Can the environmental impact of livestock feed be reduced by using waste-fed housefly larvae?

Hannah van Zanten - Animal Production Systems

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Introduction

- Growing world population and developing countries
  ⟶ increase animal proteins

- Livestock pressure on environment
  - 70% of agricultural land
  - 15% of greenhouse gas emissions ⟶ feed

- Need for efficient production of livestock feed
  - Insects?

- Environmental benefits:
  - Replace ingredients with high impact
  - Not land intensive
  - Feed with organic waste streams

Aim

Explore if the environmental impact of livestock production can be reduced by using larvae of the common housefly fed with chicken manure and food waste as livestock feed

including indirect consequences ⟶ ‘waste’

Method: life cycle assessment

Assess environmental impact ⟶ LCA

1. Direct environmental impact of larvae meal production
2. Indirect environmental impact

Environmental impact per ton larvae meal

- Global warming potential (GWP): kg CO_2-eq
- Energy use (EU): MJ
- Land use (LU): m^2

Data from testing site: rearing place of 20 tons of larvae meal per day

Method: life cycle assessment

Step 1: Direct environmental impact of larvae meal

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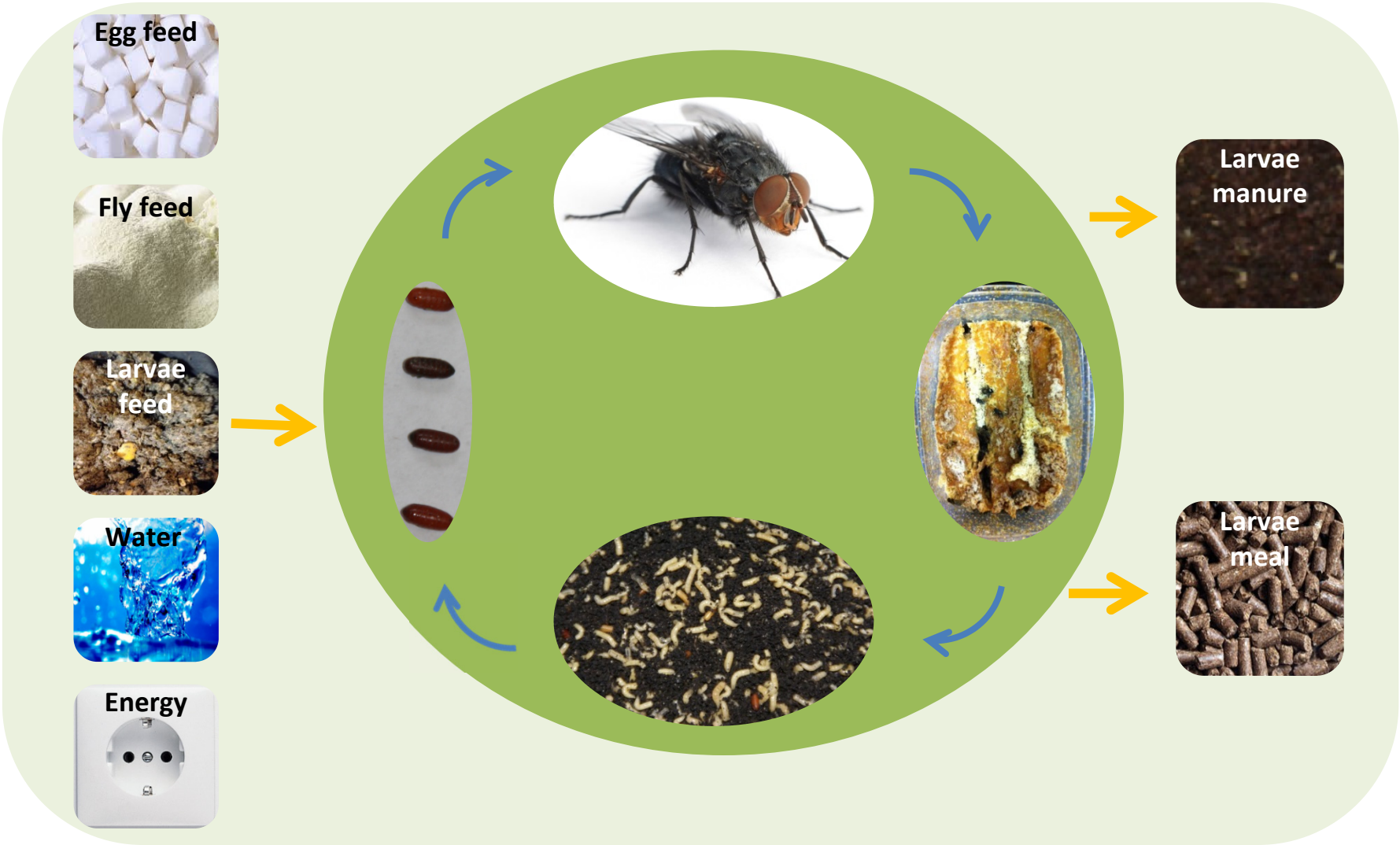

Method: life cycle assessment

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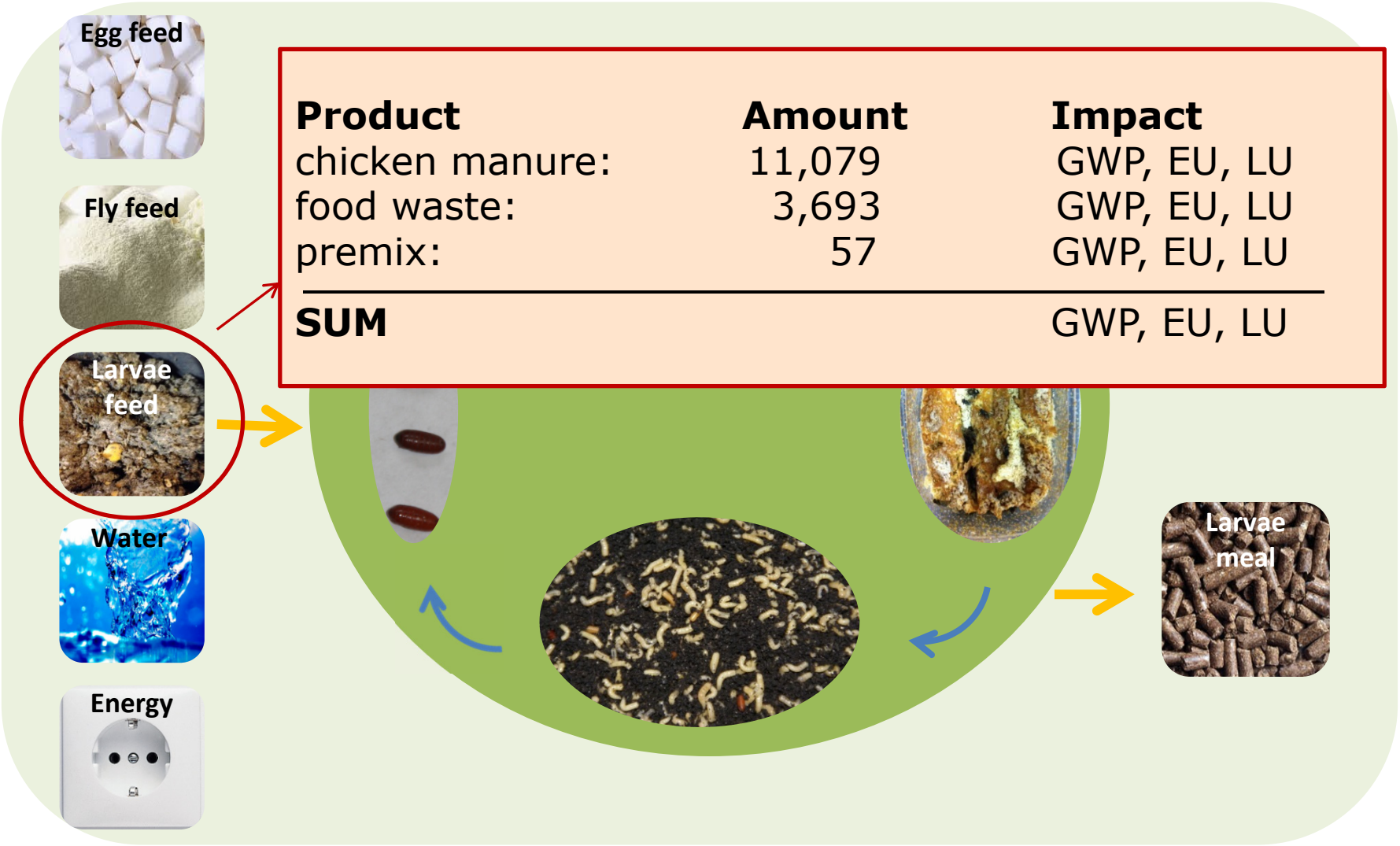
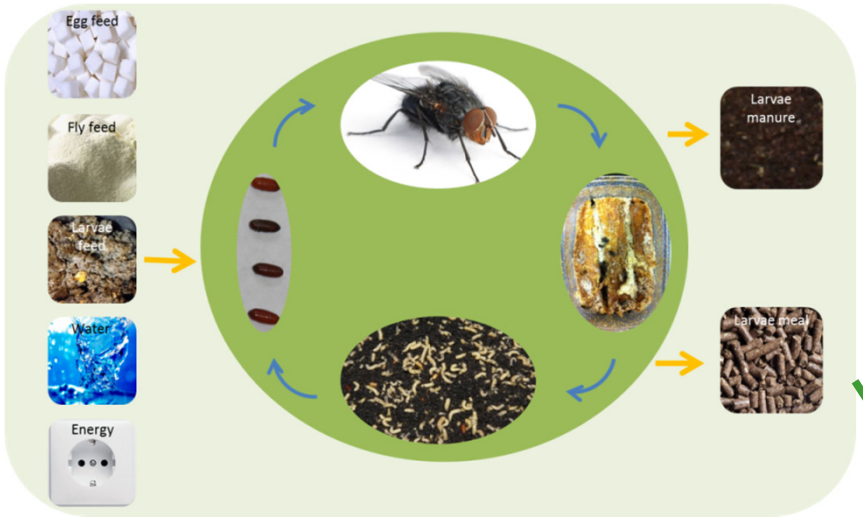


Method: life cycle assessment

Step 2: Indirect environmental impact



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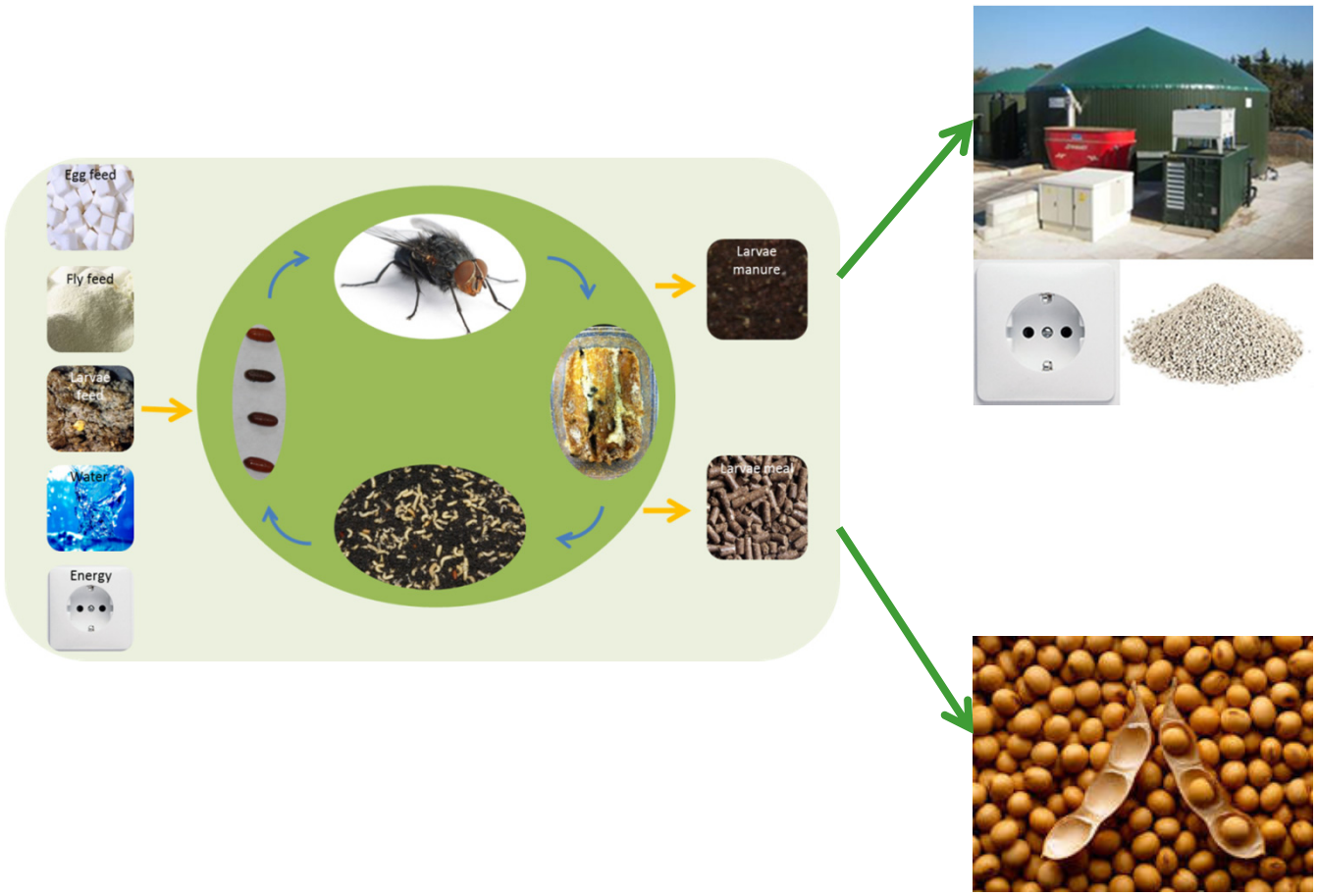

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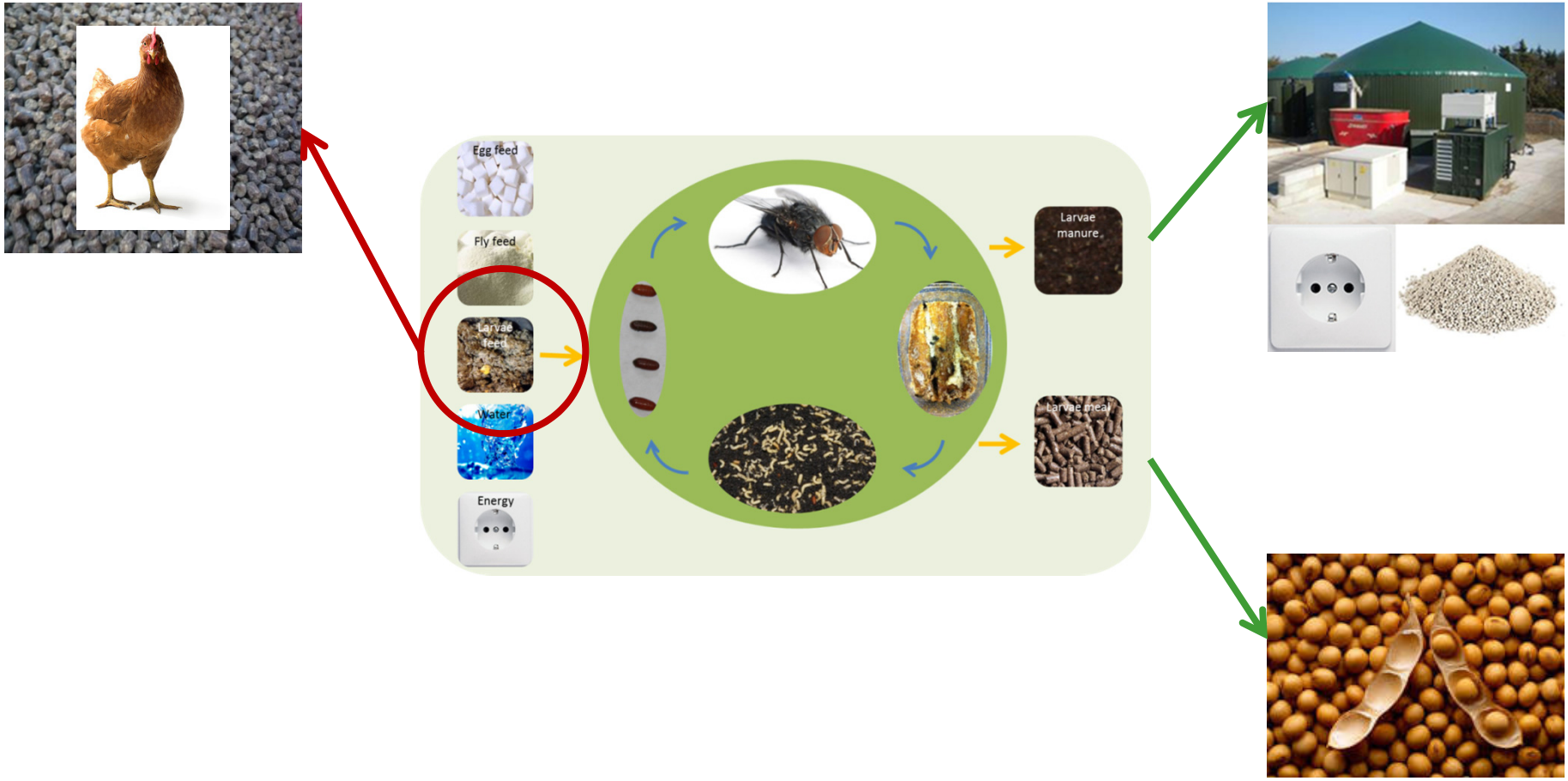

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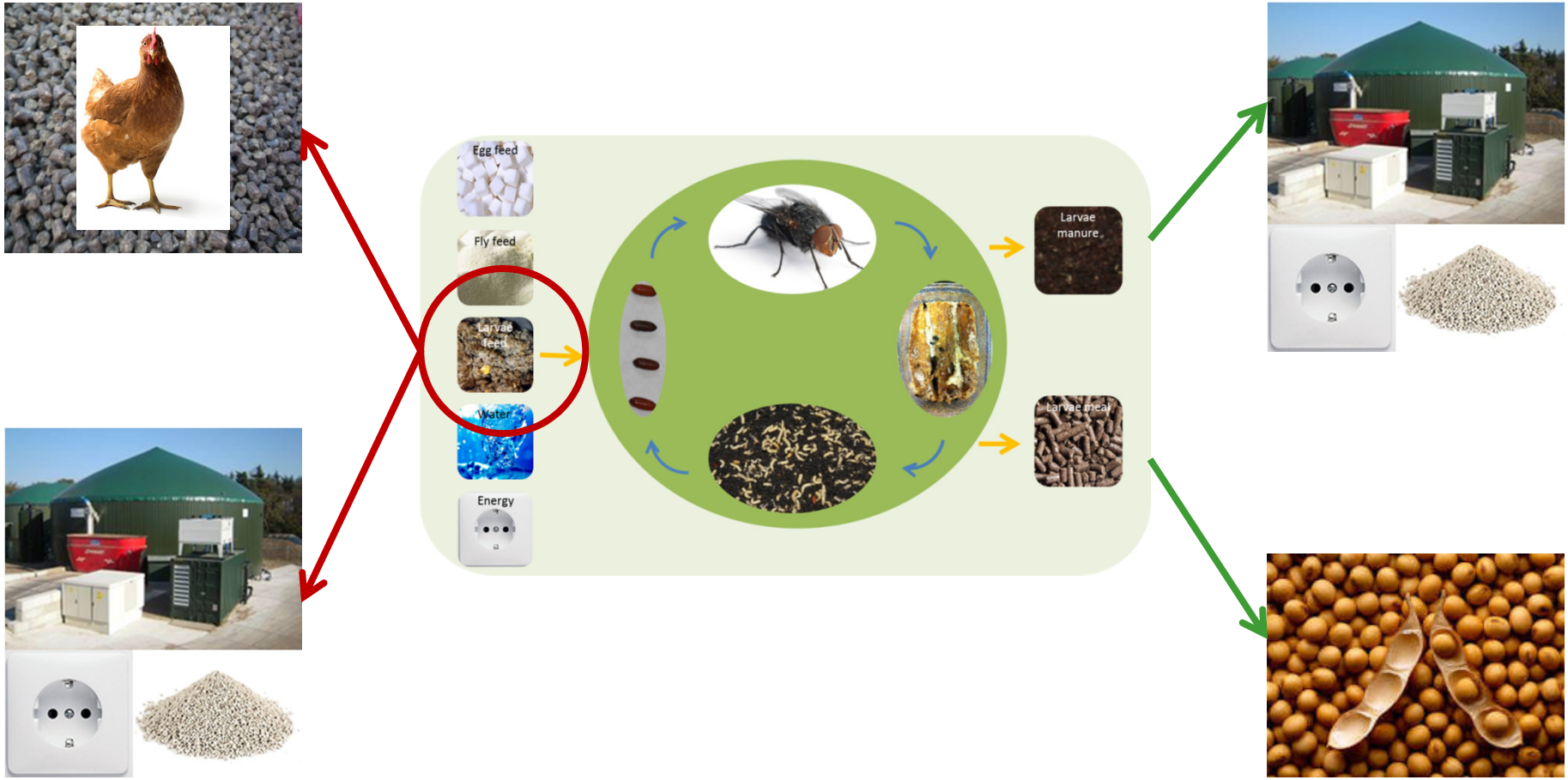
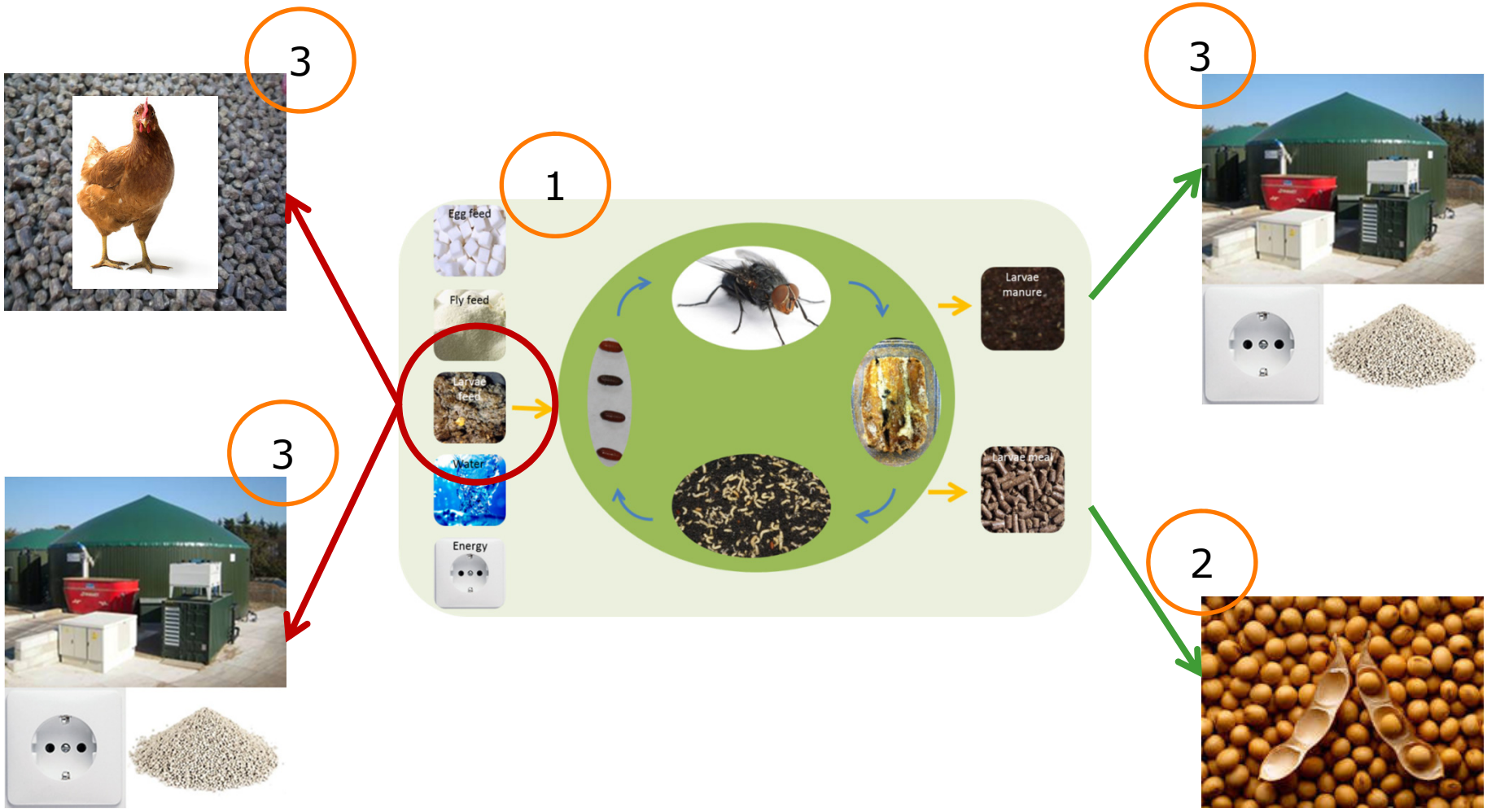


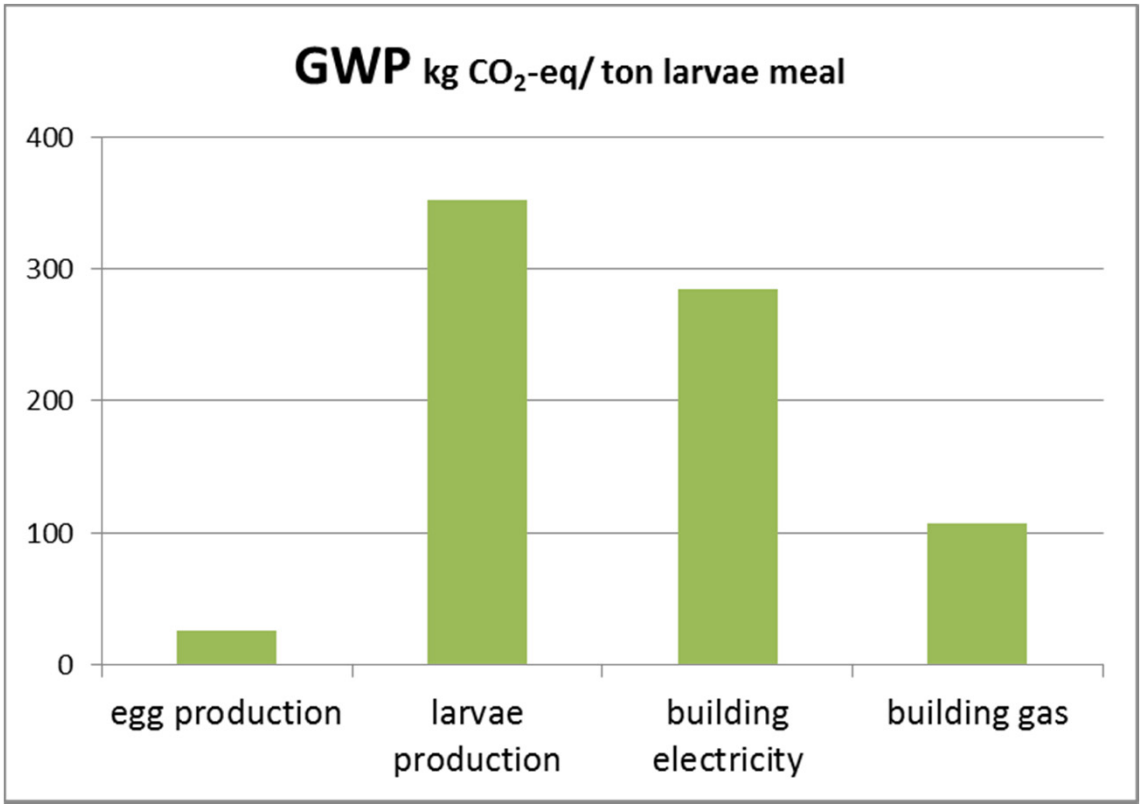
Results: life cycle assessment



Results 1: direct environmental impact of larvae meal

Larvae meal	average	unit dm/ton
GWP	770	kg CO_2eq/ton
EU	9329	MJ/ton
LU	32	m²/ton

Results 1: processes of larvae meal



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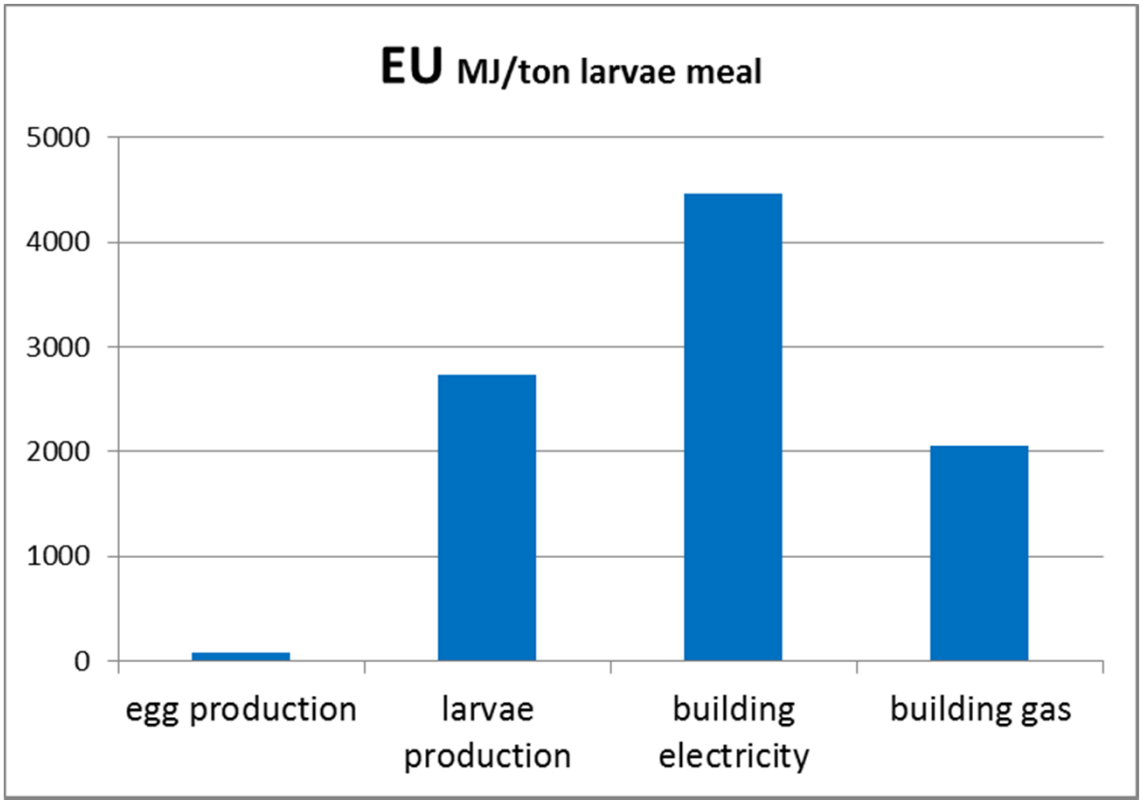

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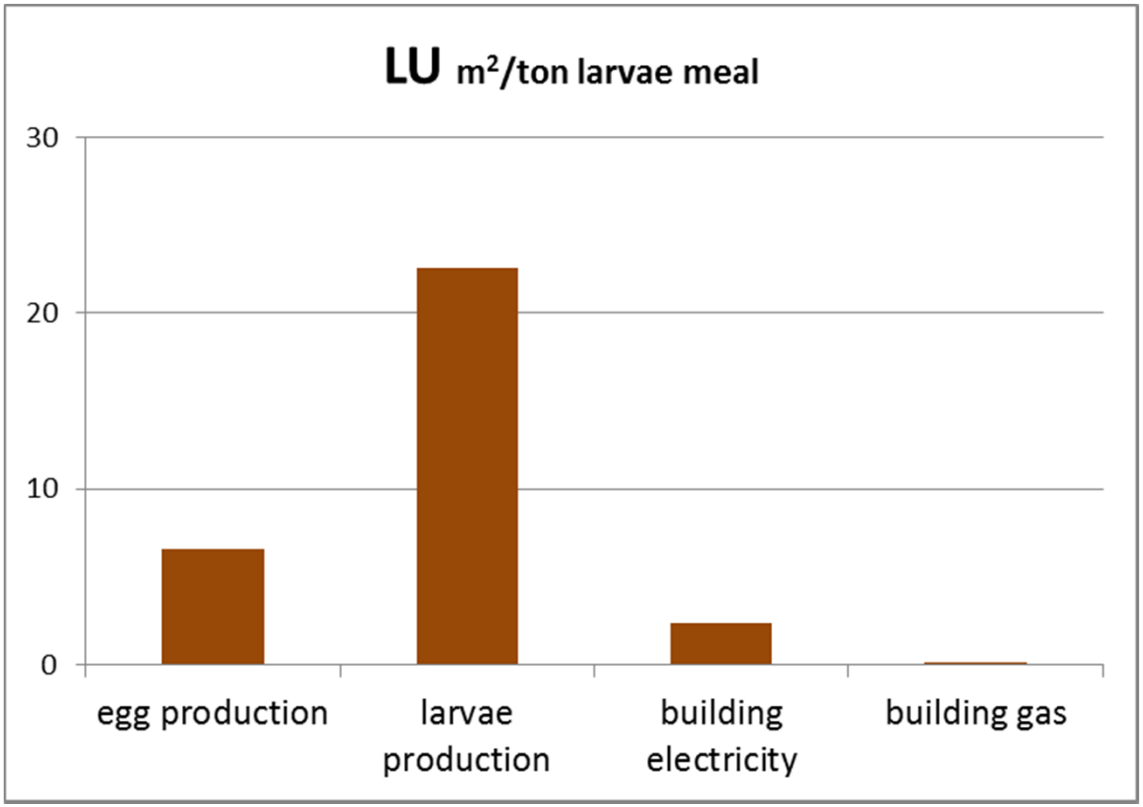
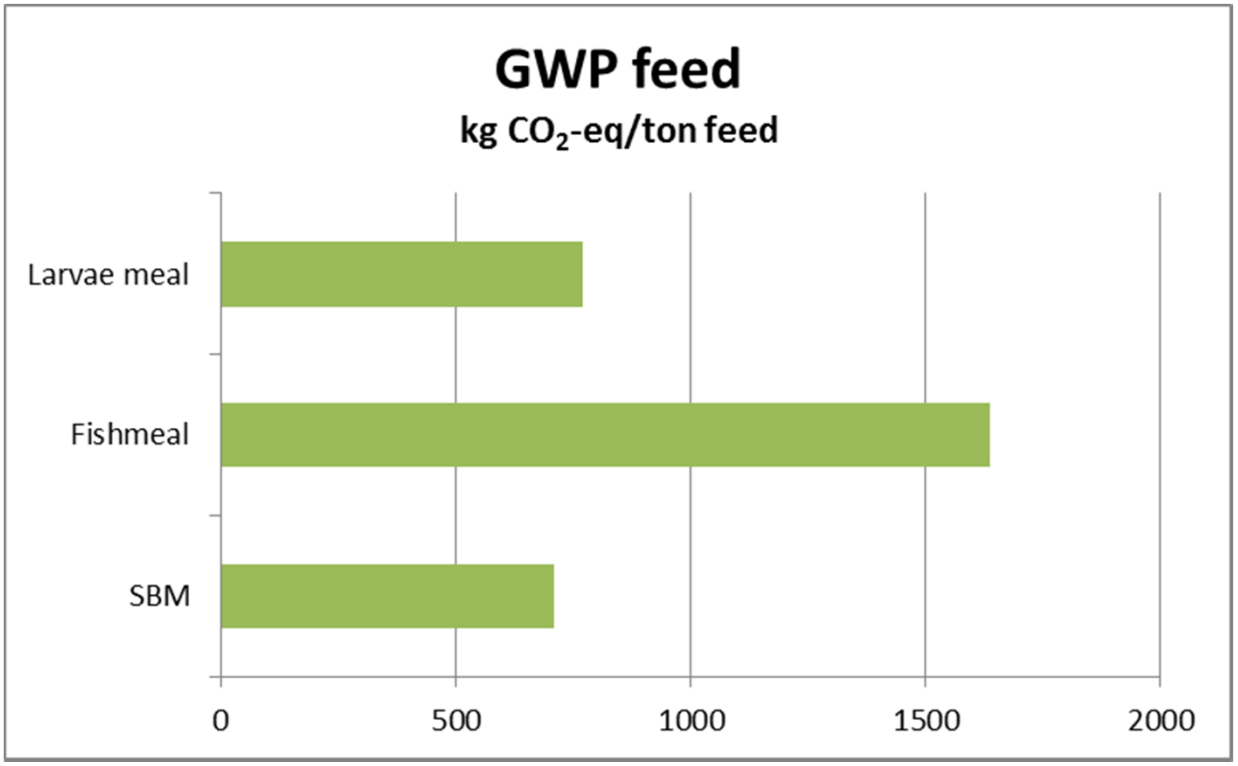


Results 2: comparison livestock feed



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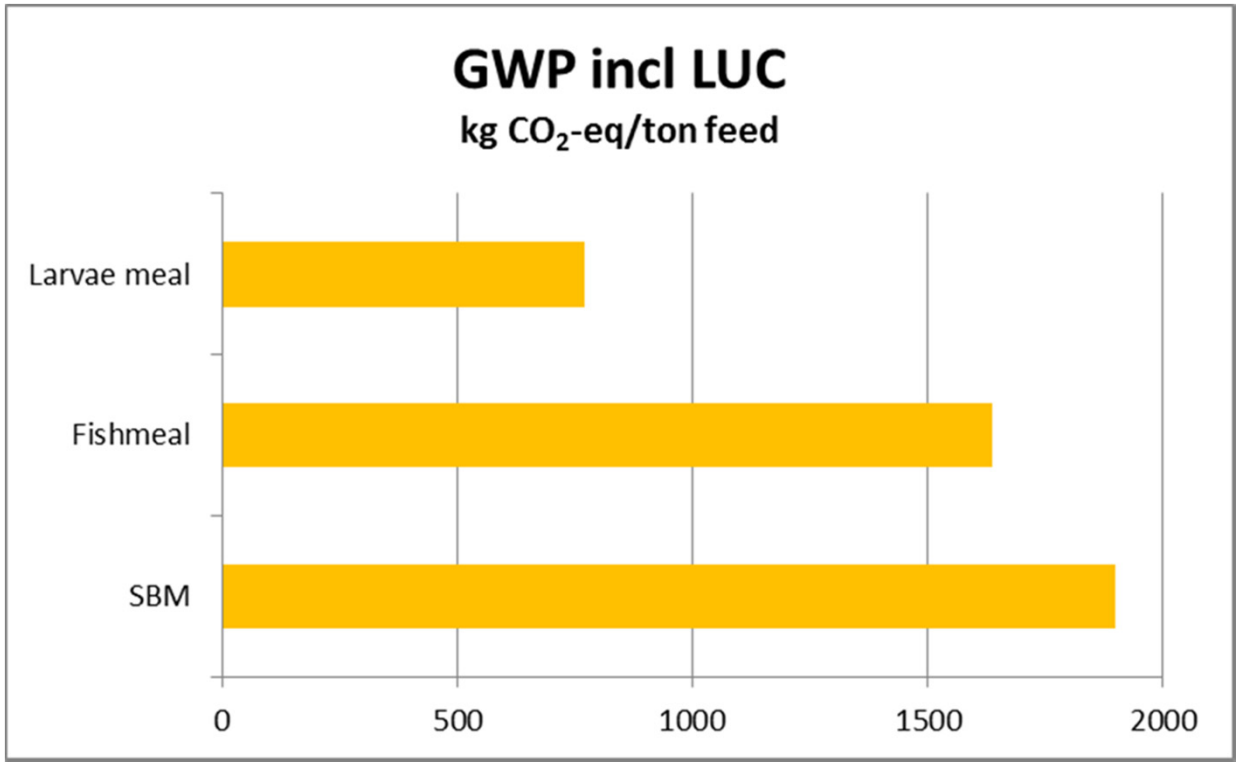

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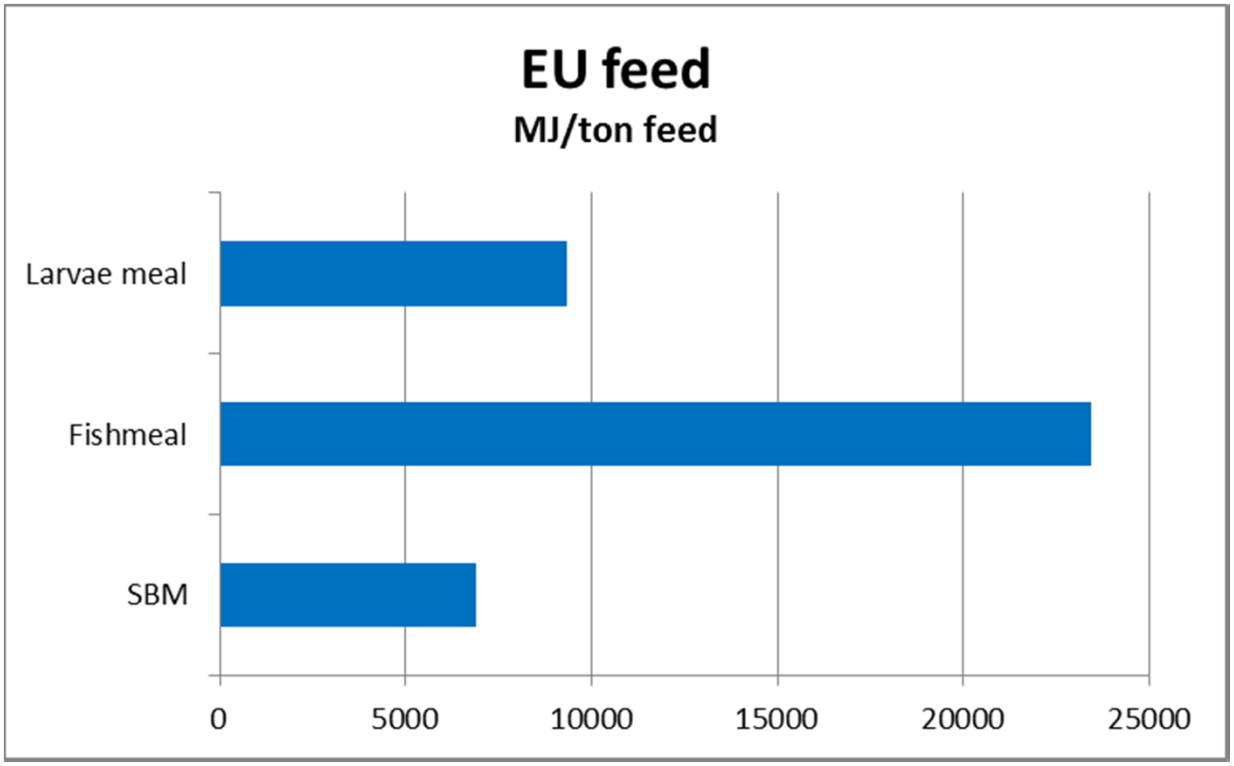

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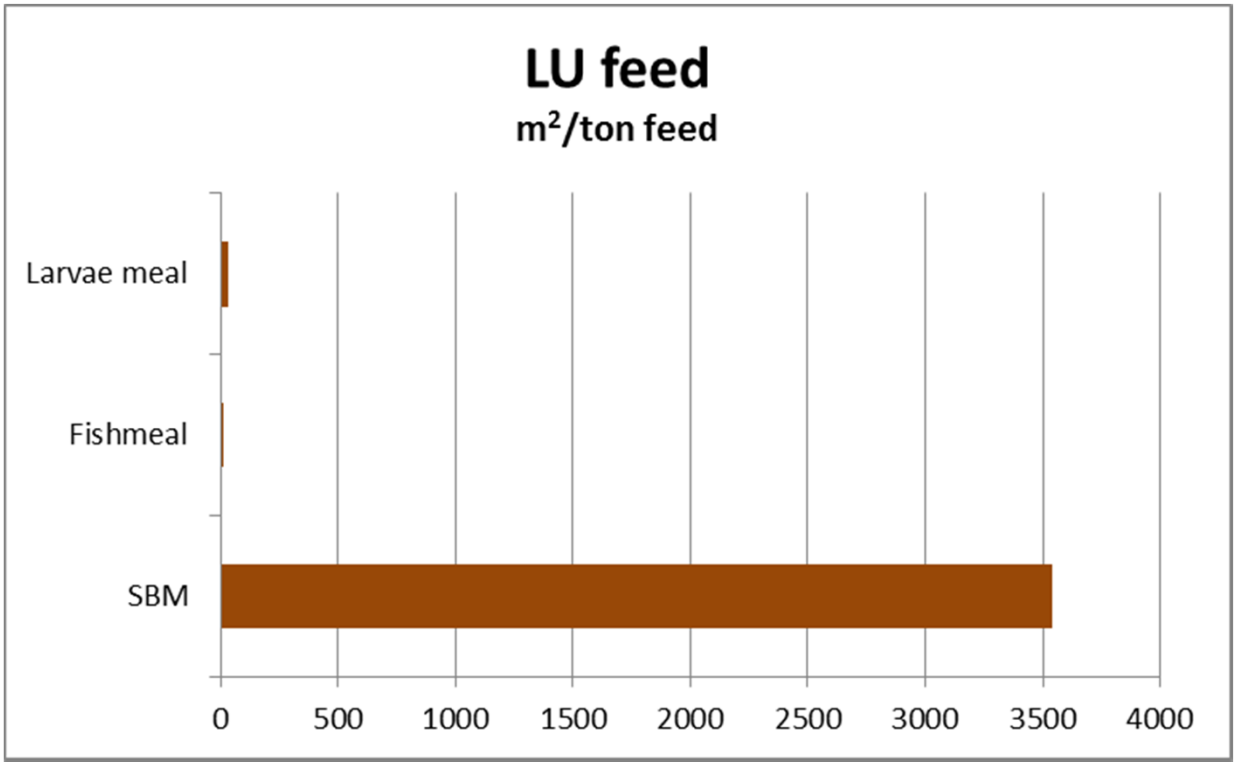
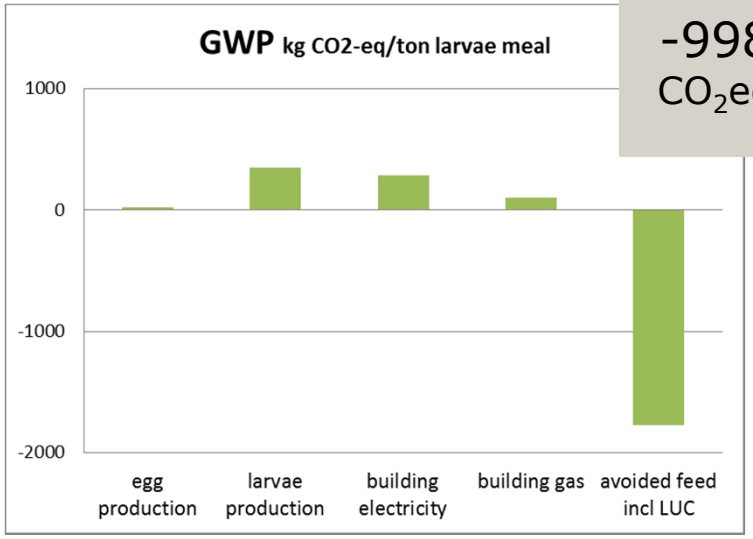
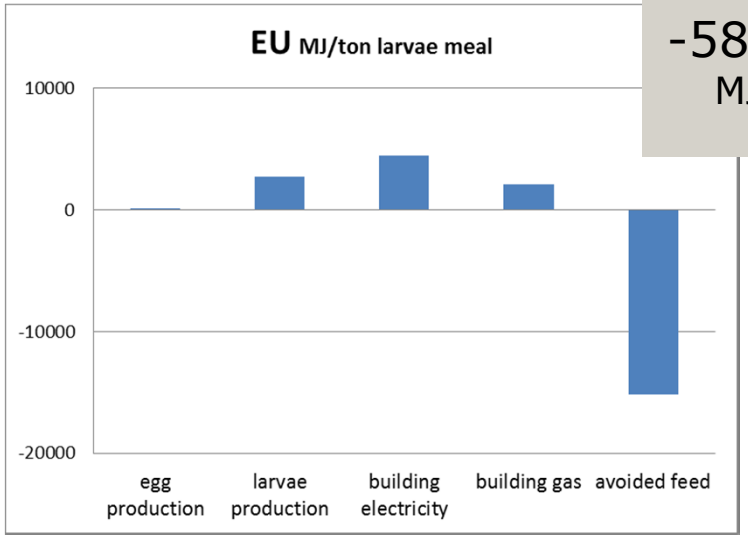


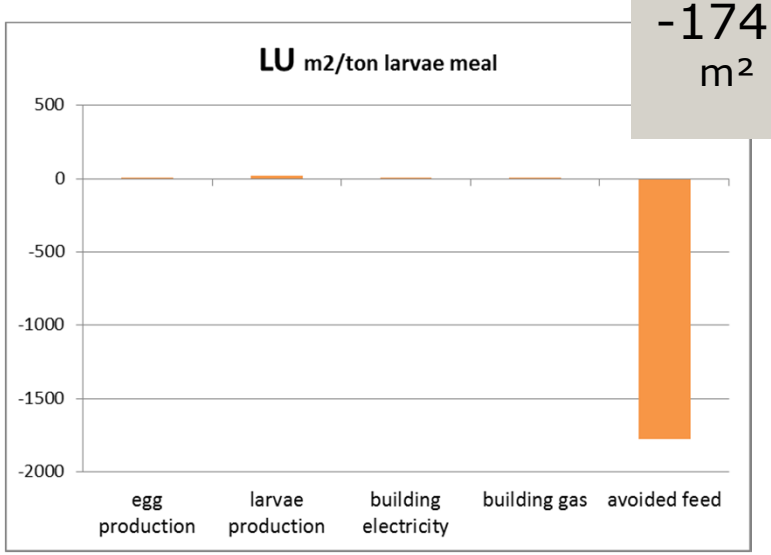
Results 2: inclusion avoided feed



-998
CO_2eq

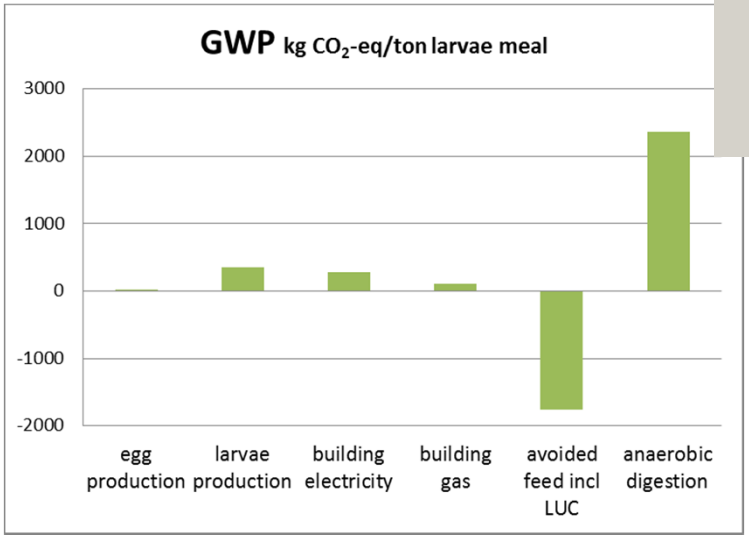


-5843
MJ

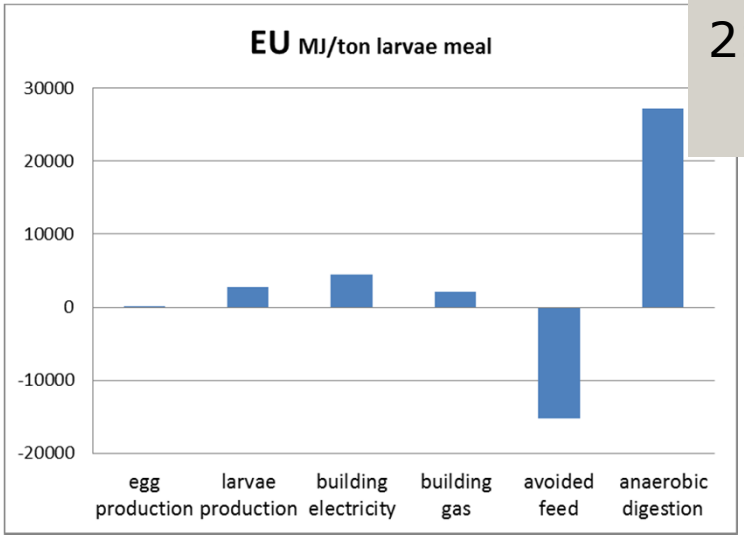


-1747
m²

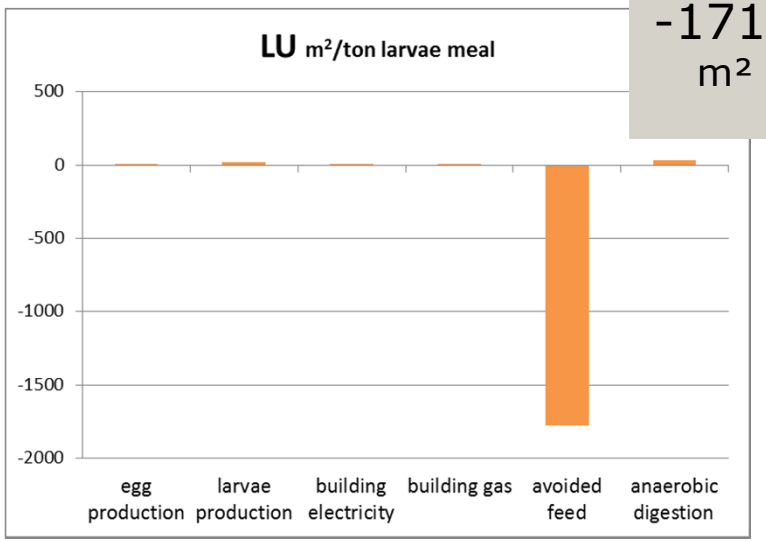
Results 2: total indirect



1364
CO_2eq



21342
MJ



-1713
m²

Conclusion

Can the environmental impact of livestock feed be reduced by using waste-fed housefly larvae?

- LU will decrease
- GWP and EU?
    - Current situation
    - Decrease energy use

Waste: anaerobic digestion or larvae meal?

- Land and fossil fuels scarce
    - Fossil fuel replaced by sustainable sources
    - No other solution scarcity of land

Thank your for your attention!

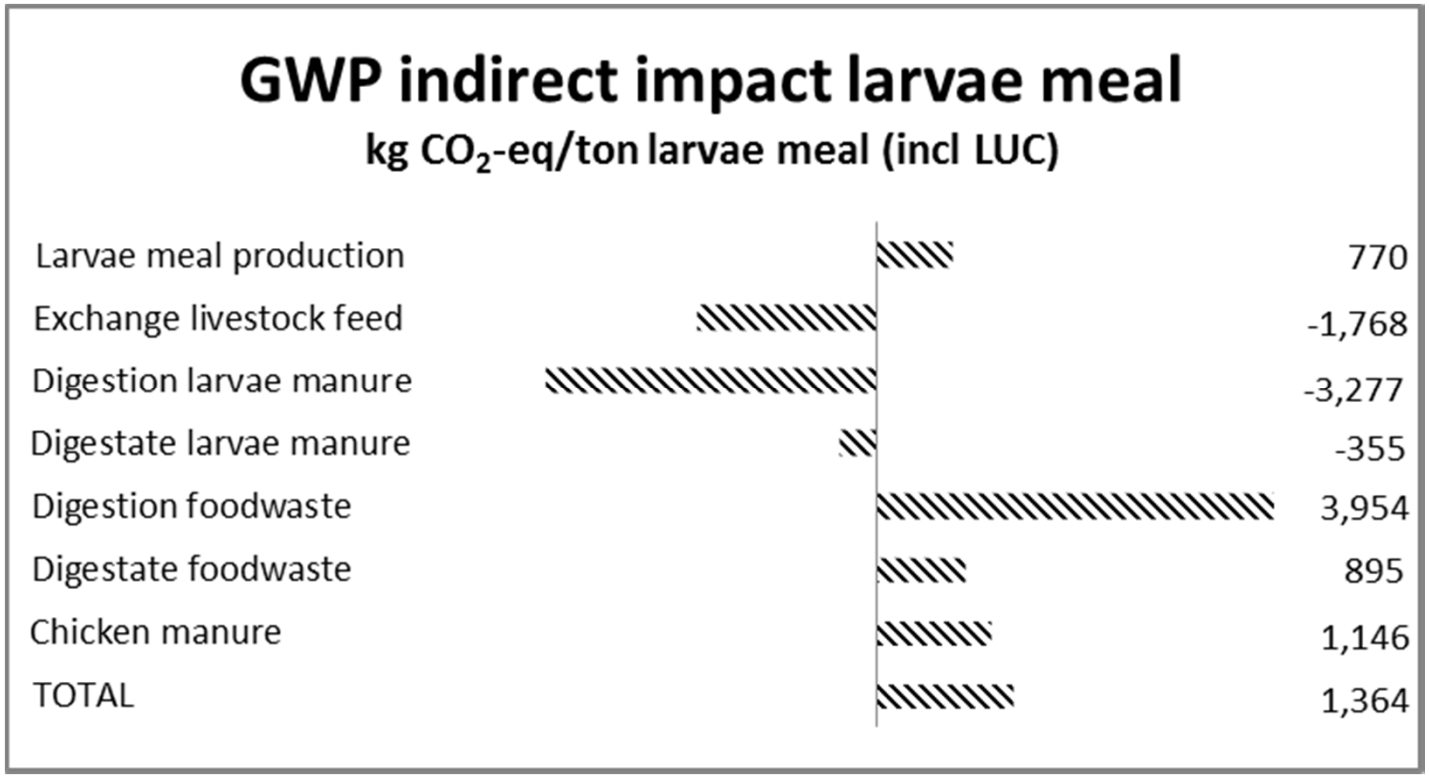
Sensitivity analysis (direct)

- GWP: energy use (gas and electricity use) and feed for larvae,
- EU: electricity use of larvae production, followed by gas use for the total building.
- LU: production of feed for the larvae

Sensitivity analysis (indirect)

- GWP and EU: changes in anaerobic digestion.
  - methane production potential influencing the amount of energy assumed to be produced by anaerobic digestion.
  - the electricity factor used for greenhouse gas emissions which was merely determined by the mixer of electricity sources (in this cased based on the Dutch situation).
- LU: production of SBM, and LU outcomes, therefore, were sensitive to changes in the relative replacement of SBM and fishmeal by larvae meal.

Anaerobic digestion and manure



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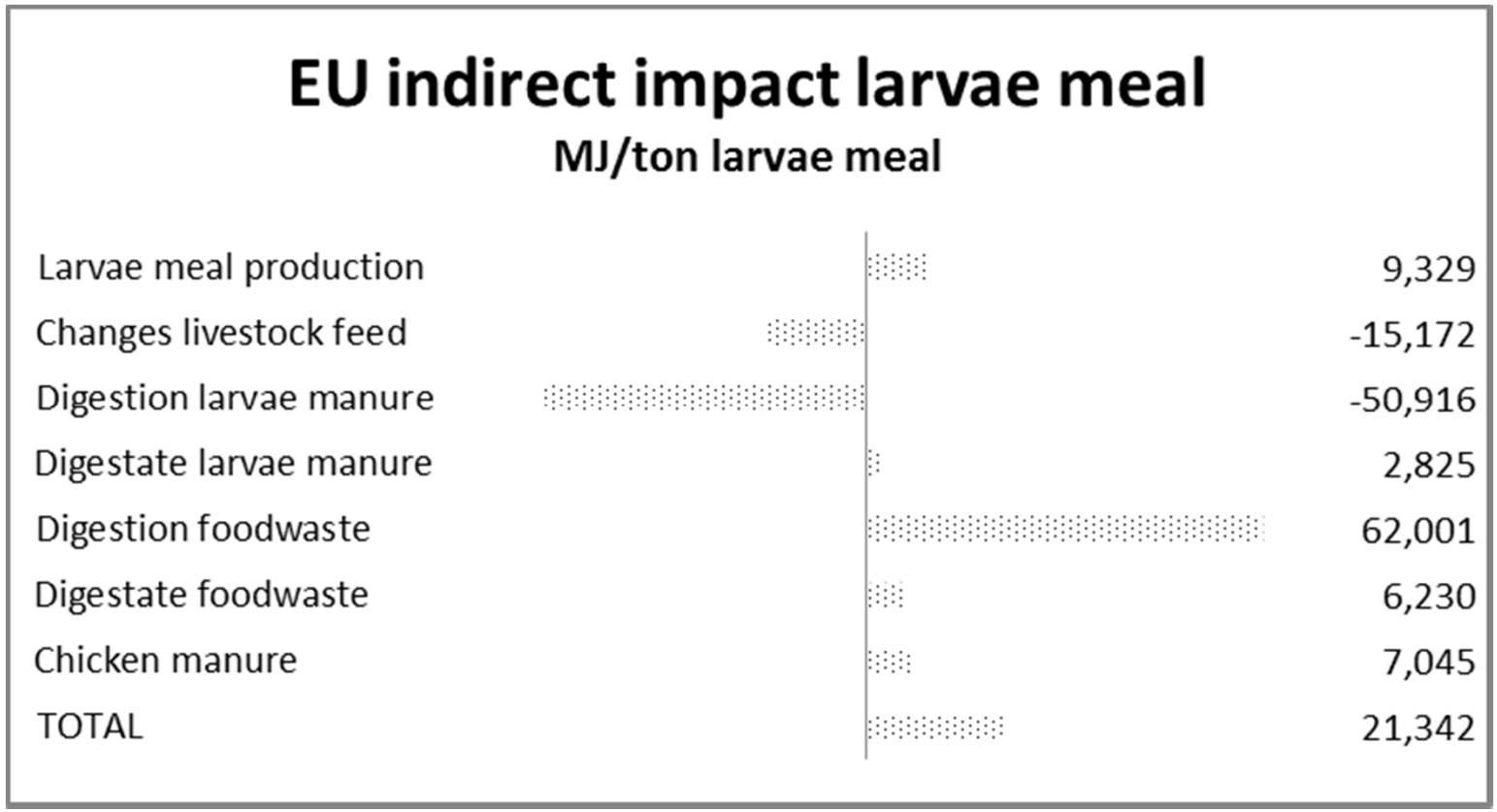

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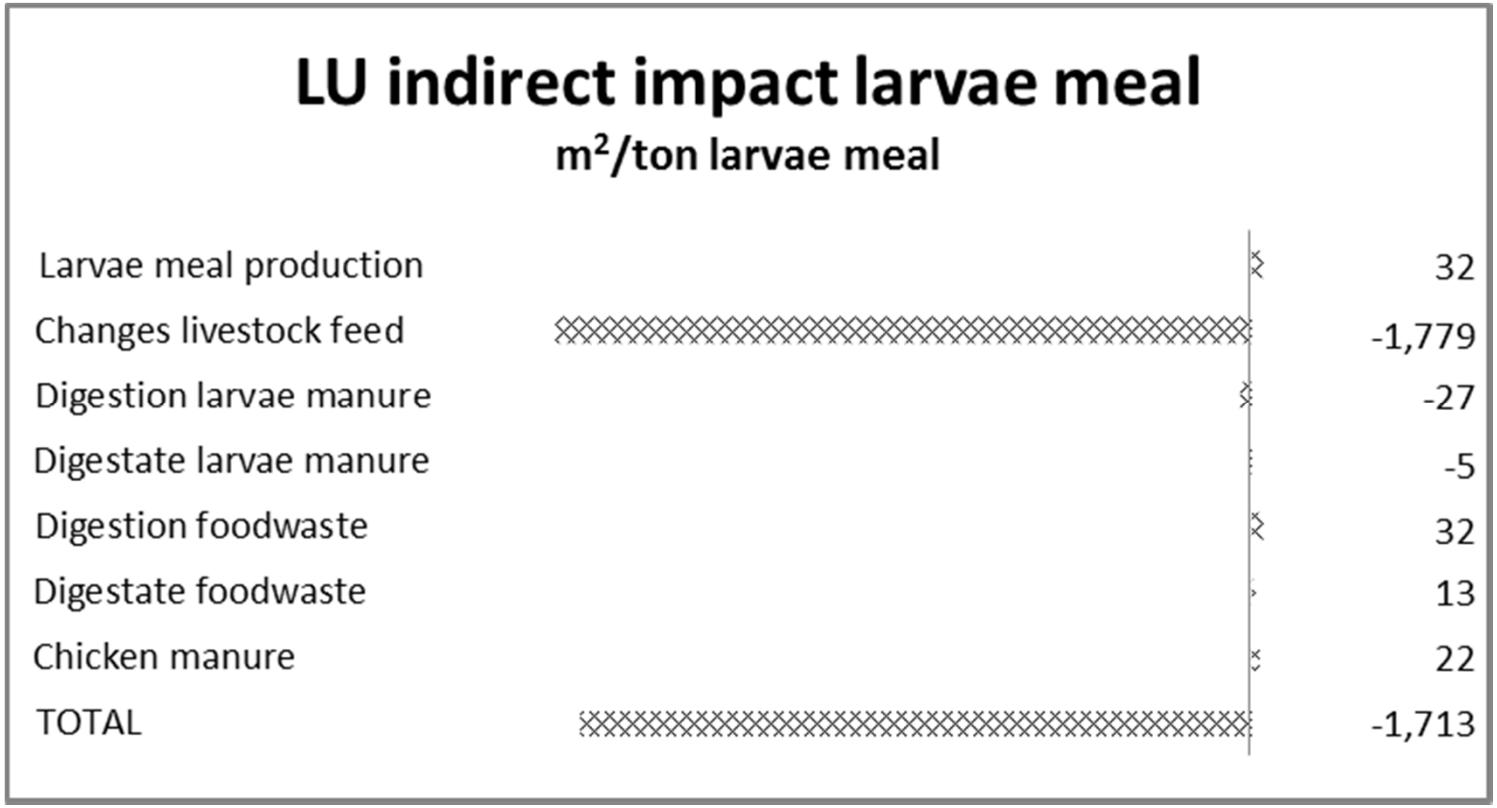

Nutrient content (%)

	Larvae meal	SBM	Fishmeal
Dry matter	88.0	92.7	87.5
Crude protein	47.9	56.7	46.0
Fat	24.2	15.8	18.4
Lysine	32.6	43.1	28.5
Methionine	11.3	15.9	6.4

- Pupae will eclose into flies within 2 days.
- Feed of the flies: sugar, milk powder and egg powder. Flies are kept at a temperature of 25 degrees Celsius. Female flies start to lay eggs after 7 days in an oviposition substrate: milk powder, yeast, fiber, vegetable oil and vitamins.,
- Larvae are kept at a temperature of 27 degrees Celsius and are full grown after 5 days.
- Per 4 kilograms of substrate, one kilogram of larvae is produced.
- Harvesting of the larvae is performed by shutting off the ventilation, which makes the larvae crawl to the surface of the substrate when oxygen levels drop.
- Per day 65 ton of live larvae are produced resulting in 20 ton of larvae meal.