administered in adequate quantities, confer benefits on the hospital's health (WHO).
- Integration with probiotics (*Lactobacillus acidophilus* and *Pediococcus acidilactici*) in the diet of pig resulted in a reduction in E. coli's fecal count and clostrides, pathogens responsible for the onset of diarrhea in this animal species (Dowarah et al., 2017).

Probiotics

- Recently, the interest in probiotics has focused on their ability to influence the specific and nonspecific immune response response.
- Some studies have shown that a treatment with L. casei and L. acidophilus determines an increase in IgA production (Galdeano et Perdigòn, 2006), which improves the intestinal barrier function.
- Moreover, probiotics, through the production of cytokines, have the ability to influence the cellular immune response mediated by t cells in the intestinal epithelium.
- Finally, it has been shown that lactobacilli are able to stimulate macrophage activity towards different species of bacteria.

Mitigation Strategies for Greenhouse Gas Emissions from Animal Agriculture

https://www.youtube.com/watch?v=qQGFzzUHvsY&t=56s

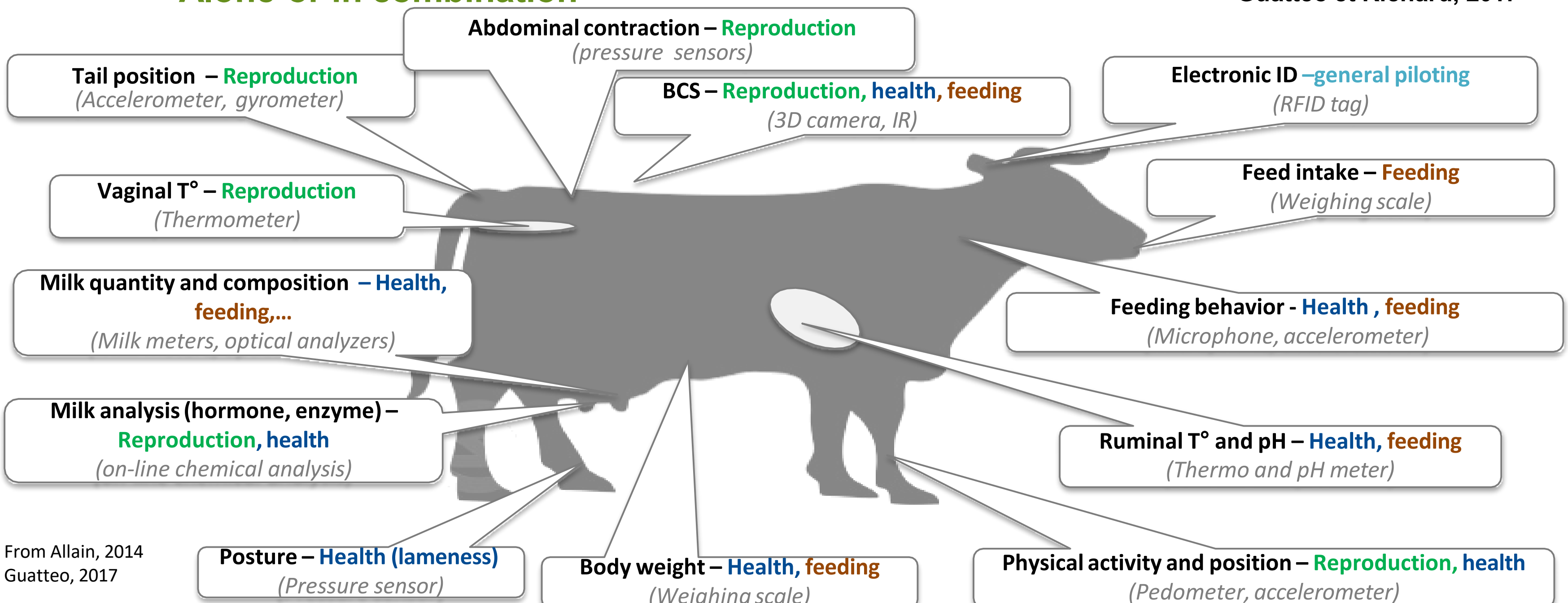
PRECISION LIVESTOCK FARMING (PLF)

Sensors and automatons in cattle

Large panel of possibilities

Alone or in combination

Guatteo et Richard, 2017



From Allain, 2014
Guatteo, 2017

Some examples…

Some examples…

Perspectives and advantages of Precision Livestock Farming

Dairy Farming
https://www.youtube.com/watch?v=xDZ1PscDm7c

Pig Farming
https://www.youtube.com/watch?v=T7nCk1aKVgM

Environmental assessment of animal productions


LIFE CYCLE ASSESSMENT
RESOURCES
PROCESSING
MANUFACTURING
DISTRIBUTION
USE
END OF LIFE

Life Cycle Assessment (LCA)

The LCA is a methodology of analysis that evaluates a set of interactions that a product or service has with the environment

Environmental impacts associated with the entire life cycle of a product from raw materials to final disposal

Why make an LCA?

- ✓ Allows to obtain a punctual evaluation of the environmental impact of a product
- ✓ Provides environmental information that may be required by other producers, governments, and consumers.
- ✓ Enables the development of marketing strategies, being supportive to the acquisition of **Environmental Labeling**
- ✓ Allows a greater rationalization of the production processes (better use of resources)

International standard for LCA

The reference is the family of ISO 14040 (International Organization for Standardization)

ISO 14040: Principles and guidelines.

ISO 14041: Definition of Objectives, Field of Application and Inventory Analysis.

ISO 14042: Impact Assessment of the Life Cycle (LCIA).

ISO 14043: Interpretation of results.

ISO 14067: Carbon footprint

The LCA study is divided into 4 main phases:

- ✓ Definition of objectives and scope (functional units and system boundaries)
- ✓ Inventory analysis
- ✓ Impact assessment
- ✓ Interpretation of the results

✓ Definition of objectives and scope (functional units and system boundaries)

Functional Unit

Represents the reference unit to which the input and output data that make up the environmental balance are reported

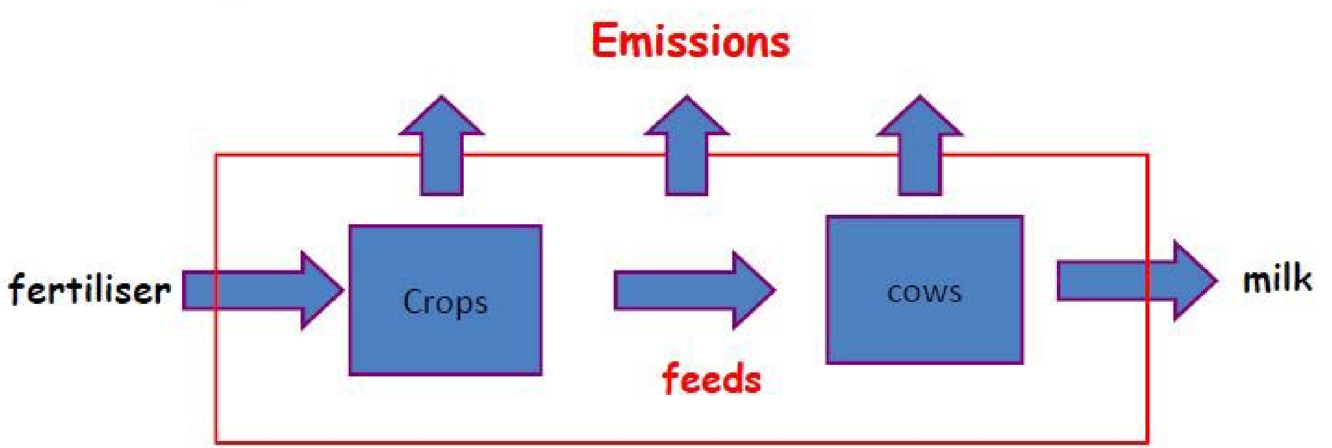
<u>Some examples</u>

- Kg of milk, meat or other foods
- Kwh ....

✓ Definition of objectives and scope (functional units and system boundaries)

system boundaries

- The boundaries of the system are defined by the set of unitary processes that compose it, their interrelations, and their input and output elements



system boundaries

Should be considered

Production and transportation of raw materials including packaging
es. Fertilizers, fuels, energy, food, etc

OFF FARM

Use of raw materials within the unit process;
The production of intermediate products and their destination;

ON FARM

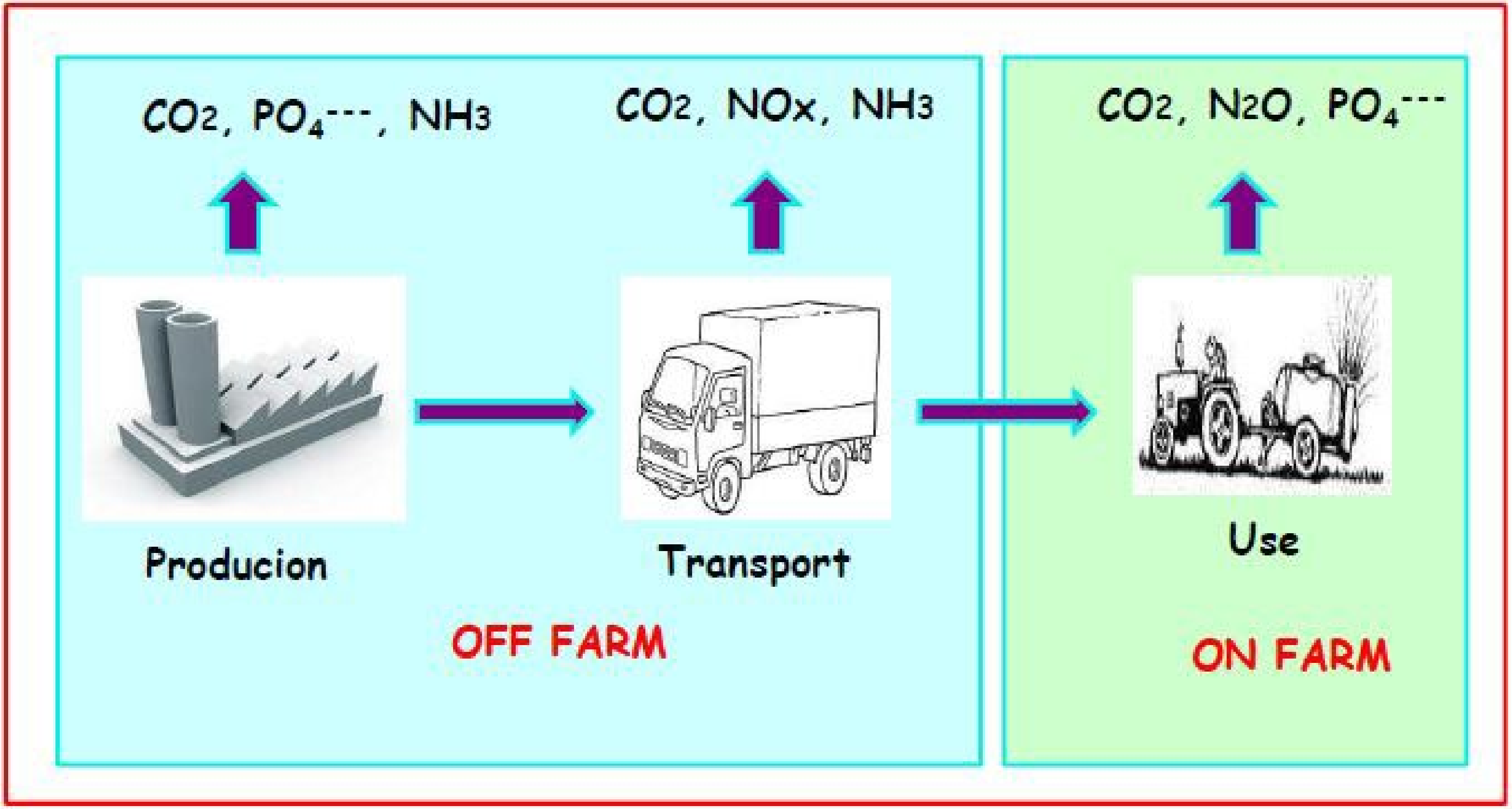
Processing, distribution / transport;
Waste disposal and process products;
Recovery of products after use (intended as reuse, recycling and recovery of energy)

OFF FARM

Life cycle

System boundaries

Input fertilizer



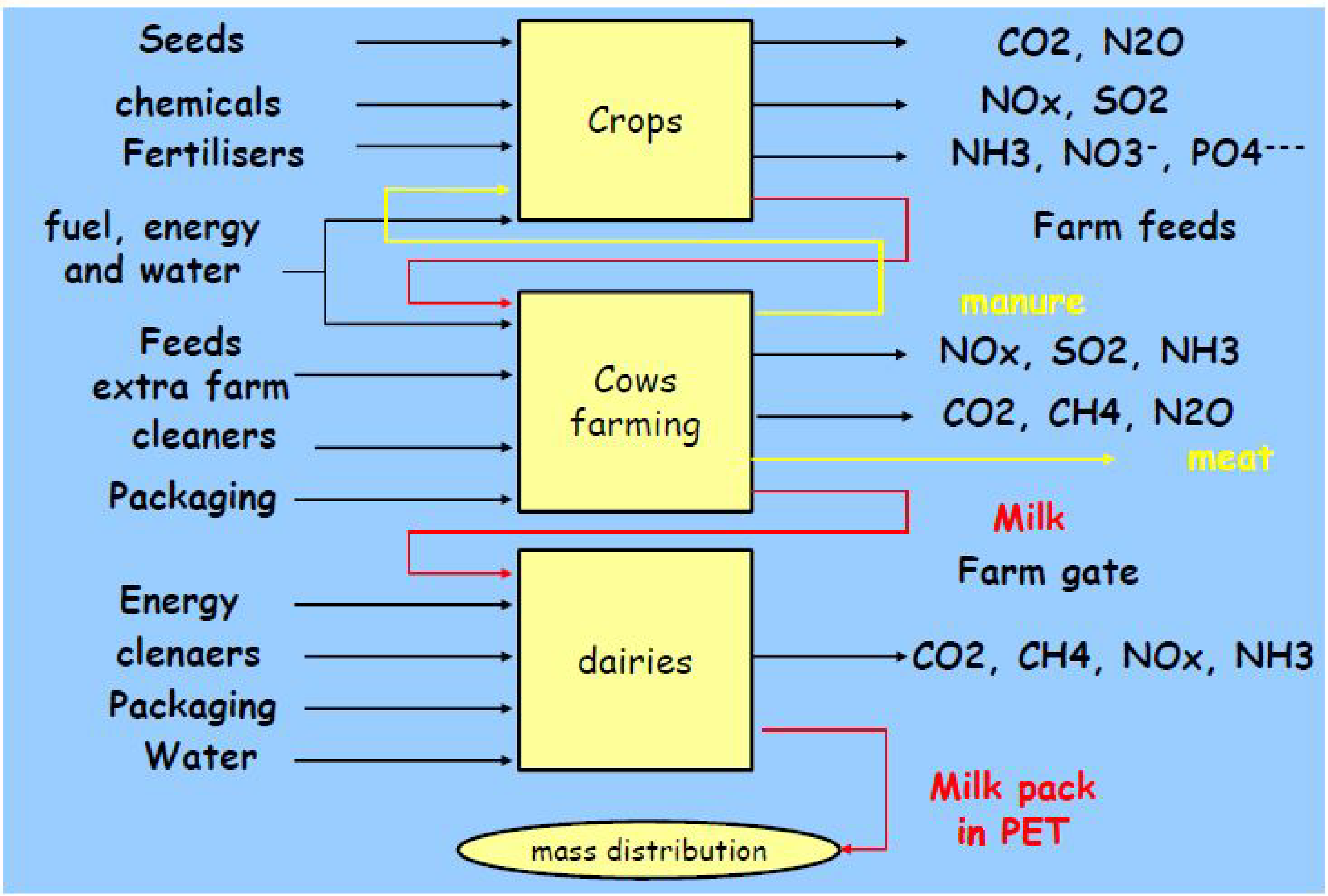
A Case study…

LCA in a dairy cow farm

Objective: Environmental evaluation by LCA of milk production.

Functional unit: 1 kg of milk in a bottle of polyethylene terephthalate (PET)

Boundaries systems



LCI (life cycle inventory)

- Data can be collected directly within the process (primary). For example, bills, delivery bubbles, countryside book, herd management software.
- They can be extracted from databases (EcoInvent) and/or by bibliography.
- They can be estimated with appropriate models (IPCC).

Secondary and tertiary data

Transport:

ECOINVENT provides emission default values for the type of vehicle and refers to full and empty load conditions

Enteric fermentation:

IPCC provides templates for estimating CH4 emissions from enteric fermentation and manure management

Life Cycle Assessment (LCA)

https://www.youtube.com/watch?v=f9cwa9QD7gw&t=73s

Environmental labels/certifications

Environmental Marketing

Environmental Labeling (ISO14020) is a set of voluntary tools to stimulate demand for more environmentally friendly products and services

The ISO14020 identifies three types of labels

- Type I: eco-label (European) and national brands.
- Type II: auto environmental declarations.
- Type III: Environmental Product Declarations (EPD).

Environmental labels/certifications

- TYPE I: based on multiple criteria that take into account the life cycle of the product through independent organisms. Eg Ecolabel, Biological (ISO 14024)

- TYPE II: environmental self-declarations without the intervention of a certification body Eg. "Recyclable", "Computable", (ISO 14021)

- TYPE III: environmental product declaration based on LCA, with independent verification (ISO 14025)

Type III
Environmental Product Declaration or carbon trust

- The main objective is to provide relevant, verified and comparable information on the environmental impact of a product or service

- Environmental statements based on established parameters (Product Category rules or PCRs) and subjected to independent control

Product Category Rules PCR

- Rules for conducting an environmental assessment of a product/service designed to obtain the EPD brand
- Evaluation via LCA
- For each product, functional units, system boundaries and their input and output elements are established

Products certified EPD

Informazione: Environmental Product Declaration

EPD®
THE INTERNATIONAL EPD® SYSTEM

- **oggettive**
- **confrontabili**
- **credibili**

relative alla prestazione ambientale dell'intero ciclo di vita del prodotto

Granarolo è stato il primo in Italia ad ... ere la Dichiarazione Ambientale di Prodotto per il latte fresco e tra i primi a comunicarlo in etichetta ai consumatori.

Granarolo primo in Italia con la **Dichiarazione Ambientale di Prodotto** per il latte fresco e tra i primi a **comunicarlo in etichetta ai consumatori**.

Environmental Footprints

LE IMPRONTE AMBIENTALI

Confezione 1 litro	Latte	Packaging	Altre materie prime	Processo	Distribuzione	TOTALE	Conservazione domestica	Fine vita packaging
ECOLOGICAL FOOTPRINT	4,3	0,3	<0,1	0,3	0,1	5,0 *global m²/l*	0,4	<0,1
CARBON FOOTPRINT	1,3[7]	0,1	<0,1	0,1	<0,1	1,5 *kg CO_2 eq/l*	0,1	<0,1
VIRTUAL WATER CONTENT	1.653,3	0,4	0,1	5,4	<0,1	1.659,2[8] *litri/l*	0,6	<0,1

EPD - Fresh Organic Eggs

https://www.environdec.com/Detail/?Epd=6102

4. METODOLOGIA

La quantificazione della prestazione ambientale del prodotto è stata effettuata, secondo quanto previsto dalle regole generali dell'**International EPD System**[1], oltre che dalle specifiche del gruppo di prodotti "*Product Category Rules 2011:15 Hen eggs in shell, fresh - CPC 0231*"; come strumento di valutazione è stata utilizzata la metodologia di **Analisi del Ciclo di Vita** (LCA – Life Cycle Assessment) (LCA – Life Cycle Assessment) regolata dagli standard internazionali ISO Serie 14040, la quale permette di determinare gli impatti ambientali in termini di consumo di risorse e rilasci verso l'ambiente di un prodotto o servizio da un punto di vista complessivo ("*dalla culla alla tomba*").

Nel caso specifico, l'analisi LCA è stata sviluppata utilizzando sia dati primari, sia secondari grazie all'utilizzo di alcune banche dati quali Ecoinvent e Plastics Europe.

Per la raccolta di dati primari, lo studio ha coinvolto direttamente i fornitori co-packer, ai quali sono stati inviati questionari dettagliati per la caratterizzazione completa della attività di produzione.

Per quanto riguarda gli aspetti temporali, i dati sono riferiti:
- al 2016/2017 per le fasi di svezzamento dei pulcini, di allevamento delle ovaiole, la produzione degli imballaggi e il confezionamento delle uova
- al 2017 per il trasporto alle piattaforme di distribuzione.

1 www.environdec.com

La razione somministrata alle galline ovaiole è costituita in genere da mais (circa 35%), grano duro (15%), soia(15%), girasole (5%), integratori, carbonato di calcio e fosfato (5%) e il restante 15% da favino, crusca ed erba medica; le percentuali di ciascun ingrediente possono variare a seconda degli allevamenti e delle disponibilità.

L'unità funzionale adottata è, in conformità con le PCR di riferimento, 1 kg di uova fresche biologiche.

5. CONFINI DEL SISTEMA E PRINCIPALI IPOTESI

I confini del sistema oggetto dello studio includono l'intera filiera delle uova fresche biologiche Granarolo e più precisamente lo svezzamento dei pulcini, la produzione delle uova presso le aziende agricole, il processo di selezione e confezionamento e il trasporto verso le piattaforme logistiche e i transit point.

Uno schema dettagliato del sistema analizzato è riprodotto in **Figura 2**, ove si possono distinguere tre diversi livelli o sottosistemi relativi alle seguenti attività produttive:

Upstream processes
- produzione dei mangimi biologici per l'allevamento
- svezzamento dei pulcini
- produzione dei materiali per il confezionamento.

Core processes
- produzione delle uova
- selezione e confezionamento

Downstream processes
- Trasporto del prodotto confezionato alle piattaforme distributive e ai transit point
- Conservazione domestica del prodotto
- Fine vita del packaging primario
- Fine vita del guscio delle uova.

Non sono inclusi nel sistema i trasporti dai punti vendita ai consumatori finali a causa dell'impossibilità di stimarne in modo ragionevole le modalità.

FIGURA 2 – SCHEMA DEL SISTEMA DI PRODUZIONE DELLE UOVA FRESCHE BIOLOGICHE GRANAROLO.

6. LE PRESTAZIONI AMBIENTALI

USO DI RISORSE

Il consumo di risorse viene riportato suddiviso tra risorse rinnovabili e non rinnovabili, utilizzate come materie prime e a scopo energetico.

Il contenuto energetico dell'imballaggio è pari a **1,49 MJ** per chilogrammo di prodotto.

		UPSTREAM			CORE		DOWNSTREAM			
USO DI RISORSE		Svezzamento pulcini	Produzione mangimi	Imballaggio	Allevamento galline	Selezione e confezionamento	Distribuzione	Conservazione domestica	Fine vita imballaggio e guscio	**TOTALE**
Risorse energetiche rinnovabili (MJ)	Utilizzate come vettore energetico	1,2E+01	2,6E+01	3,3E+00	2,3E-01	4,5E-03	9,5E-03	6,8E-01	6,2E-04	**4,2E+01**
	Utilizzate come materie prime	3,9E-02	1,4E-01	3,5E+00	2,7E-03	4,4E-05	1,1E-03	2,1E-03	6,1E-05	**3,7E+00**
	TOTALE	1,2E+01	2,6E+01	6,7E+00	2,3E-01	4,5E-03	1,1E-02	6,8E-01	6,8E-04	**4,5E+01**
Risorse energetiche non rinnovabili (MJ)	Utilizzate come vettore energetico	4,3E+00	6,0E+00	4,5E+00	7,3E+00	2,0E-01	1,8E+00	1,4E+01	9,6E-03	**3,9E+01**
	Utilizzate come materie prime	0	0	0	0	0	0	0	0	**0**
	TOTALE	4,3E+00	6,0E+00	4,5E+00	7,3E+00	2,0E-01	1,8E+00	1,4E+01	9,6E-03	**3,9E+01**
Materie prime seconde (g)		0,0E+00	0,0E+00	7,7E+01	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	**7,7E+01**
Combustibili secondari rinnovabili (MJ, potere calorifico netto)		0	0	0	0	0	0	0	0	**0**
Combustibili secondari non rinnovabili (MJ, potere calorifico netto)		0	0	0	0	0	0	0	0	**0**
Uso di risorse idriche (litri)		1,2E+02	2,3E+02	4,0E+00	4,7E+00	3,8E-02	7,8E-02	3,1E+00	2,1E-02	**3,6E+02**

TABELLA 2 – USO DI RISORSE RINNOVABILI E NON RINNOVABILI. DATI ESPRESSI PER CHILOGRAMMO DI UOVA FRESCHE BIOLOGICHE GRANAROLO.

I valori riportati in questa tabella e nelle successive sono il risultato di un arrotondamento.
Per tale motivo i totali possono differire leggermente dalla somma dei contributi delle diverse fasi.

PRODUZIONE DI RIFIUTI

In **Tabella 3** sono riportati gli indicatori relativi ai rifiuti avviati a discarica, riferiti ad 1 chilogrammo di uova.

	UPSTREAM			CORE		DOWNSTREAM			
PRODUZIONE RIFIUTI	Svezzamento pulcini	Produzione mangimi	Imballaggio	Allevamento galline	Selezione e confezionamento	Distribuzione	Conservazione domestica	Fine vita imballaggio e guscio	**TOTALE**
Rifiuti pericolosi (g)	0,0E+00	5,8E-05	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	**5,8E-05**
Rifiuti non pericolosi (g)	1,3E-01	1,1E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	2,4E+01	**2,5E+01**
Rifiuti radioattivi (g)	0	0	0	0	0	0	0	0	0

TABELLA 3 – PRODUZIONE TOTALE DI RIFIUTI E FLUSSI IN USCITA DAL SISTEMA. DATI ESPRESSI PER CHILOGRAMMO DI UOVA FRESCHE BIOLOGICHE GRANAROLO.

FLUSSI IN USCITA DAL SISTEMA

In **Tabella 4** sono riportati gli indicatori relativi ai flussi in uscita dal sistema, riferiti ad 1 chilogrammo di uova.

 FLUSSI IN USCITA DAL SISTEMA	UPSTREAM			CORE		DOWNSTREAM			TOTALE
	Svezzamento pulcini	Produzione mangimi	Imballaggio	Allevamento galline	Selezione e confezionamento	Distribuzione	Conservazione domestica	Fine vita imballaggio e guscio	
Componenti per il riuso (g)	0	0	0	0	0	0	0	0	**0**
Materiali per il riciclo (g)	0	0	0	2,3E+01	2,7E+01	0	0	1,4E+02	**1,9E+02**
Materiali per il recupero energetico (g)	0	0	0	0	0	0	0	2,4E+01	**2,4E+01**
Energia esportata, elettricità (MJ)	0	0	0	0	0	0	0	8,1E-03	**8,1E-03**
Energia esportata, termica (MJ)	0	0	0	0	0	0	0	2,5E-02	**2,5E-02**

TABELLA 4 – FLUSSI TOTALI IN USCITA DAL SISTEMA. DATI ESPRESSI PER CHILOGRAMMO DI UOVA FRESCHE BIOLOGICHE GRANAROLO.

INDICATORI DI IMPATTO AMBIENTALE

INDICATORI DI IMPATTO AMBIENTALE	UPSTREAM			CORE		DOWNSTREAM			TOTALE
	Svezzamento pulcini	Produzione mangimi	Imballaggio	Allevamento galline	Selezione e confezionamento	Distribuzione	Conservazione domestica	Fine vita imballaggio e guscio	
Potenziale riscaldamento globale, GWP - **fossile** kg CO_2 eq	4,7E-01	7,7E-01	2,5E-01	5,1E-01	1,3E-02	1,5E-01	7,9E-01	3,9E-03	**3,0E+00**
Potenziale riscaldamento globale, GWP - **biogenico** kg CO_2 eq	1,6E-01	2,2E-04	-1,2E-01	1,6E-01	7,5E-07	5,1E-05	6,9E-05	5,4E-02	**2,6E-01**
Potenziale riscaldamento globale, GWP - **uso suolo e cambiamento uso suolo** kg CO_2 eq	5,5E-04	1,2E-03	1,2E-04	6,1E-05	1,4E-08	3,6E-06	4,5E-07	1,2E-08	**1,9E-03**
Potenziale riscaldamento globale, GWP TOTALE kg CO_2 eq	6,3E-01	7,7E-01	1,3E-01	6,7E-01	1,3E-02	1,5E-01	7,9E-01	5,8E-02	**3,2E+00**
Potenziale di acidificazione, AP g SO_2 eq	1,6E+01	1,6E+01	9,9E-01	2,4E+01	3,8E-02	6,7E-01	2,3E+00	1,0E-02	**6,0E+01**
Potenziale di eutrofizzazione, EP g PO_4^{3-} eq	7,6E+00	1,2E+01	2,2E-01	4,4E+00	5,5E-03	1,1E-01	2,6E-01	1,8E-02	**2,5E+01**
Potenziale di ossidazione fotochimica, POFP g NMVOC eq	1,8E+00	3,2E+00	8,5E-01	1,3E+00	3,8E-02	8,3E-01	1,4E+00	2,1E-02	**9,5E+00**
Potenziale di impoverimento abiotico - elementi g Sb eq	1,3E-04	3,9E-04	4,5E-05	1,9E-06	3,2E-08	1,1E-06	3,5E-06	1,7E-08	**5,7E-04**
Potenziale di impoverimento abiotico - combustibili fossili MJ, potere calorifico netto	3,8E+00	5,2E+00	3,7E+00	7,0E+00	1,9E-01	1,8E+00	1,3E+01	6,4E-03	**3,5E+01**
Pontenziale scarsità di acqua, m^3 eq (AWARE v 1.01, 2016)	1,2E+01	2,1E+01	3,5E+01	1,3E+01	2,8E-01	3,0E-01	3,8E+01	1,5E-01	**1,2E+02**

TABELLA 5 – INDICATORI DI IMPATTO AMBIENTALE. DATI ESPRESSI PER CHILOGRAMMO DI UOVA BIOLOGICHE GRANAROLO.

10. ORGANISMO DI CERTIFICAZIONE E PCR

Programme operator: EPD International AB, Box 210 60, SE-100 31 Stockholm, Sweden, Email: info@environdec.com

Product category rules (PCR): PCR 2011:15 Hen eggs, in shells, version 3.1, UN CPC 0231.

PCR review, was conducted by: Technical Committee of the International EPD® System. Review chair: Adriana Del Borghi. Contact via *info@environdec.com*.

Independent verification of the declaration and data, according to ISO 14025:2006:
☑ EPD process certification ☐ EPD verification

Third party verifier: Certiquality (accreditation number: 003H)
Accredited or approved by: Accredia

Procedure for follow-up of data during EPD validity involves third party verifier:
☐ Yes ☑ No

Granarolo S.p.a. è l'unico proprietario e ha piena responsabilità dei contenuti dell'EPD.

EPD appartenenti alla stessa categoria di prodotto, ma derivanti da diversi programmi, possono non essere paragonabili.

11. PRINCIPALI RIFERIMENTI BIBLIOGRAFICI

- EPD International (2017) General Programme Instructions for the International EPD® System. Version 3.0, dated 2017-12-11. (www.environdec.com)

- FAO (2014a) Greenhouse gas emissions and fossil energy demand from poultry supply chains, http://www.fao.org/3/a-mj752e.pdf. Accessed 5 July 2018

- IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Agriculture, Forestry and Other Land Use chapter 10 emissions from livestock and manure management (www.ipcc-nggip.iges.or.jp)

- ISO 14025:2006. Environmental labels and declarations – Type III environmental declarations – Principles and procedures (www.iso.org)

- ISO 14040/14044:2006. ISO series on Life Cycle Assessment (Valutazione del ciclo di vita), UNI EN ISO 14040:2006 e 14044:2006 (www.iso.org)

- Product Category Rules UN CPC 02310. Hen eggs in shell, fresh. 2011:15. Version 3.1. 2018-12-17

- Software SimaPro versione 8.5.2 del 2018 (www.pre.nl)

13. SUMMARY

ENGLISH SUMMARY

THE GRANAROLO GROUP

The company was set up in 1957 by a small cooperative situated near Bologna and owned by Granlatte Società Cooperativa Agricola, together with which it forms the largest milk chain in Italy with shares held directly by the farmer members of the cooperative. Since the early nineties the Group has been divided into two distinct synergistic structures: a consortium of milk producers (Granlatte) – which operates in the farming industry and collects the raw material – and a joint-stock company (Granarolo S.p.A. - www.granarolo.it), which controls the industrial and marketing activities.

THE PRODUCT

Granarolo fresh organic eggs, packaged in 4 eggs wood pulp box, come from free-range hens, free to move outdoors and in sheds. Hens are fed with vegetable products only, supplemented with vitamins, minerals and lactic ferments, that improve animals' welfare and eggs organoleptic characteristics. Granarolo fresh organic eggs come from a 100% Italian supply chain and they are subjected to strict controls, in excess compared to the standards of the law, both for quality and quantity.

SYSTEM BOUNDARIES

The system boundaries include the production and packaging of eggs, the distribution, the conservation in the refrigerator and the end of life of the primary packaging and shells.

DECLARED UNIT

Data are referred to 1kg of product, equivalent to about 18 eggs.

ADDITIONAL INFORMATION

For further information about the Granarolo Group or this environmental declaration, contact Mirella Di Stefano (Environmental Management System Specialist of the Granarolo Group) by telephone: no. 051-41.62.599, by e-mail: mirella.distefano@granarolo.it or by writing to Granarolo S.p.A.. Via Cadriano 27/2 – 40127 Bologna - Italia.

ENVIRONMENTAL IMPACTS per 1 kg of Granarolo organic fresh eggs

Impact category	Unit	Data
Global Warming Potential - *GWP total*	kg CO_2 eq	3,2E+00
Acidification Potential - AP	g SO_2 eq	6,0E+01
Eutrophication Potential - EP	g PO_4^{---} eq	2,5E+01
Photochemical oxidant formation potential - POFP	g NMVOC eq	9,5E+00
Water Scaricity Potential	m^3 eq	1,2E+02

ISO14025 Environmental Labelling

https://www.youtube.com/watch?v=s_2G4V5NiKM&t=231s