

Environmental impacts of substituting soybean with rapeseed or haemoglobin meal in broiler diets



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Background

- Soybean meal commonly used in broiler diets as a protein source
- Soybean production (especially from rainforest regions) is known to result in high environmental impacts
- Sustainable development goals from the United Nations (2015) request a reduction of environmental impacts
- At present the production of more sustainable foods is one of the main topics in agriculture



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SUSTAINABLE DEVELOPMENT GOALS



www.sdg-portal.de/en

Background



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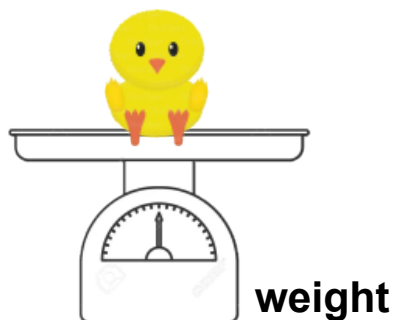
- Decreasing the usage of soybean meal in broiler diets can be realized by a partial substitution
- Alternative protein sources may be rapeseed meal and haemoglobin meal
- Alternative protein sources show a lower relative impact on the environment
- Performance of the broilers might change using an alternative protein source



Can a partial substitution of soybean meal in the diet reduce the environmental impact of broiler production?

Materials and methods

- 120 day-old broilers (Ross 708)
- divided into 3 treatment groups at day 8
- Protein source:
 - Soybean meal (SBM) only (origin: Brasil)
 - SBM and rapeseed meal (RSM)
 - SBM and haemoglobin meal (HBM)
- Performance parameters measure weekly until day 44



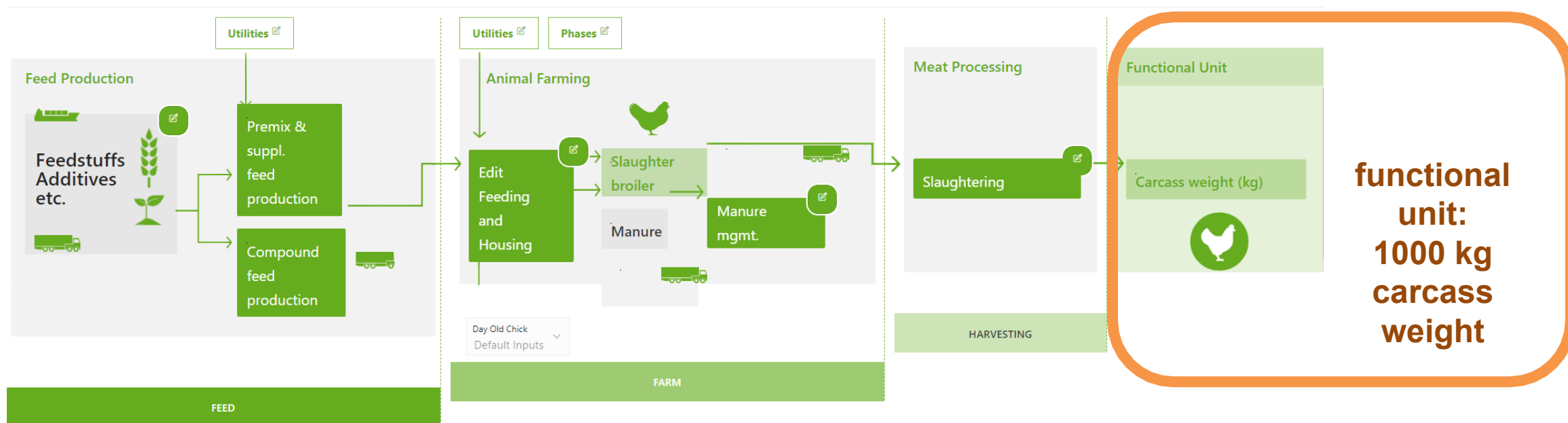
→ **feed conversion rate**

| Ingredient (incomplete; %)* | SBM only | SBM + RSM | SBM + HBM |
|-----------------------------|----------|-----------|-----------|
| Wheat | 48.9 | 40.5 | 34.6 |
| Maize | 9.0 | 12.5 | 28.4 |
| SBM | 32.5 | 22.9 | 22.5 |
| RSM | - | 14.5 | - |
| HBM | - | - | 4.5 |

* Further ingredients: Oil, CaCO₃, Dicalcium phosphate, Sodium chloride, Lysine, Methionine, Threonine, Trace elements supplement, vitamin supplement

Materials and methods

- Life cycle assessment (**LCA**) using the software application „Opteinics“ (according to **ISO 14040 / 14044**)
- All feed data are from the database of the Global Feed LCA Institute (**GFLI**) according to **FAO and LEAP** guidelines



Materials and methods

Output of Opteinics, 10 impact categories:

- Climate change (kg CO₂ eq.)
- Ozone depletion (kg CFC-11 eq.)
- Acidification (mol H⁺ eq.)
- Eutrophication, terrestrial (mol N eq.)
- Eutrophication, marine (kg N eq.)
- Eutrophication, freshwater (kg P eq.)
- Particulate matter (disease incidences)
- Water use (m³ water eq. deprived)
- Resource use, fossils (MJ)
- Land use (soil quality index)






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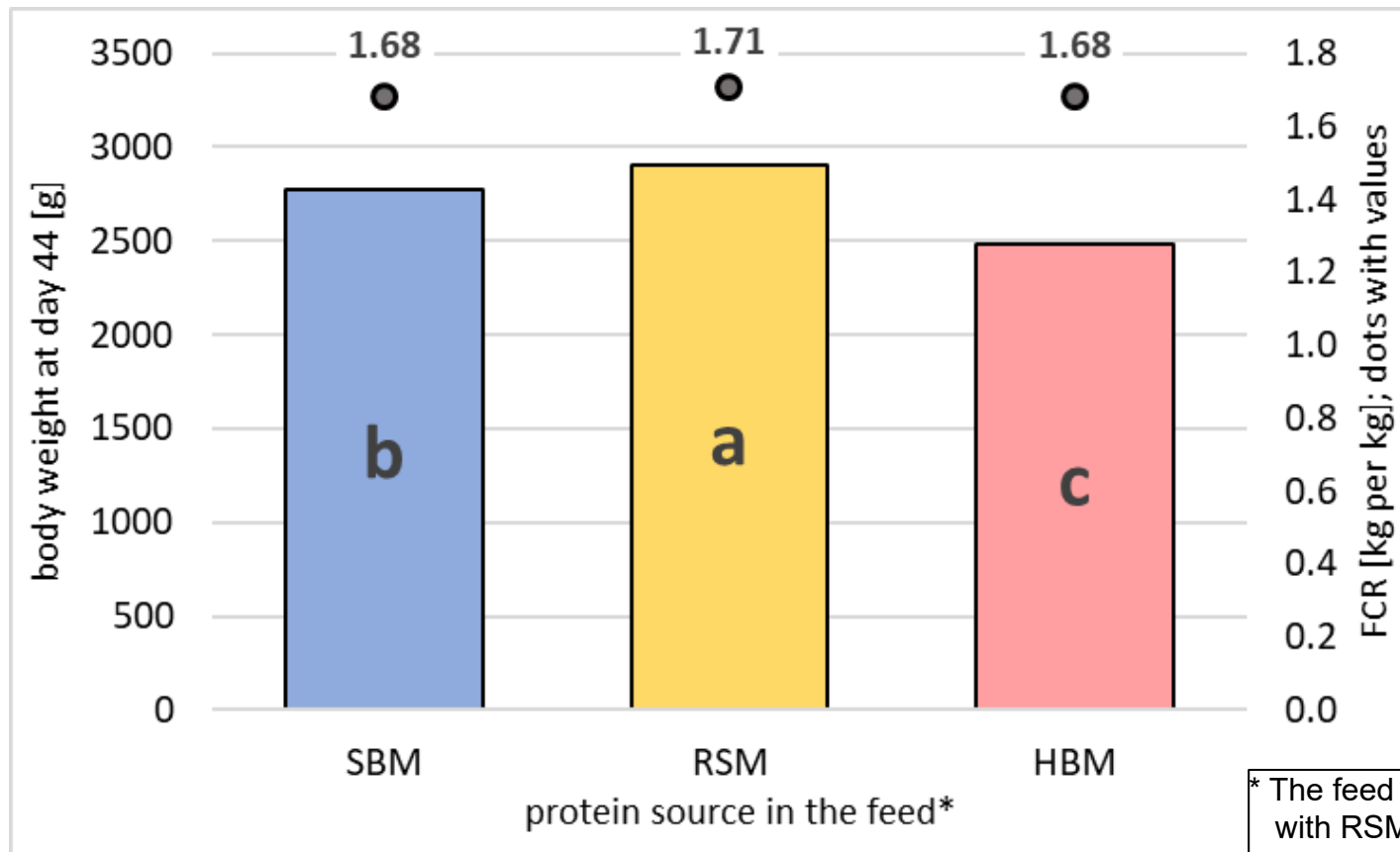
Results

Environmental impact of the feed (per 1000 kg feed; selection)

| | SBM  | RSM  | HBM  |
|-----------------------------------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Climate change <i>... compared to SBM</i> | 1875 kg CO ₂ eq | 1499 kg CO ₂ eq - 20 % | 1488 kg CO ₂ eq - 21 % |
| Acidification <i>... compared to SBM</i> | 9.6 mol H ⁺ eq | 9.7 mol H ⁺ eq + 1 % | 9.3 mol H ⁺ eq - 3 % |
| Ozone depletion <i>... compared to SBM</i> | 29 mg CFC-11 eq | 31 mg CFC-11 eq + 5 % | 32 mg CFC-11 eq + 11 % |

Results

Body weight and feed conversion ratio

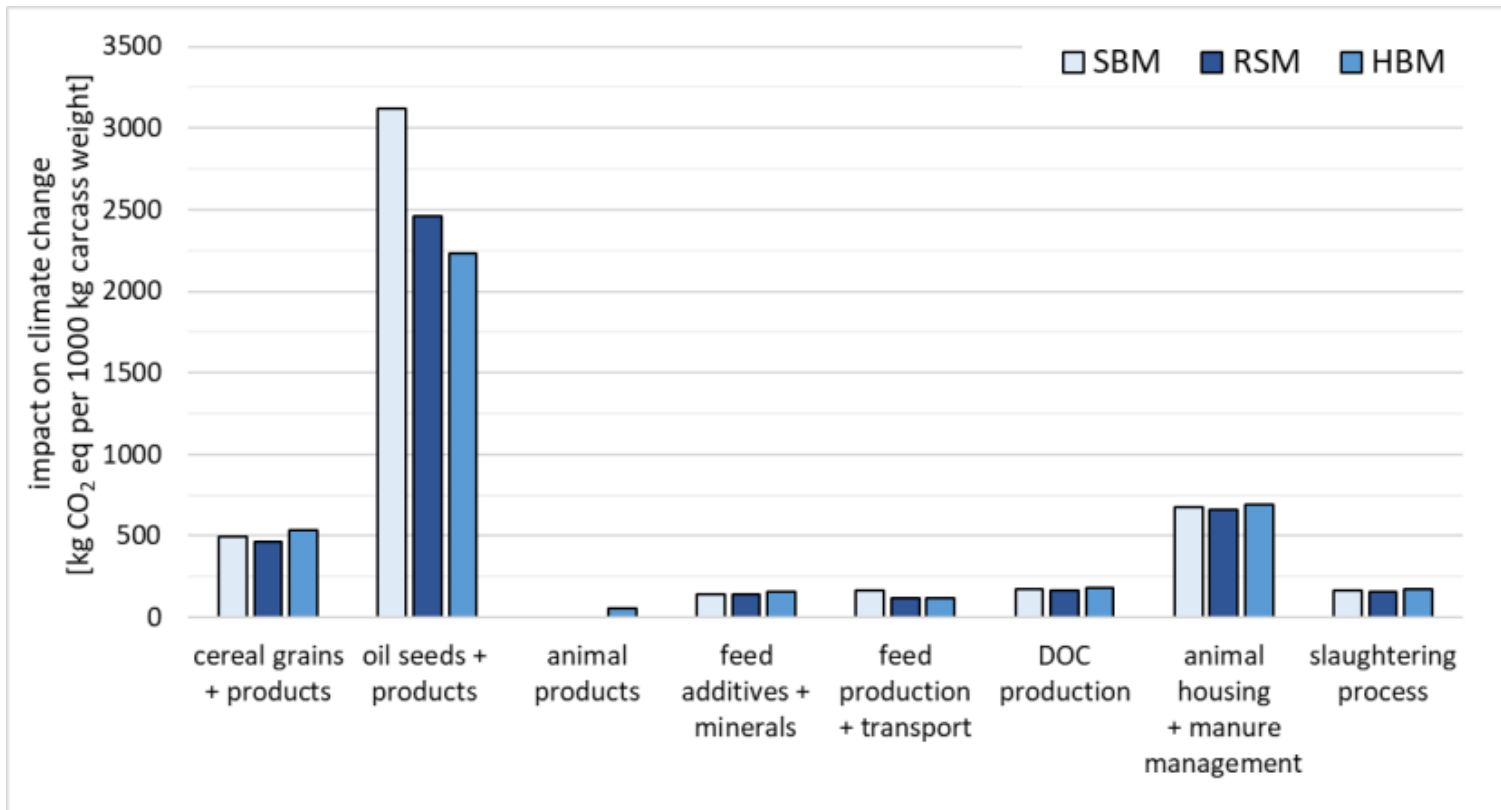


* The feed in the group with RSM and HBM also contains SBM

- **Highest** bodyweight in the group with **RSM**
- **Lowest** bodyweight in the groups with **HBM**
- **FCR** around **1.7** for all groups (*day 8 to 44*)

Results

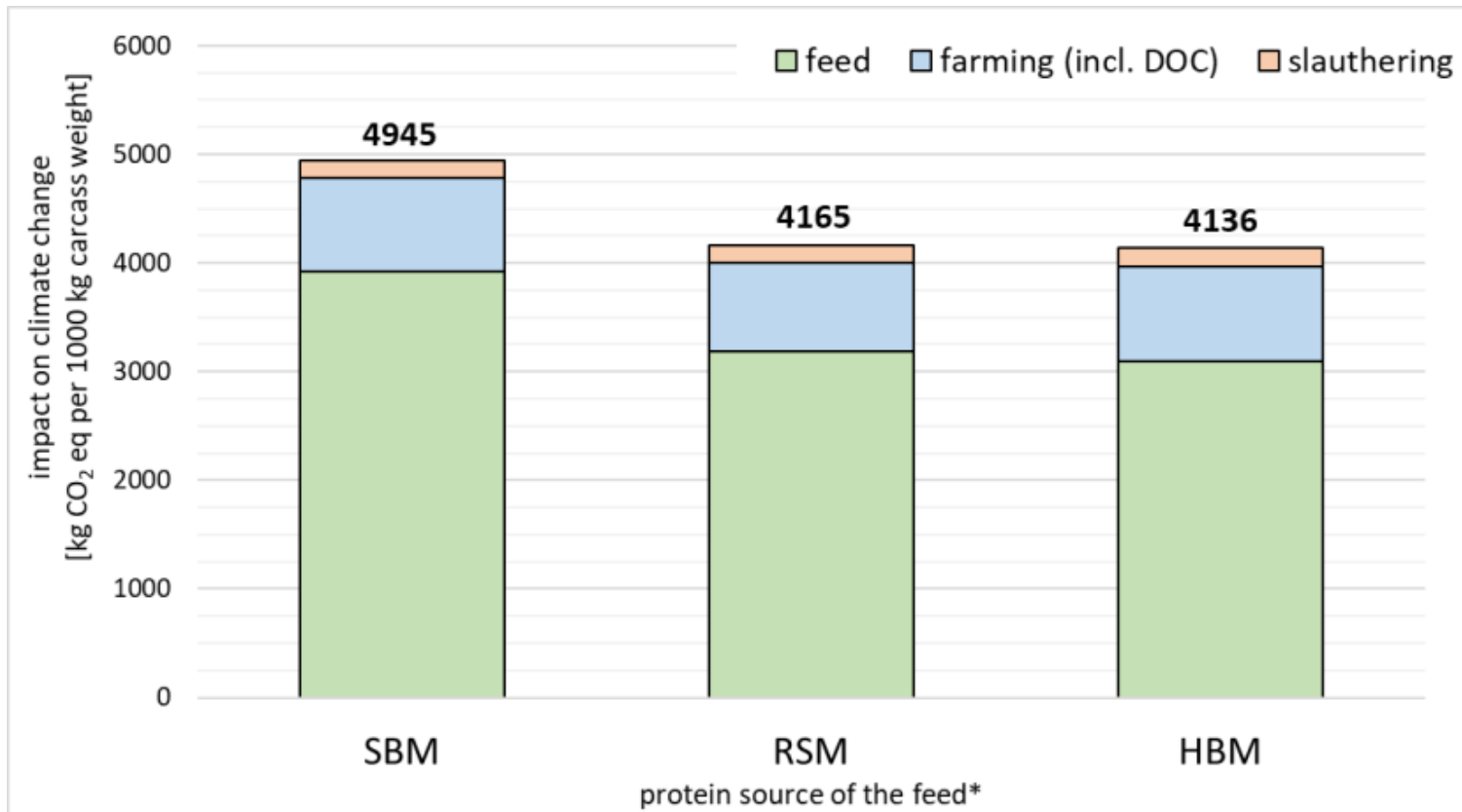
Climate change



- **Highest** impact from **oil seeds + products** in all groups
- Impact from **oil seeds + products** shows **reduction** for group with **RSM** or **HBM**
- Impact from the **other categories** on a **similar level**

Results

Climate change



* The feed in the group with RSM and HBM also contains SBM

- **More than 70%** from the carbon footprint related to **feed**
- **Slaughtering process** lowest contributor (about **3-4%**)
- Carbon footprint from groups with **RSM or HBM lower** than for the group with SBM only
- **Important:** as day 1-7 is missing in this trial these values are **not representative for broiler meat in general**

Other impact categories

| | unit | SBM | RSM | HBM |
|-----------------------------|-----------------------------------|-----|-----|-----|
| Acidification | mol H+ eq | - | ○ | + |
| Eutrophication, marine | kg N eq | + | ○ | - |
| Eutrophication, freshwater | kg P eq | - | + | ○ |
| Eutrophication, terrestrial | mol N eq | - | ○ | + |
| Land use | soil quality index points | + | ○ | - |
| Ozone depletion | kg CFC-11 eq | - | ○ | + |
| Particulate matter | disease incidences | + | - | ○ |
| Resource use. fossils | MJ | + | - | ○ |
| Water use | m ³ water eq. deprived | ○ | - | + |

- **Highest impact** from **SBM** group in: Eutrophication (marine), land use, particulate matter and resource use
- **Highest impact** from **RSM or HBM** in acidification, eutrophication (freshwater and terrestrial), ozone depletion and water use
- **Lowest impact** 4x from SBM, 3x from RSM and 2x from HBM

Conclusions

- Feed ingredients highest contributor to carbon footprint
- A partial substitution of SBM by RSM or HBM in the feed of broiler may result in a lower carbon footprint of the production
- ... but can lead to higher values in different impact categories

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