# *PLF-assisted quantification of carbon footprint; Preliminary analysis of Agroforestry system*

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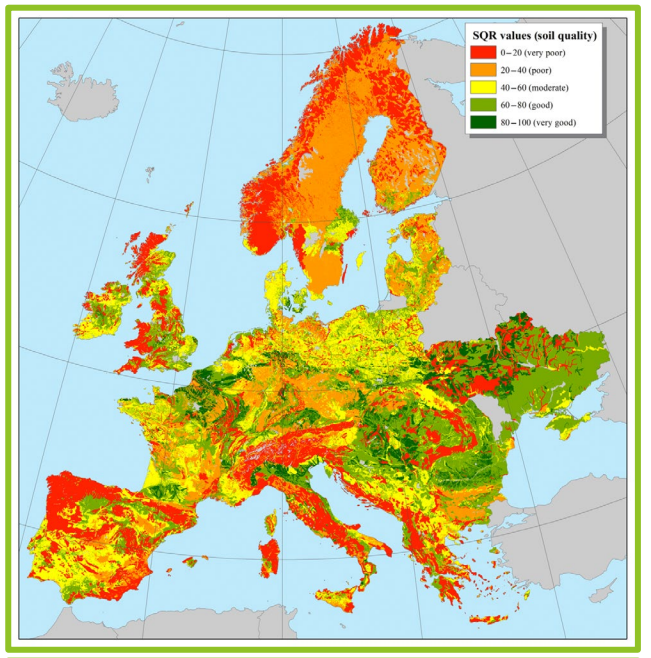
Regrowth

ANIMAL-BASED INTELLIGENCE

# Introduction– Small farm characterization:

- Predominantly small scale farms (1-5 ha)
- **71.2% of total registered farms (average 3.5 ha )**
- Low economic unit (0-1 employees in  81% of the farms)
- Average yearly gain less than 14,999 euro
- Average net income per ha =1.601 euro
- **Average net income per farm = 6.456 euro**
- **Decrees of 30%  in farm n' in recent years (2010 – 2020)**
- **Decrees of 63% in long term view (1980 -2020)**





*https://www.istat.it/it/files//2019/12/Struttura-unit%C3%A0-economiche-settore-agricolo.pdf
**http://dati.istat.it/Index.aspx?DataSetCode=DCSP_RICAREA
***https://www.ruminantia.it/wp-content/uploads/2023/06/Noi-Italia-in-breve-2023.pdf

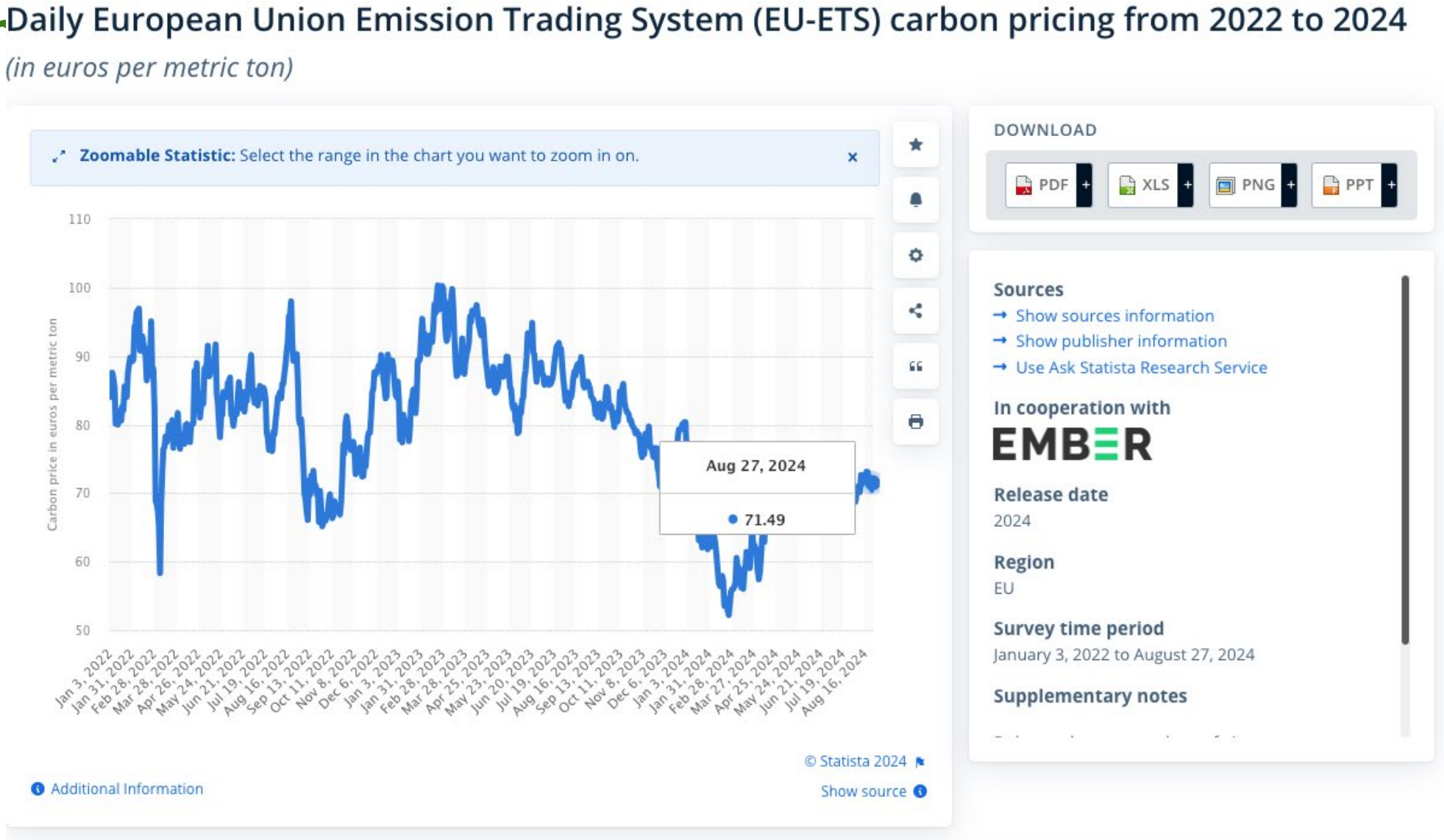
# Monetization of ecosystem services–current CAP strategy:

- Growing interest in funding scheme correlated to ecosystem services
- Yearly payment of 424 euro / ha on average
- **25% of the actual farm revenue / ha**
- A yearly total of 1200 - 1700/ year (net gain)

Example: "Bio" certified 4 ha farm with organic matter increase scheme.

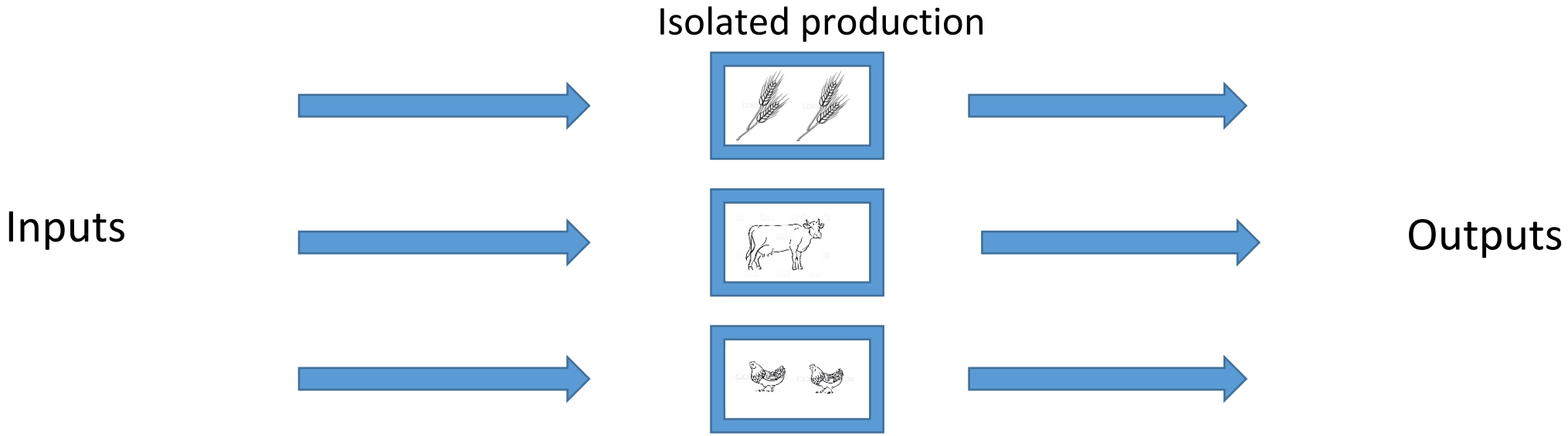
| **Service** | **CAP payment (€)** |
|---|---|
| Soil organic matter increase | 782 |
| Biological farming | 480 |
| Farming potential reserve | 1770 |
| *Total* | 3030 |
| Registry costs | 830 |
| *Net CAP payment* | *2200* |

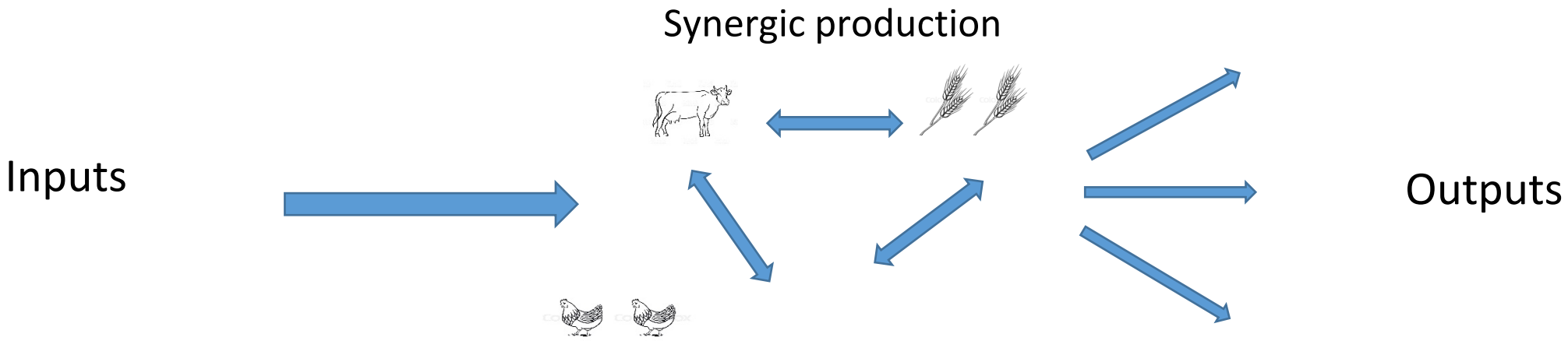
# Quantification of CO2 capture– Potential value per farm




https://www.statista.com/statistics/1322214/carbon-prices-european-union-emission-trading-scheme/#:~:text=The%20price%20of%20emissions%20allowances,reform%20of%20the%20EU%2DETS.

# Complicated VS complex production systems and LCA:



# Challenge and objective of the current work :

1. Construct a LCA model flexible enough to fit small scale farms, in particularly Agroforestry.

1. Automatize the data intake and tracking of processes in field

1. Compare the different production and management methods using real time data

1. Identify key data provided by PLF systems for better integration of farm sustainability and productivity.

# Materials and methods – site and farm


1. 3 ha of natural pasture (no external seeding)
2. 650 hazelnut trees (Micolized)
3. Rotational grazing of poultry unit
4. Control: Small scale traditional coop

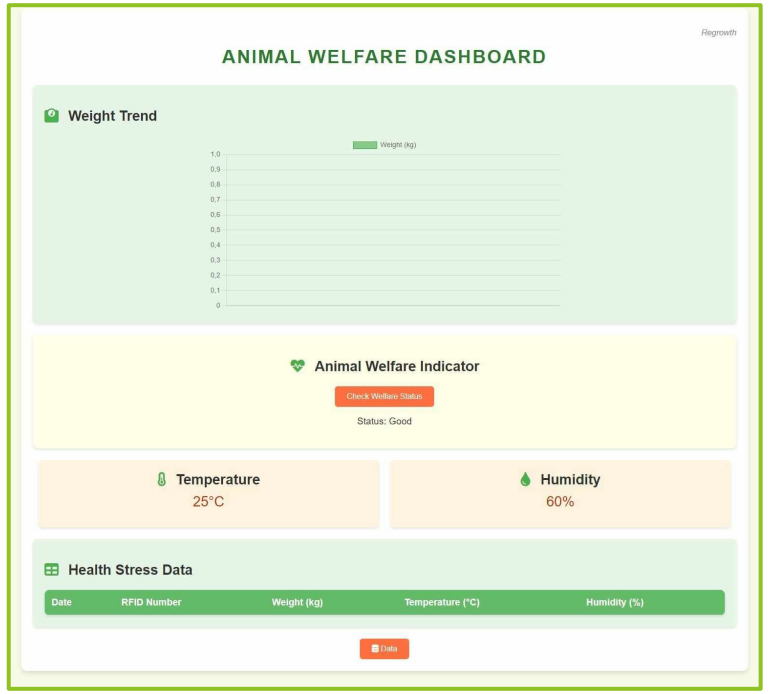
# Materials and Methods– technological tracking systems:

1. Feed use registry
2. Daily weight, growth and CR
3. Individual animal recognition and tracking
4. Group analysis
5. Historical depository

*IoT station*

*LoRa communication*

*LoRa to GSM*

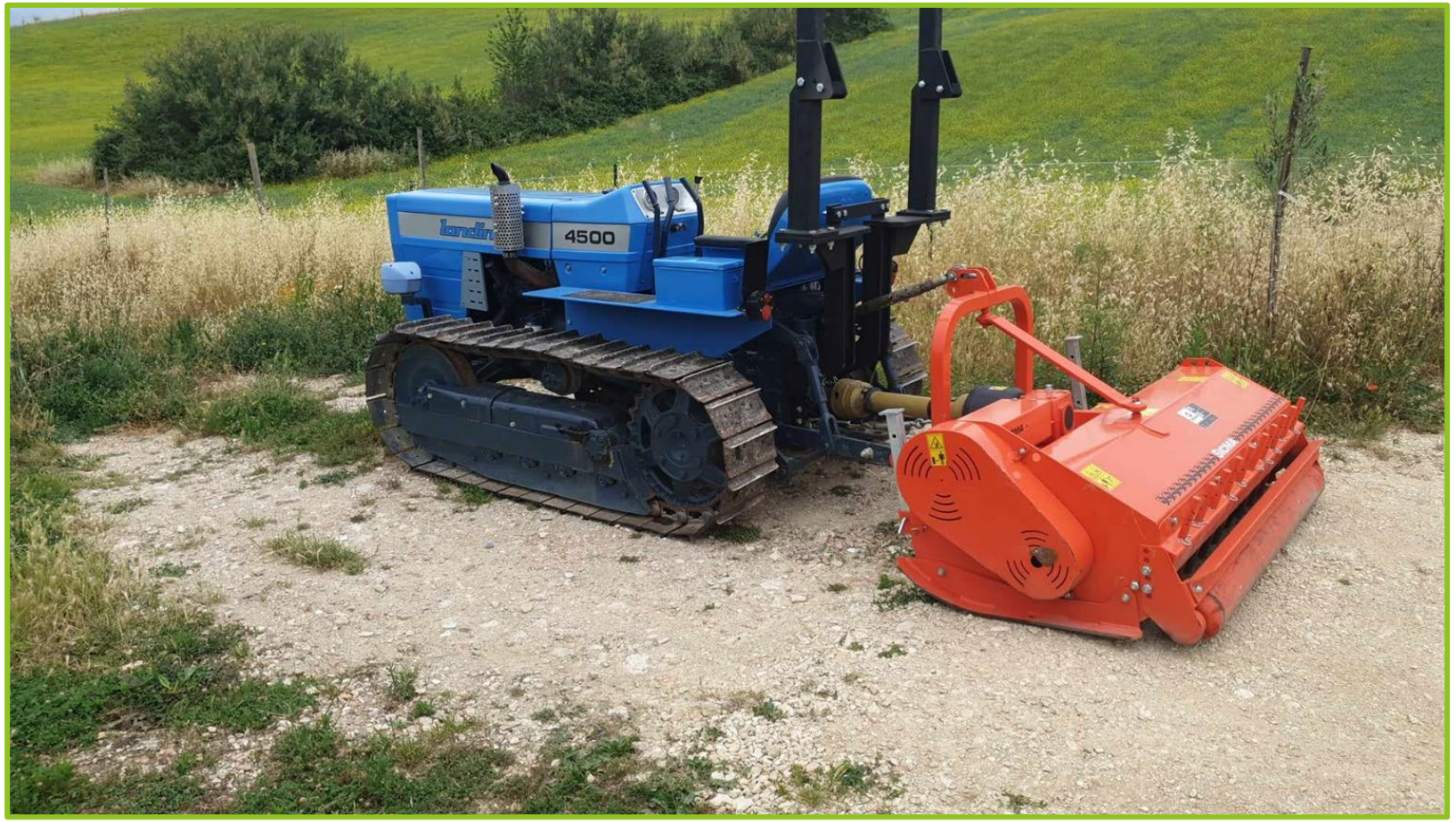



*Data analysis / visualization*

# Materials and Methods– control:

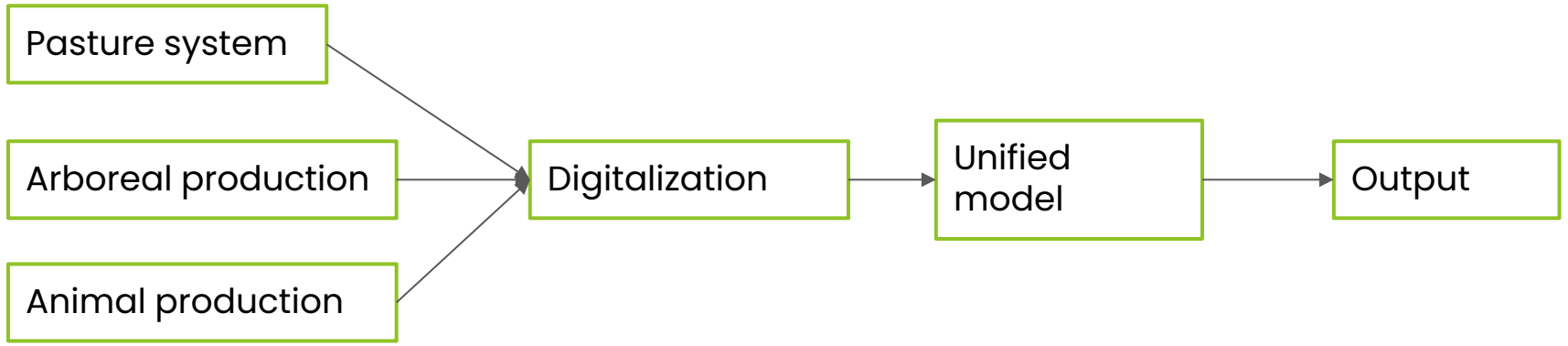
**LCA comparison models:**

- Functional unit 1: Daily growth rate of pullets in commercial farm
- Functional unit 2: Cleared unit of pasture by mechanical tools



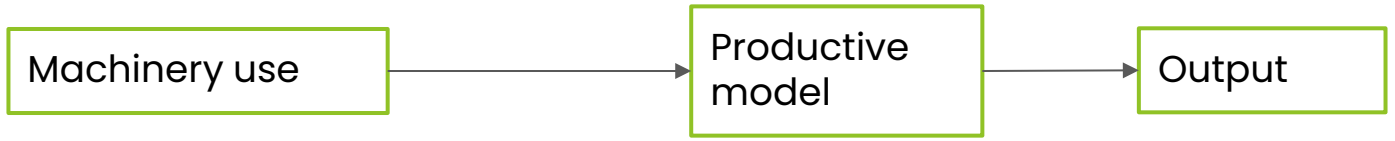
# LCA Modelling (IPCC guidelines, simplified):

*Agroforestry*




*Commercial coop*


*Mechanical pastur control*



# Farm setting and infrastructure:

| | *Description* | *Steel (kg)* | *PVC Plastic (kg)* | *Structural wood* (kg)* | *Gasoline (Liters)* |
|---|---|---|---|---|---|
| *Fencing* | 1500 m wire fencing | 500 | 0 | 500 | 40 |
| *Housing* | 6 modular housing structure | 500 | 100 | 100 | 5 |
| *Crops & Land* | 35 olive trees, 650 hazelnut trees | 0 | 0 | 30 | 50 |
| *Total* | | 1000 | 100 | 630 | 95 |
| *Environmental cost (average)* | CO2 equivalent (direct + indirect) | 2.1 | 2.3 | 0.3* | 2.3 |
| *CO2 equivalent emissions* | | 2100 | 230 | 189 | 218.5 |

*Presumed to be unsustainably sourced

2.73 tons/ CO2 equivalent

# Production LCA modelling:

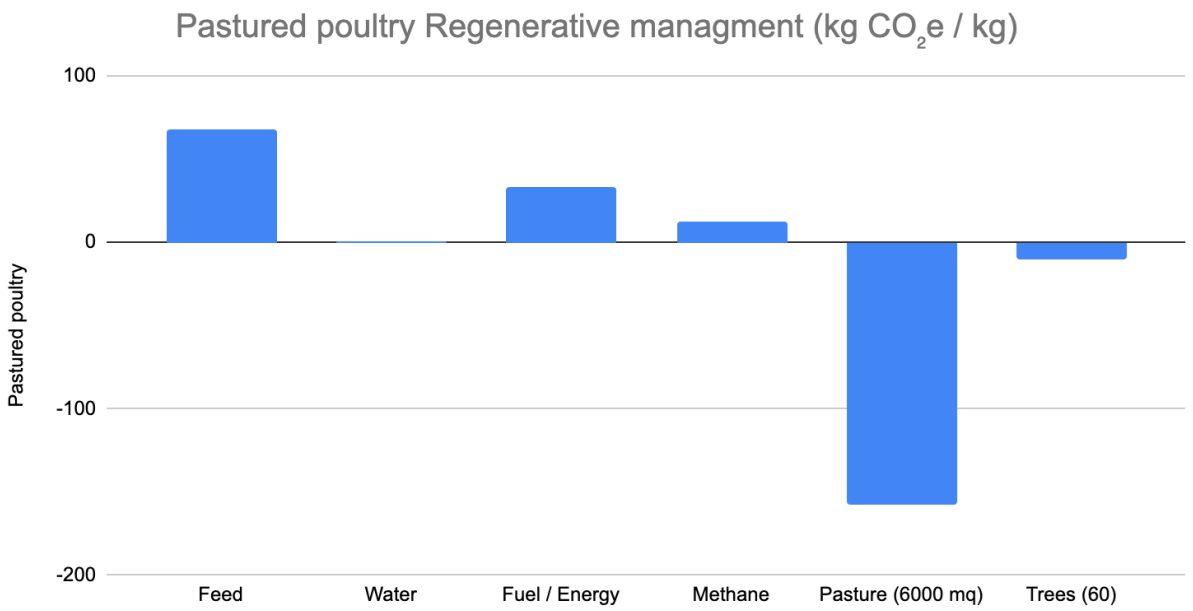
## *Poultry production*

| | |
|---|---|
| ***Feed*** | |
| Total feed (kg) | 68 |
| Feed / day (kg - gr) | 2,27 |
| Feed/day/animal (gr) | 75,56 |
| AVG gain/ day | 0,28 |
| Total growth | 8,41 |
| Daily growth (kg) | 0,28 |
| Daily growth /animal (gr) | 9,34 |
| Daily Conversion rate (avg) | 3-5 |
| ***Water*** | |
| Water / day (liters) | 20 |
| Water (total) | 600 |
| Water/day/animal | 0,67 |
| ***Fuel*** | |
| Total fuel (liters) | 10 |
| Fuel /day | 0,33 |
| ***Methane emissions (per animal)*** | |
| Enteric fermentation (kg $CO_2e$ / month) | Negligible |
| Fecal decomposition (kg $CO_2e$ / month) | 0,41 |

## *Arboreal and pasture production*

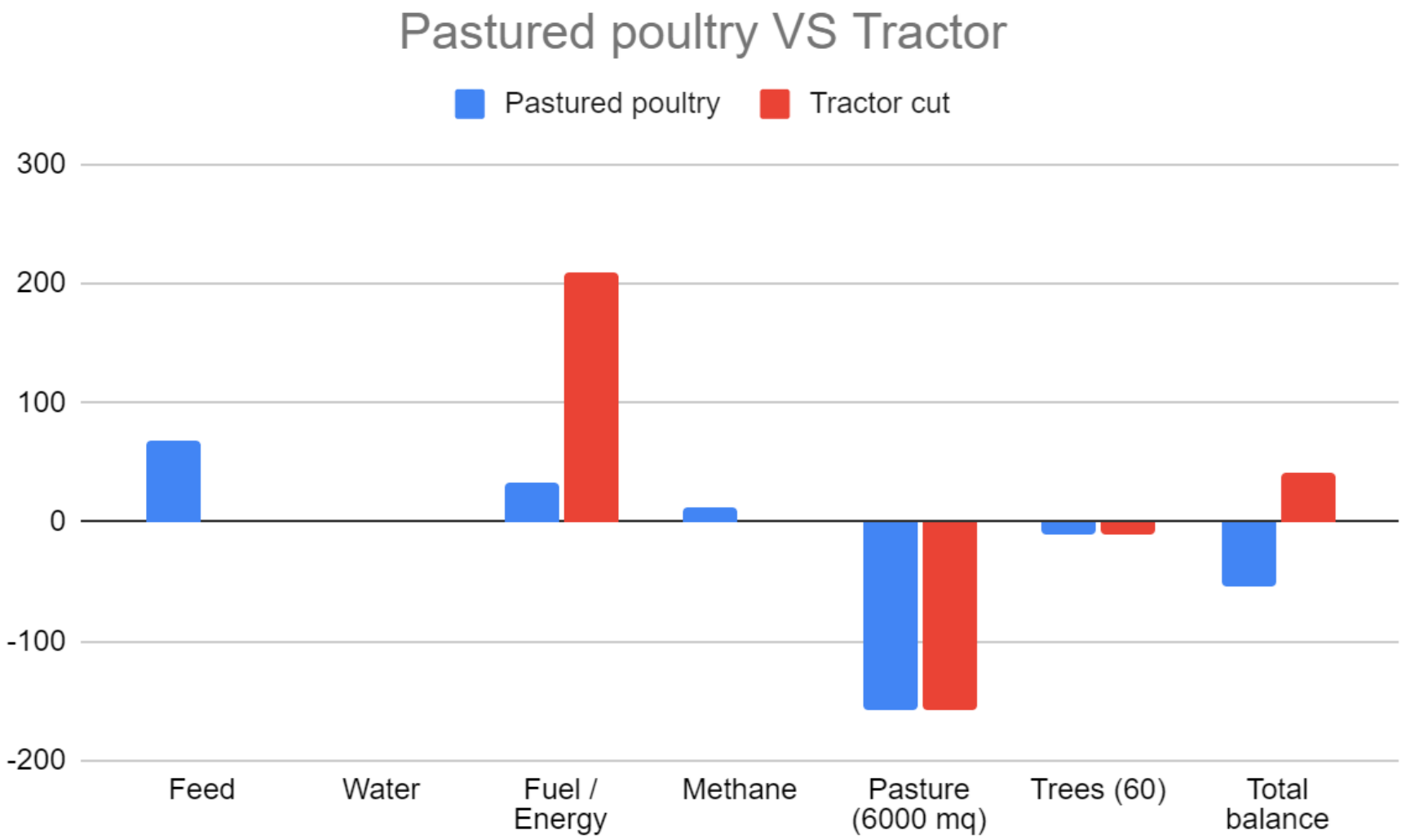
| ***Sequestration (kg $CO_2e$ / month)*** | |
|---|---|
| Pasture (6000 mq) | -158 |
| Trees (60) | -10 |

## *Unified model*



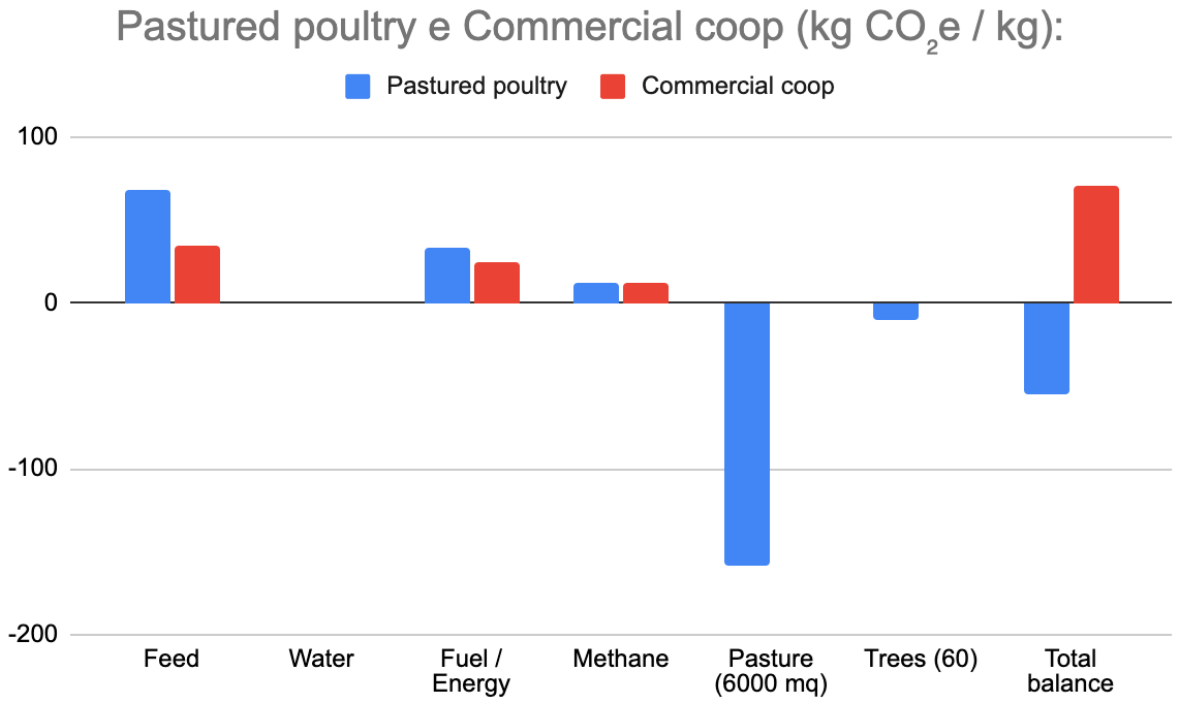

| Total balance (***kg $CO_2e$ / month)*** | -54,52 |
|---|---|

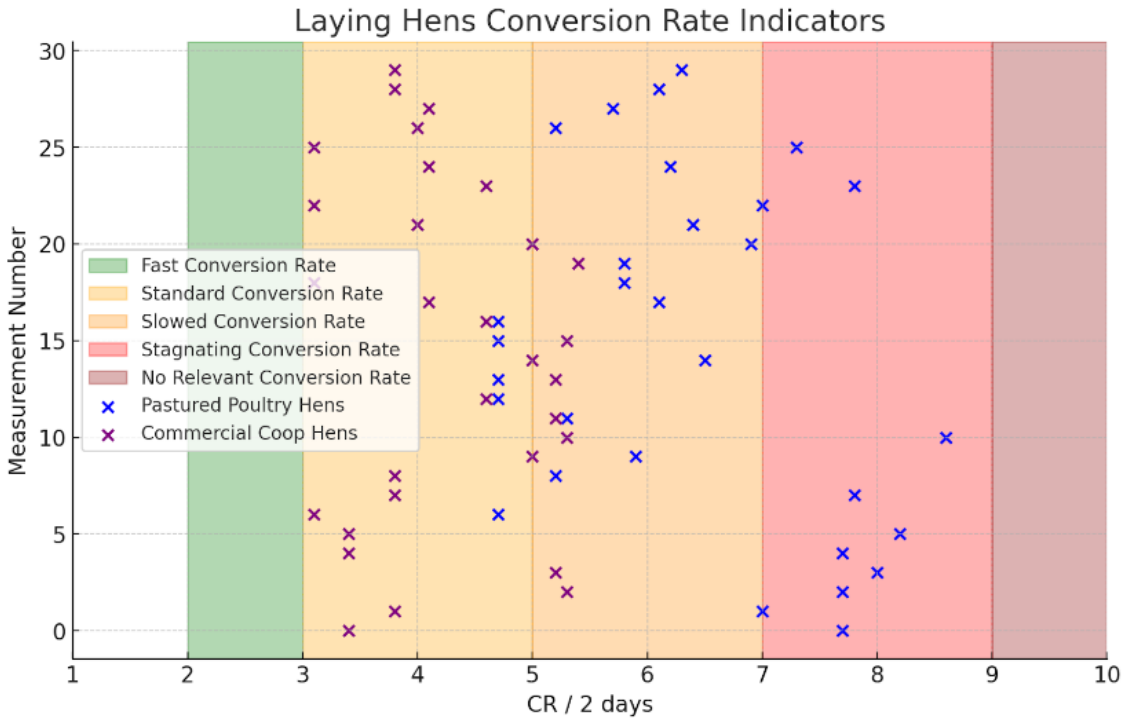
# “Chicken tractor” VS Tractor (kg $CO_2e$ / kg):



# Pasture VS commercial (kg $CO_2e$ / kg):

1. Conversion Rate - Main difference
2. Commercial farms - Reduce feed consumption, shorter production cycle
3. Energy consumption tends to be similar

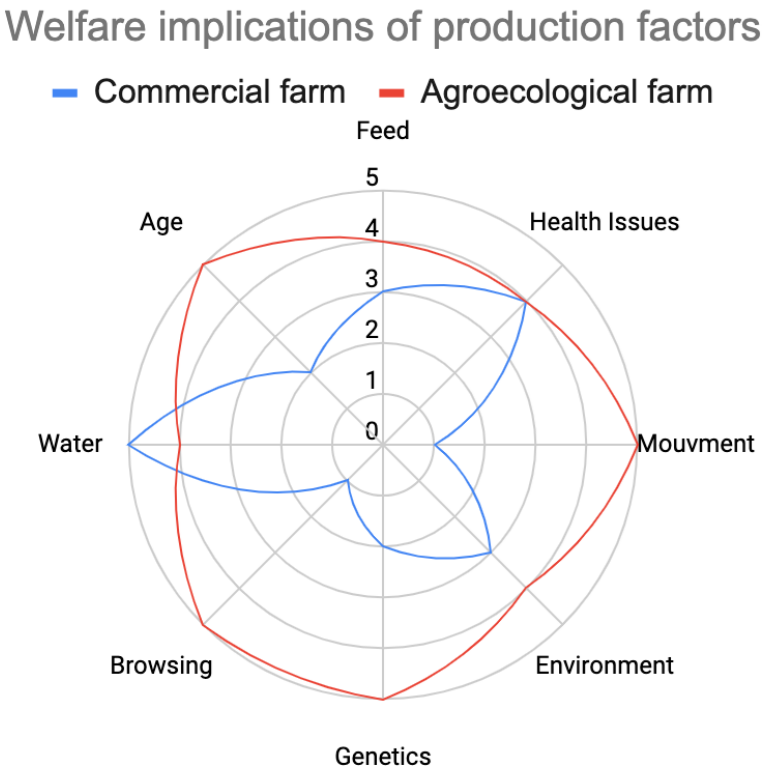


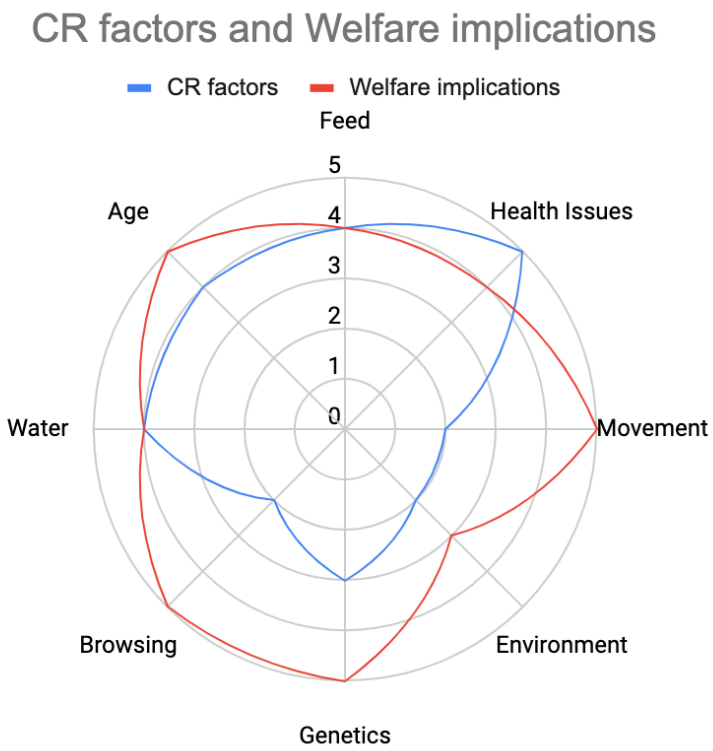



# Slow growth & “Slow Food”:

Market value (price for the consumer):

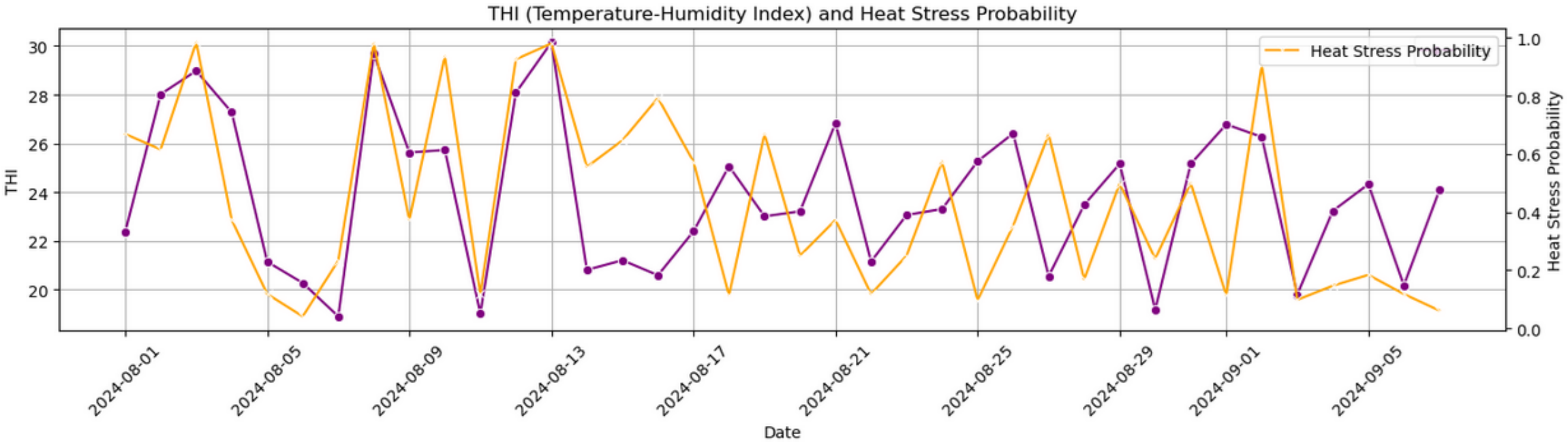
- Commercial egg ( >90% LR) = 20 cent / egg
- “Bio” certified egg (80- 90% LR) = 30 cent / egg
- “Regenerative” egg (70- 80% LR) = 40-50 cent / egg



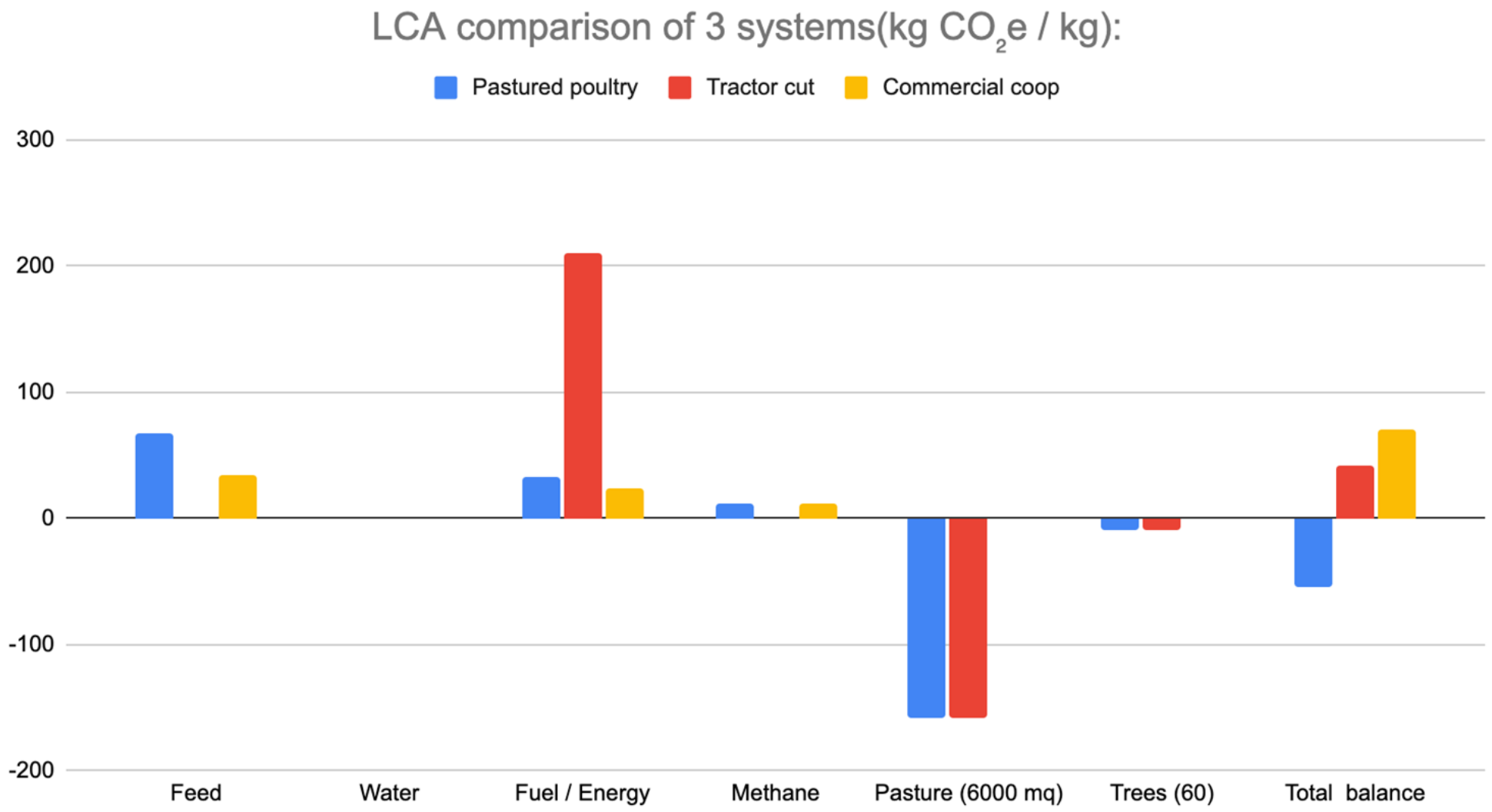



# The value of PLF:

1) "Fine tuning" of production - Feed quality / genetics / housing density
2) Reduction of external factors - Heat stress / biosecurity
3) Preserving the positive factors - positive welfare indicators
4) *Prediction models and prevention*:



# CO2 sequestration comparison:



# $CO_2$ market for farmers:

**Voluntary Carbon Markets:**

- Gold Standard: https://www.goldstandard.org/take-action/project-developers
- Verra: https://verra.org/project/vcs-program/

**EU Emissions Trading System (EU ETS):**

- https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets_en

**Local and Regional Initiatives:**

- https://ec.europa.eu/clima/eu-action/forests-and-agriculture/carbon-farming_en

**Carbon Trading Platforms:**

- Nori: https://nori.com/
- Puro.earth: https://puro.earth/

**Corporate Partnerships:**

- Carbon Disclosure Project (CDP): https://www.cdp.net/en/

# Discussions and conclusions:

- The economic sustainability of small scale farms is strongly linked to their ability to monetize their ecosystem services
- Precise quantification of such services is a complex and costly process which require specific skills and
- The use of PLF  tools can facilitate the modelling and data collection on farm
- PLF tools can have significant role in adjustment of production and communication
- Week link in the process is the access to CO2 markets, which require a minimal plot of 2 ha and have high cost of entry (5,000 euro) and maintenance (600 euro/ year)

# Thanks & questions

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