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To have your cake and eat it: can we enhance the environmental impact of poultry systems whilst improving welfare?

Ilias Kyriazakis

Thursday 14 March 2024

Context: Current trends in poultry production

- Poultry systems are considered as one of the least impacting livestock systems in terms of C footprint
  - ➢ This has been achieved through efficient use of resources, including using birds that convert feed very efficiently, and their management

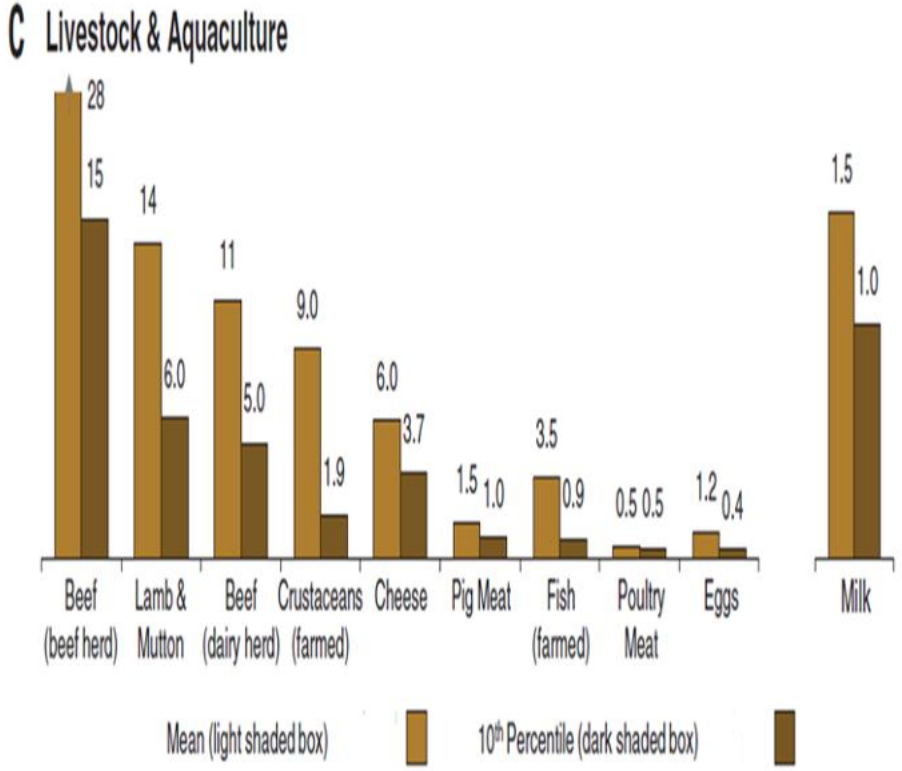
Environmental impact of poultry systems

- Broiler and layer production systems have the **lowest Carbon footprint** (**Global Warming Potential**) amongst livestock systems

- However, they contribute **significantly** to other environmental impacts, such as **eutrophication** and **acidification**, through e.g., N (NH_3) and P emissions

- A special case arises from emissions associated with Land Use and Land Use Change (deforestation)

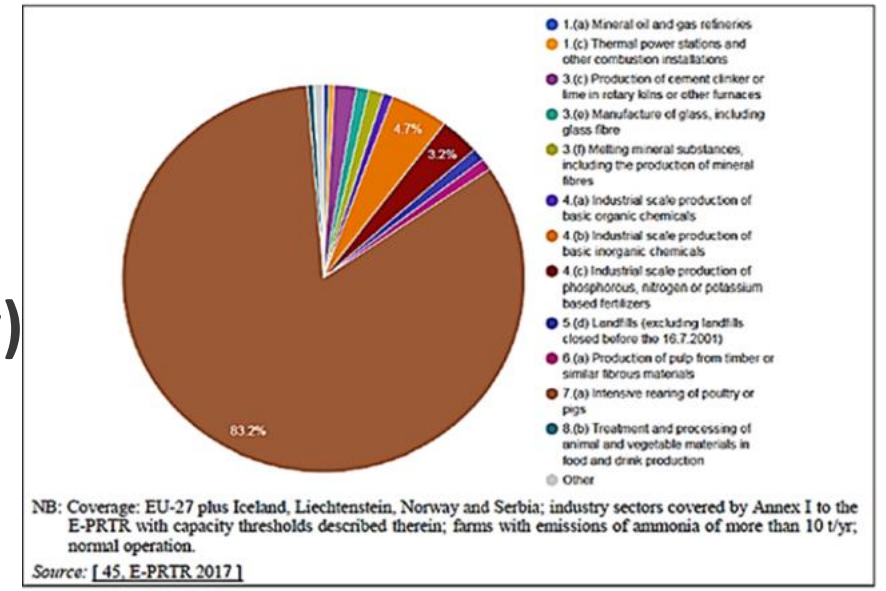
- When considering the environmental impact of poultry systems, **an all-encompassing approach is needed**



Impacts beyond Greenhouse Gases also important

Other environmental impact categories commonly considered in agricultural LCA:

- **Eutrophication Potential** (PO_4 eq)
- **Acidification Potential** (SO_2 eq)
- **Non-Renewable Energy Use** (MJ Primary Energy)
- **Agricultural land use** (m^2)
- **Water use** (m^3)

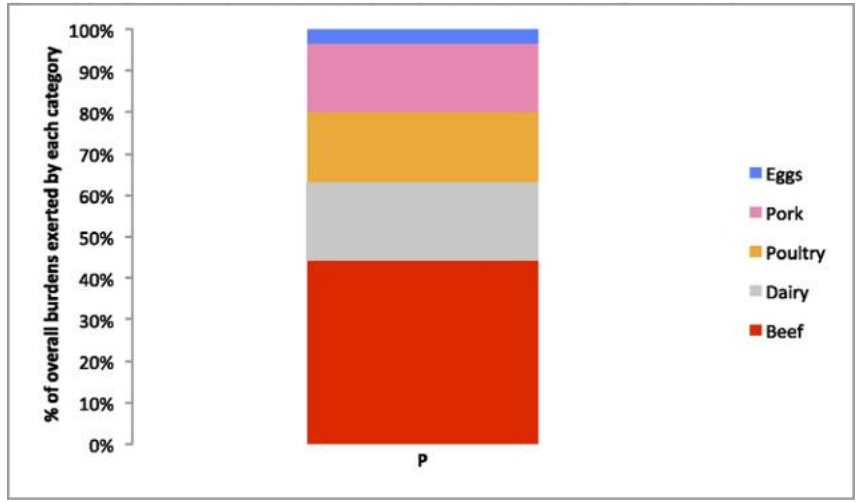


NB: Coverage: EU-27 plus Iceland, Liechtenstein, Norway and Serbia; industry sectors covered by Annex I to the E-PRTR with capacity thresholds described therein; farms with emissions of ammonia of more than 10 t/yr; normal operation.

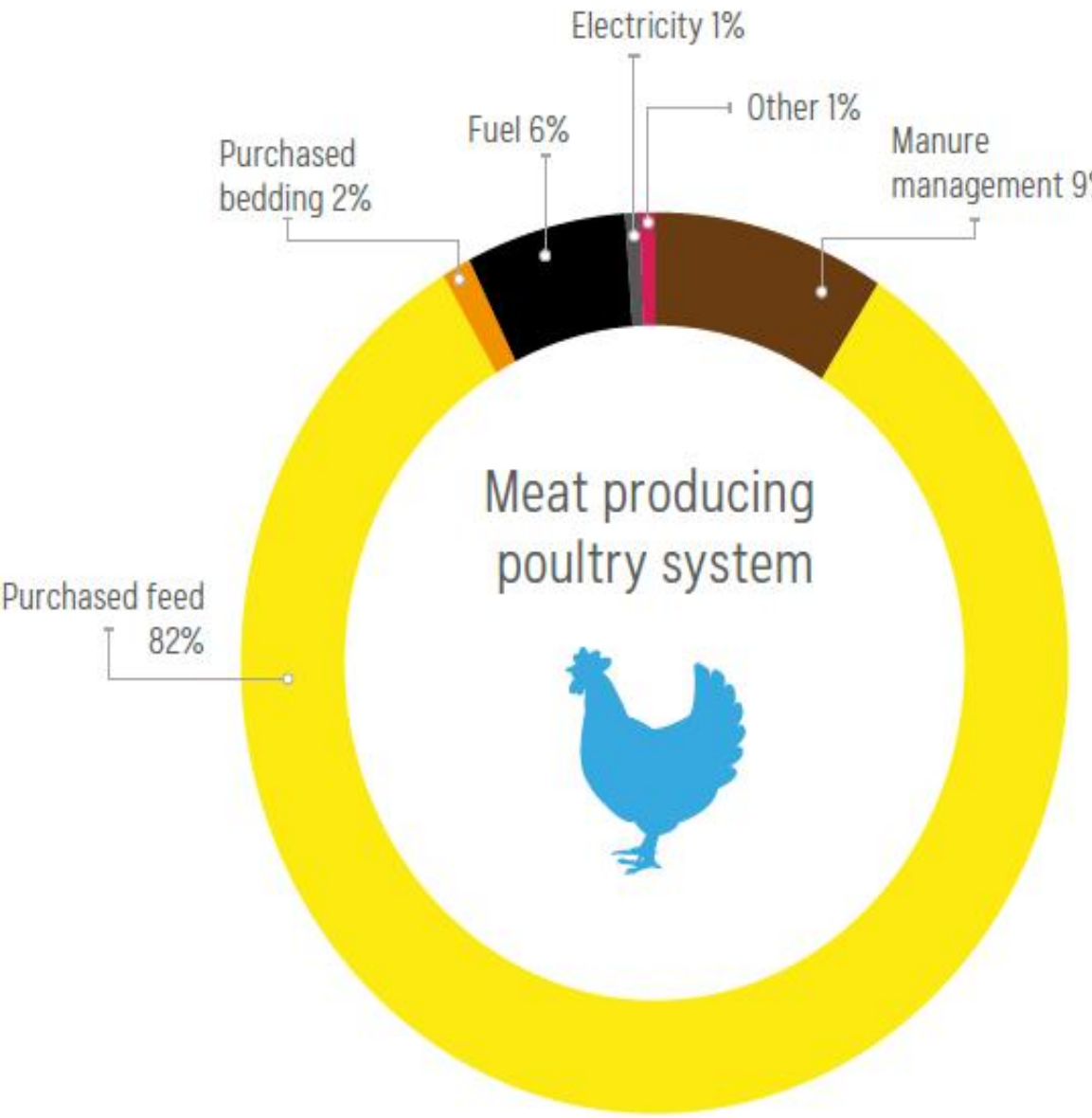
Source: [45, E-PRTR 2017]

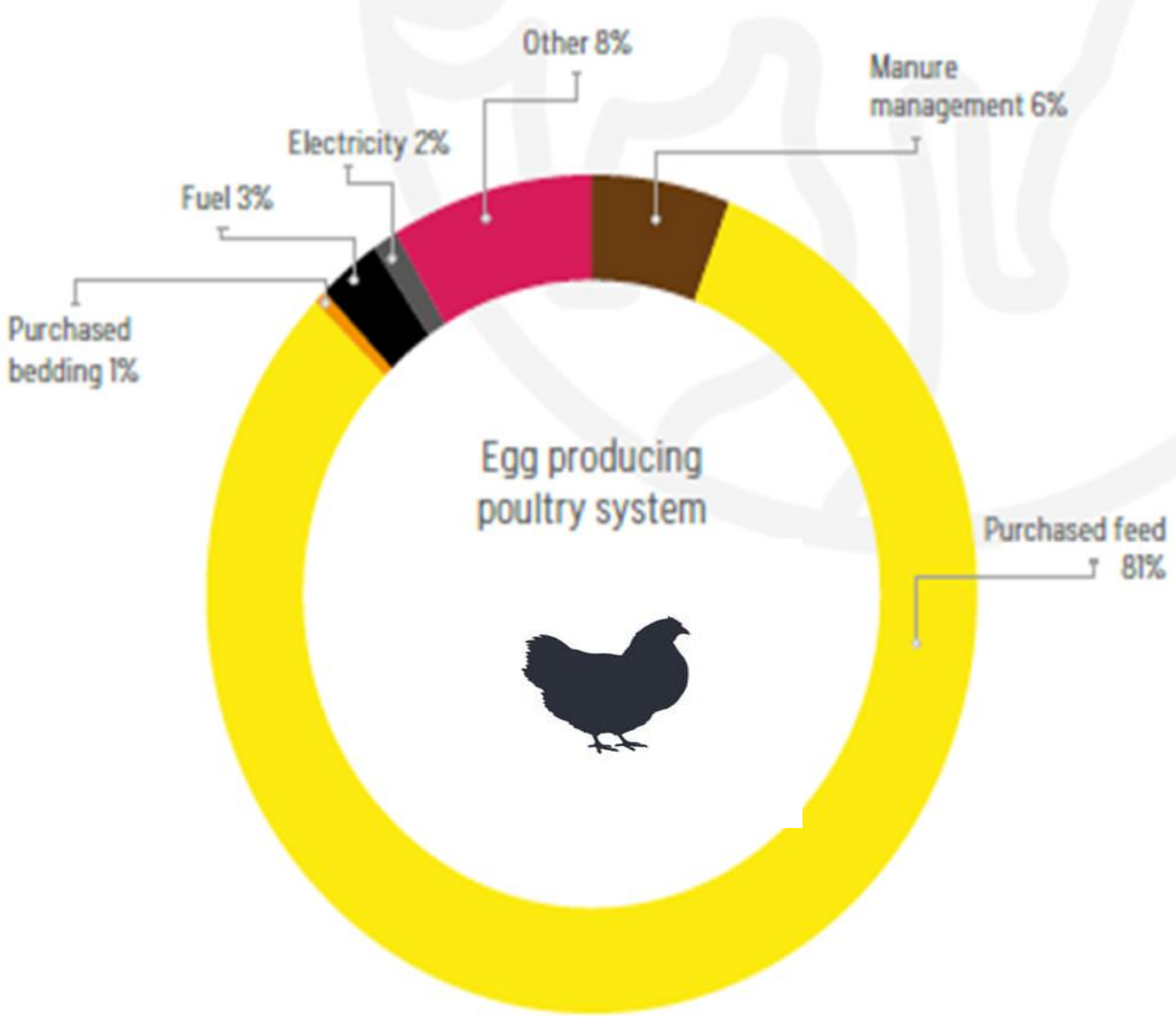
- N_2O produced from poultry manure via NH_3 has **265x** the GWP of CO_2

- CH_4 has **28x** the GWP of CO_2



Contribution of activities to the overall C footprint (kg CO_2eq/kg) of a broiler and a layer farm





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  - ➢ EFSA reviewed **the most relevant poultry husbandry systems in Europe** and identified the relevant welfare consequences for each system and hazards that can have welfare implications
  - ➢ Recommended measures to prevent or correct the hazards and/or mitigate the welfare consequences

SCIENTIFIC OPINION

efsa JOURNAL

ADOPTED: 14 December 2022

doi: 10.2903/j.efsa.2023.7788

Welfare of broilers on farm

EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare),
Søren Saxmose Nielsen, Julio Alvarez, Dominique Joseph Bicout, Paolo Calistri,
Elisabetta Canali, Julian Ashley Drewe, Bruno Garin-Bastuji, Jose Luis Gonzales Rojas,
Christian Gortázar Schmidt, Mette S Herskin, Miguel Ángel Miranda Chueca, Barbara Padalino,
Paolo Pasquali, Helen Clare Roberts, Hans Spoolder, Karl Stahl, Antonio Velarde, Arvo Viltrop,
Christoph Winckler, Inga Tiemann, Ingrid de Jong, Sabine Gabriele Gebhardt-Henrich,
Linda Keeling, Anja Brinch Riber, Sean Ashe, Denis Candiani, Raquel García Matas,
Michaela Hempen, Olaf Mosbach-Schulz, Cristina Rojo Gimeno, Yves Van der Stede,
Marika Vitali, Eléa Bailly-Caumette and Virginie Michel

Some EFSA recommendations (out of 14 key) that might affect environmental impact of broilers

- Limit the growth rate of broilers to a maximum of 50 g/day.
- Substantially reduce the stocking density to meet the behavioural needs of broilers
- Avoid the use of cages, feed and water restrictions in broiler breeders.
- Keep ammonia concentration in the barn below 15 ppm.
- Provide a covered veranda for broilers and broiler breeders from 2 weeks of age.
- Provide access to an outdoor range covered with 70% vegetation
- ….

SCIENTIFIC OPINION

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Welfare of laying hens on farm

EFSA Panel on Animal Health and Animal Welfare (AHAW),
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Lars Schrader, Inga Tiemann, Thea Van Niekerk, Michele Ardizzone, Sean Ashe,
Michaela Hempen, Olaf Mosbach-Schulz, Cristina Rojo Gimeno, Yves Van der Stede,
Marika Vitali and Virginie Michel

Some EFSA recommendations (out of 10 key) that might affect environmental impact of layers

- House all birds in non cage systems.
- Provide dry and friable litter
- House flocks with easily accessible, elevated platforms and/or perches.
- Provide a covered veranda for all birds to reduce effective/local stocking density.
- ….

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  - ➢ Recommended measures to prevent or correct the hazards and/or mitigate the welfare consequences
- **The question is are these recommendations consistent with the desire to reduce or maintain the environmental impact of poultry systems?**

ADAS

ADAS REPORT

A REVIEW OF THE EVIDENCE OF THE RELATIONSHIP BETWEEN ANIMAL WELFARE AND ENVIRONMENTAL IMPACTS

ANNEX 8.1 Poultry matrix

			Environmental Impacts						
			CLIMATE CHANGE				POLLUTION	LANDSCAPE/E	
ANIMAL WELFARE 5 FREEDOMS	Animal Welfare Objectives- Poultry	Industry Response- Poultry	Energy Use/ efficiency/ renewables	Reduce emissions of GHGs	Waste reduction/ Recycling opportunities	Water Conservation/ Flood prevention	Water Air Soil	BIODIVERSITY	PRESE LIVI LANDS
1. Freedom from hunger and thirst-- by ready access to fresh water and a diet to maintain full health and vigour.	Meet all nutritional requirements	Use approved feed materials only, on least cost basis	No effect	Least cost requirement may increase transport costs for feed materials	Unable to use processed animal proteins	No effect	No effect	Fewer home-grown crops needed (more imported)	More sc alterna landu
2. Freedom from discomfort- by providing an appropriate environment including shelter and a comfortable resting area.	Maintain a comfortable environment, no temperature extremes etc.	Broilers only - adjust stocking rate according to seasonality (fewer birds in summer)	No effect	No effect	Less waste (in the form of mortality)	More built-on land could increase flood risk	Less air pollution, due to carcass incineration	No effect	More ha need
3. Freedom from pain injury or disease--- by prevention or rapid diagnosis and treatment.	Prohibit 'un-natural' practices which may cause pain or distress	No beak-trimming of breeding or commercial egg laying birds	No energy used, if process not undertaken	No effect	Likely increase in mortality	No effect	More air pollution due to carcass incineration	No effect	No ef
3. Freedom from pain injury or disease-- by ensuring conditions and treatment which avoid mental suffering.	Maintain good health	Good biosecurity - best met by indoor production systems	No effect	More use of detergents, disinfectants and other chemicals	Less waste (in the form of mortality)	No effect	Indoors, so no risk of run-off on farm land	No effect	No poultry in lands
4. Freedom to express most normal behaviour-- by providing sufficient space, proper facilities and company of the animal's own kind.	Provide appropriate house space allowance for animals	Opt for less intensive systems, therefore more housing capacity needed	More heat may be needed during the brooding stage	No effect - if national flock size is unchanged	No effect	More built-on land could increase flood risk	No effect	No effect	More ha need
4. Freedom to express most normal behaviour-- by providing sufficient space, proper facilities and company of the animal's own kind.	Provide outdoor access	Replace indoor with free range systems	Maybe scope to save electricity whilst birds are outside	Carbon footprint higher because of inferior growth rates and FCR	No effect	Greater risk of flood damage	Risk of run-off on farm land	Scope to enhance, with planting schemes etc.	Scope to if house and des sympat
4. Freedom to express most normal behaviour-- by providing sufficient space, proper facilities and company of the animal's own kind.	Use systems that allow species-specific behaviours	Replace conventional laying hen cages with litter floored systems	No effect	No effect	More litter waste, unless recycled materials can be used as litter	No effect	More dust pollution in air	Opportunity to grow crops to provide litter materials	No ef

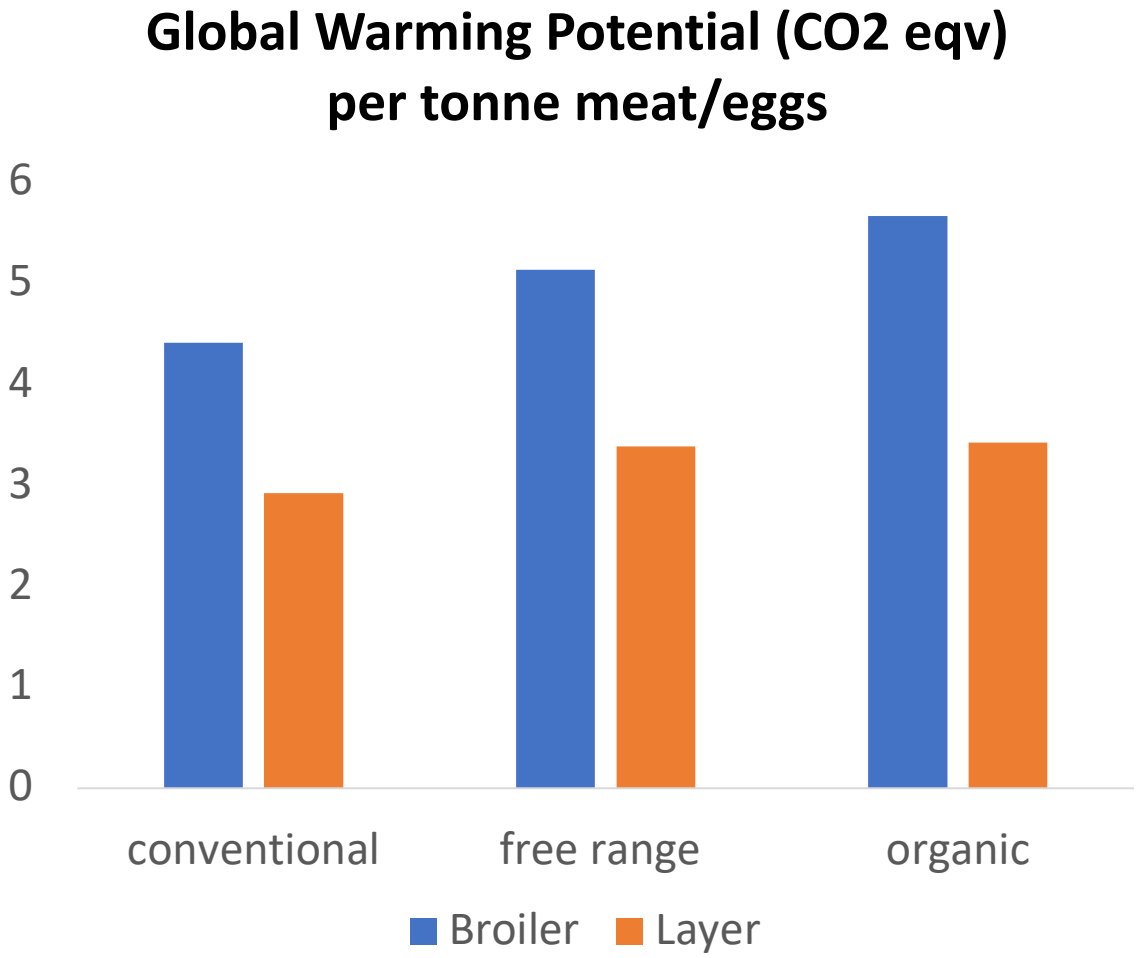
Correlation between system characteristics

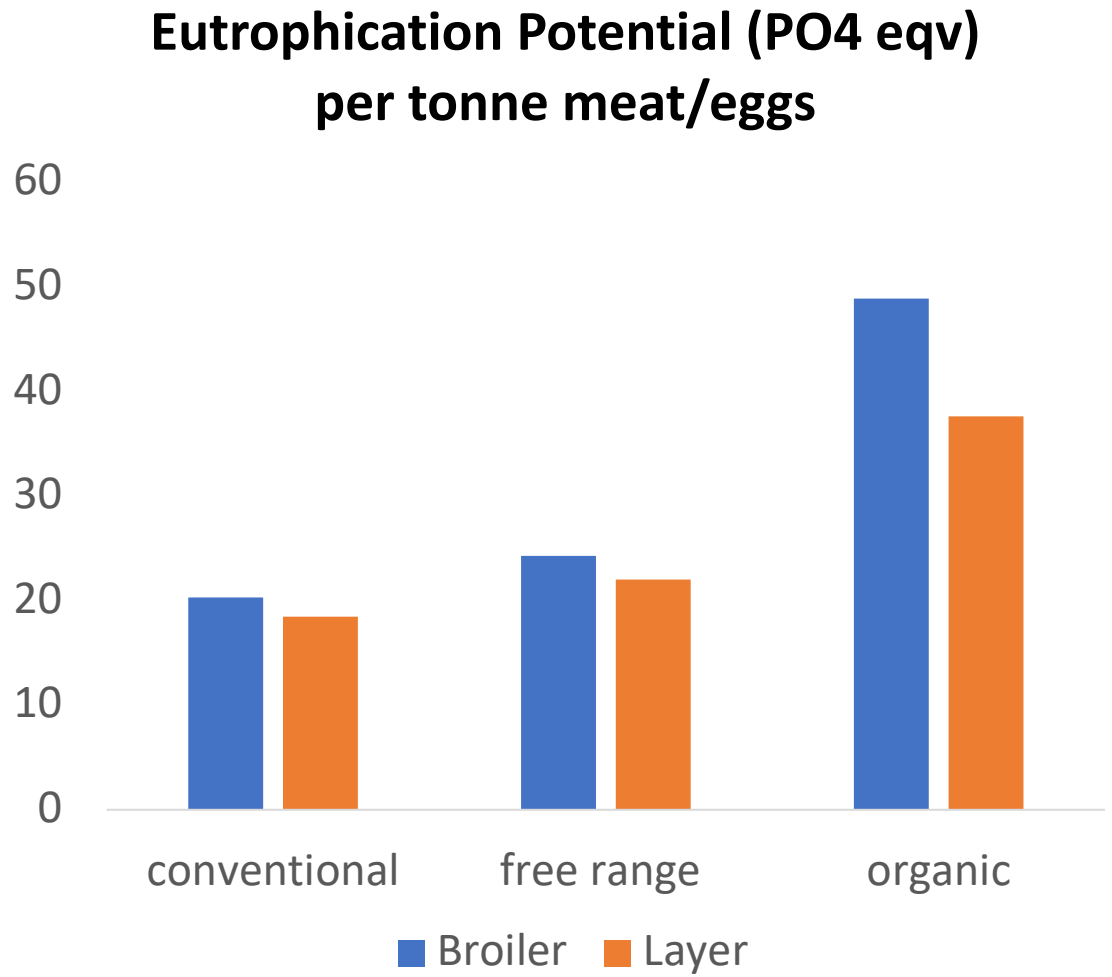
- There is a very high correlation between a system and its characteristics:
  - High correlation between system and bird strain (but not always!)
  - High correlation between system and slaughter age (which influences feed efficiency)
  - Correlation between system and feed ingredients (although most systems utilised soya, but the incorporation of other ingredients varies)

- Surprisingly, there was lack of high correlation between system and:
  - Stocking density – some conventional systems use ‘low’ stocking densities

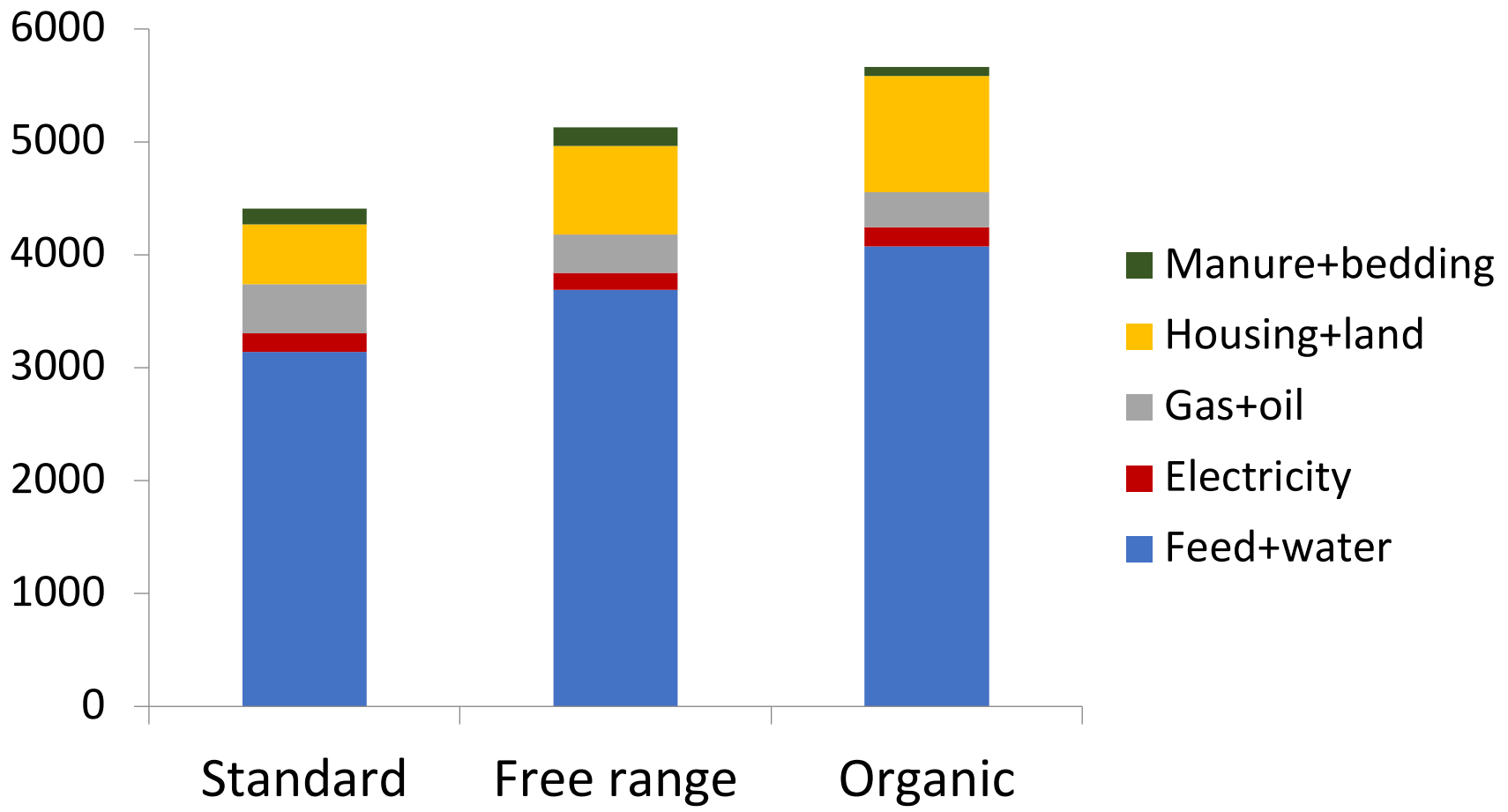
  - **A comparison between welfare enhancements and environmental impact may actually be a comparison between systems!!!**

Is there a difference between systems?





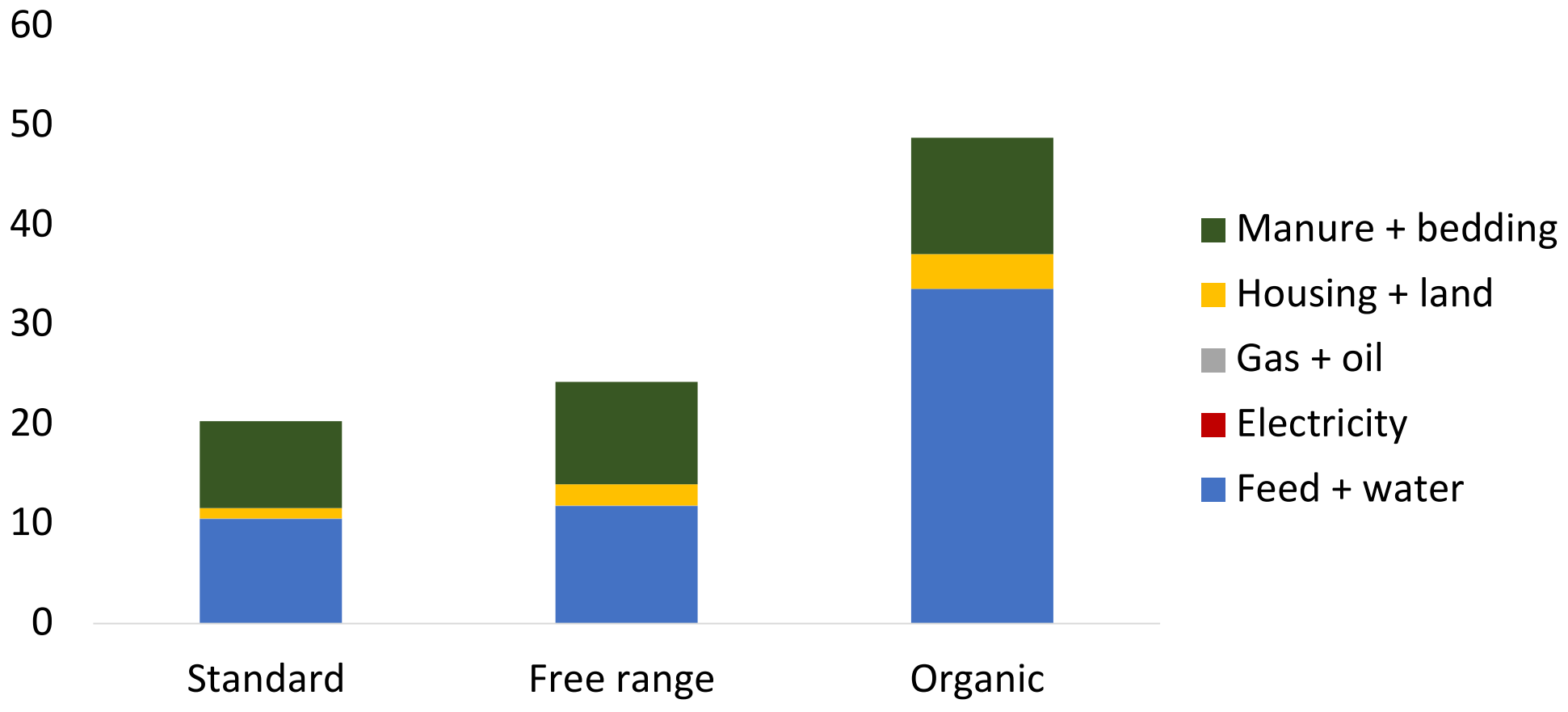
Sources of Global Warming Potential in broiler systems



Global Warming Potential (per 1000 kg of edible broiler carcass), kg CO_2 equivalent

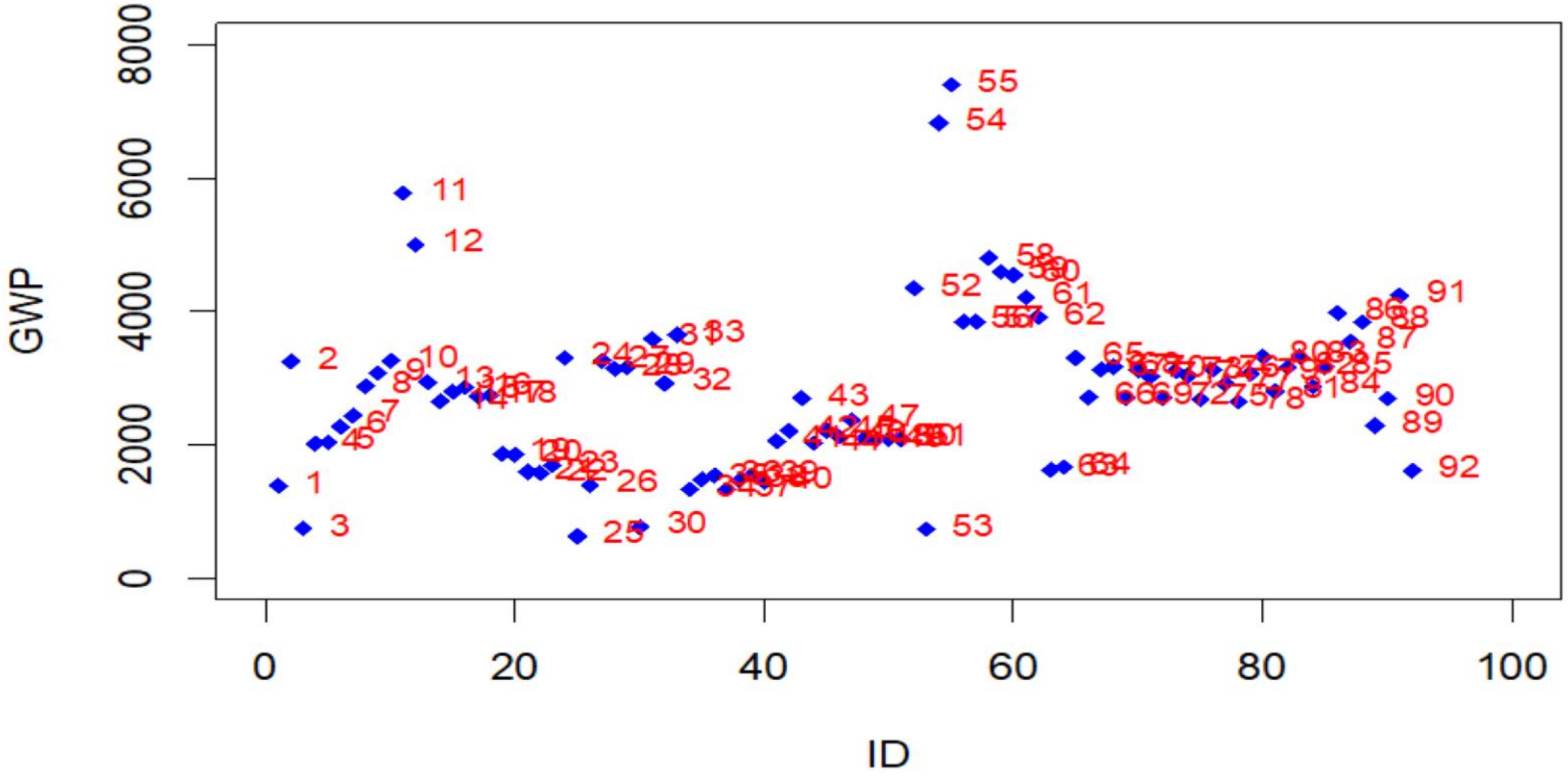
Sources of Eutrophication Potential in broiler systems

The graph is similar for acidification potential



Eutrophication Potential (per 1000 kg of edible broiler carcass), kg PO_4 equivalent

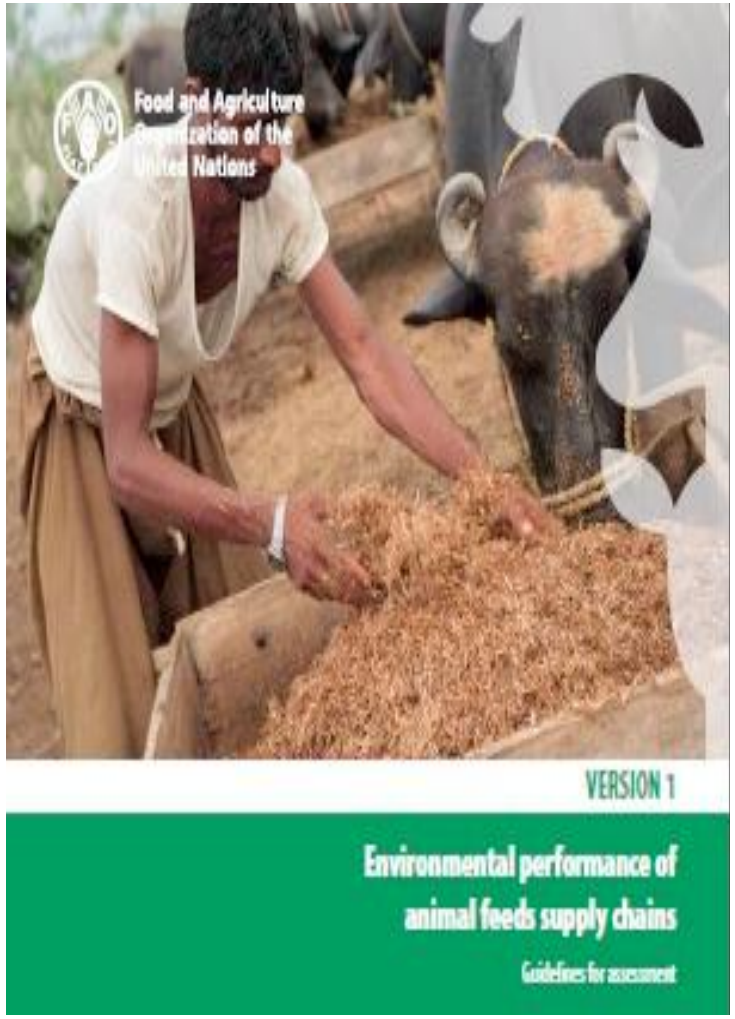
Variation in C footprint (GWP) between broiler studies

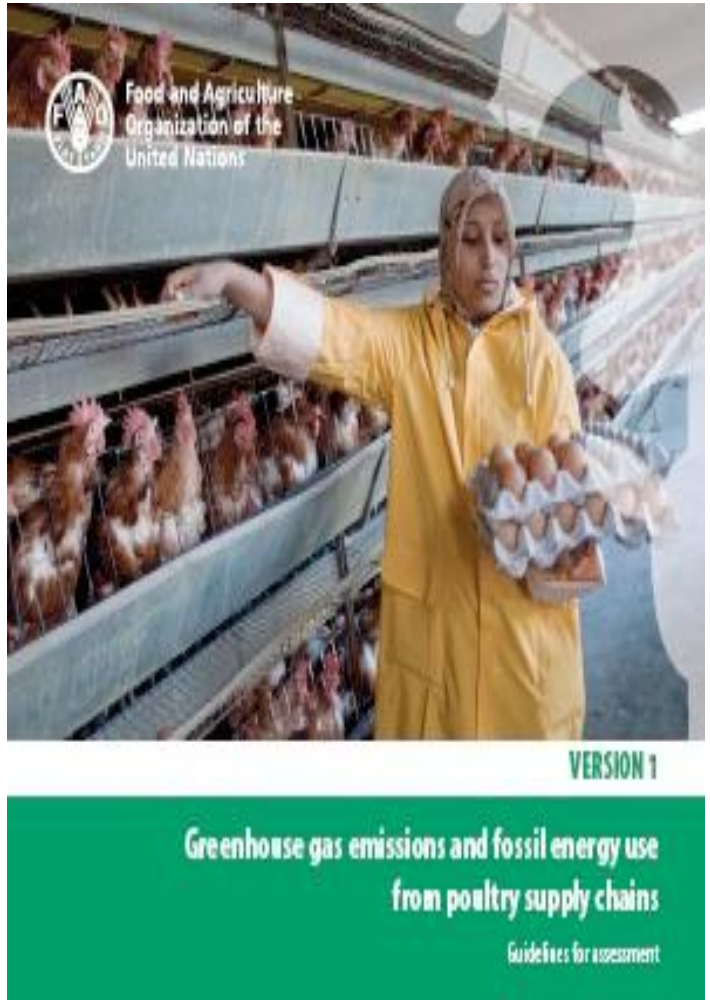


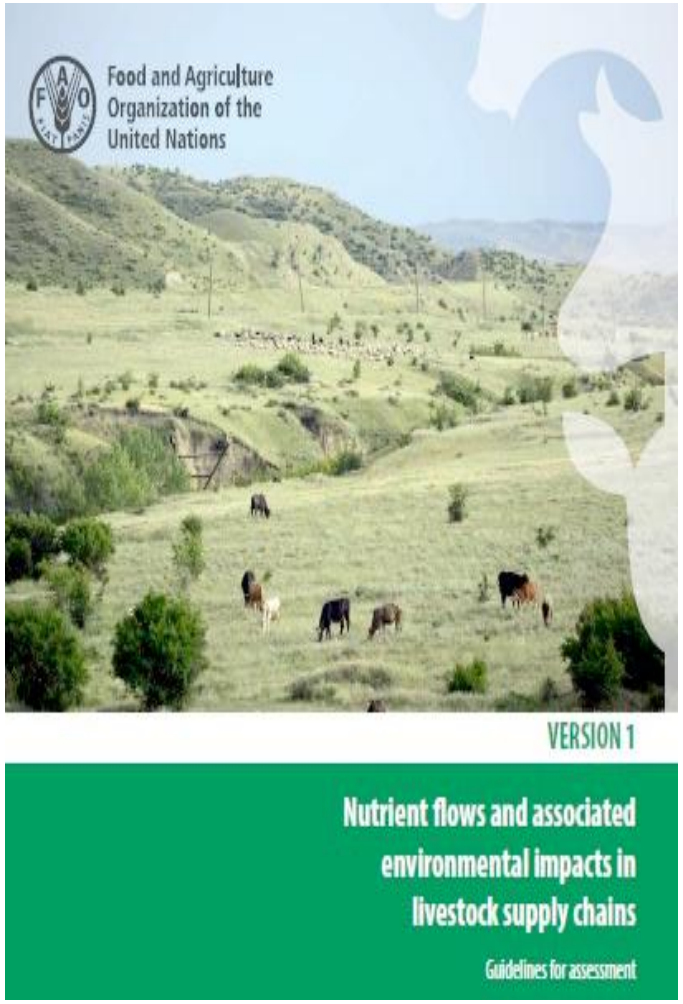
Variation in environmental impacts between broiler studies

Impact variables (/t BW)	n	Min	Max	Mean
GWP (kg CO_2 eq)	93	630	7400	2840
Acidification (kg SO_2 eq)	59	3.62	92	34.1
Eutrophication (kg PO_4 eq)	54	1.03	69.6	16.5
Ammonia emissions (kg)	54	0.480	24.6	9.1
Energy use (GJ)	42	6.01	184	26.3
Water use (m^3)	12	40.0	2285	849.5
Land use (ha)	11	0.250	2.370	0.930

Guidelines on how to assess environmental impact







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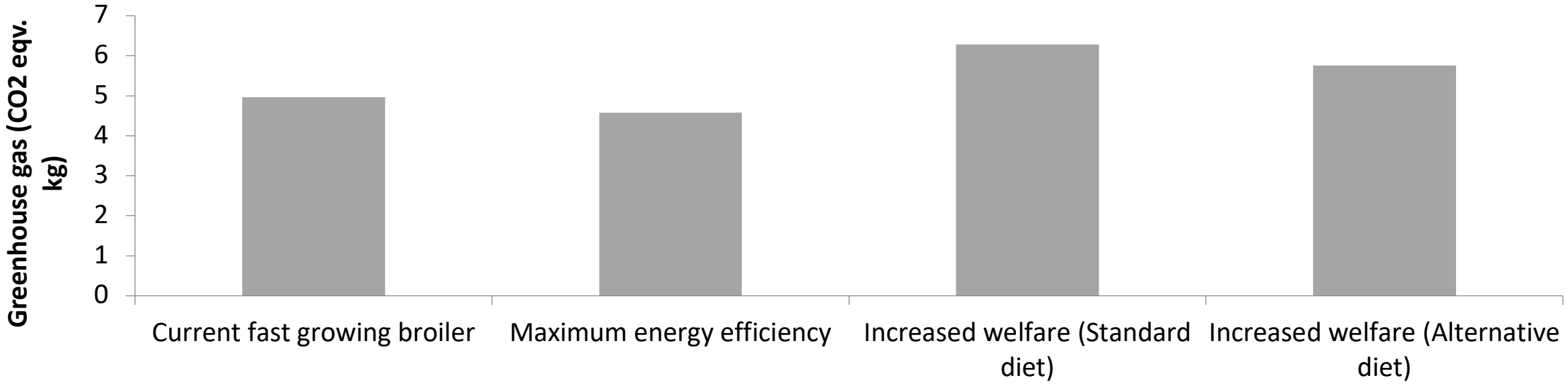
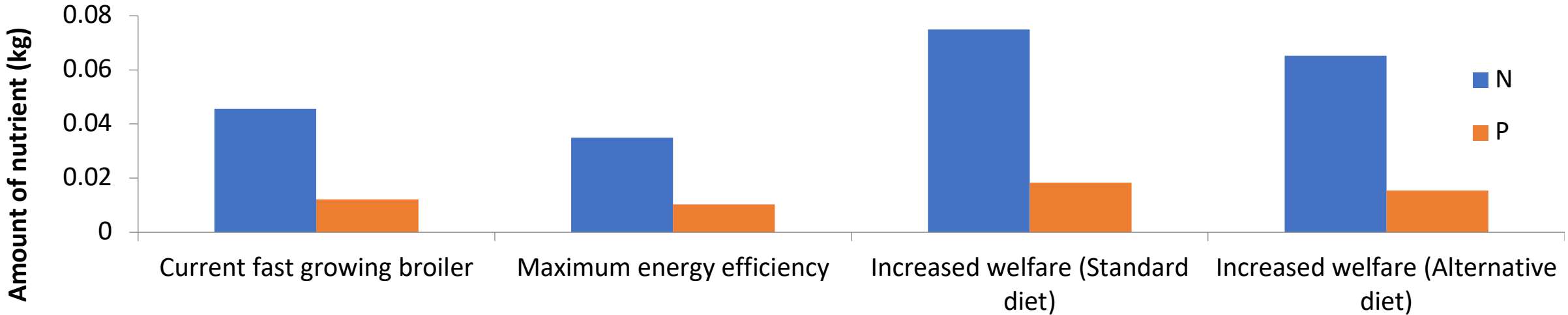
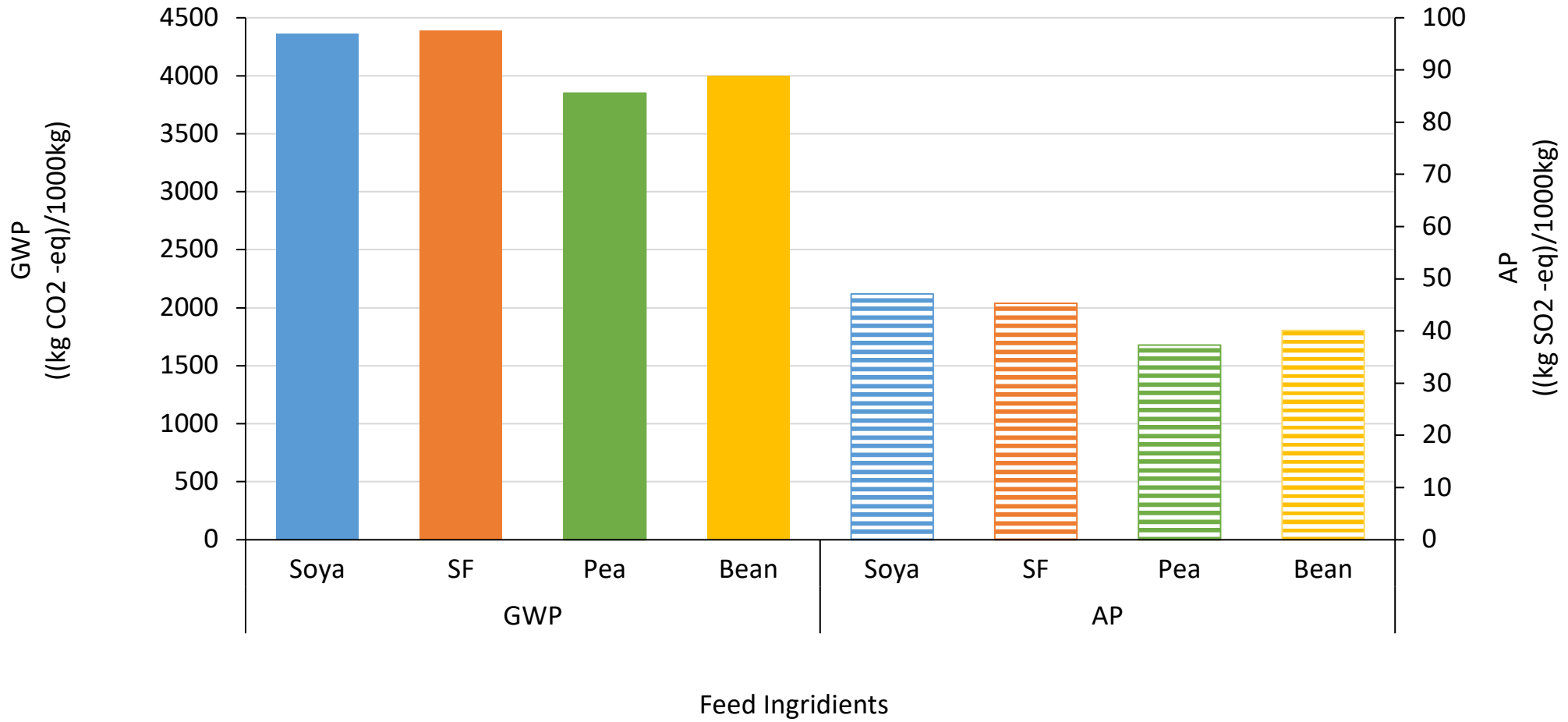
Environmental impact of different breeding strategies





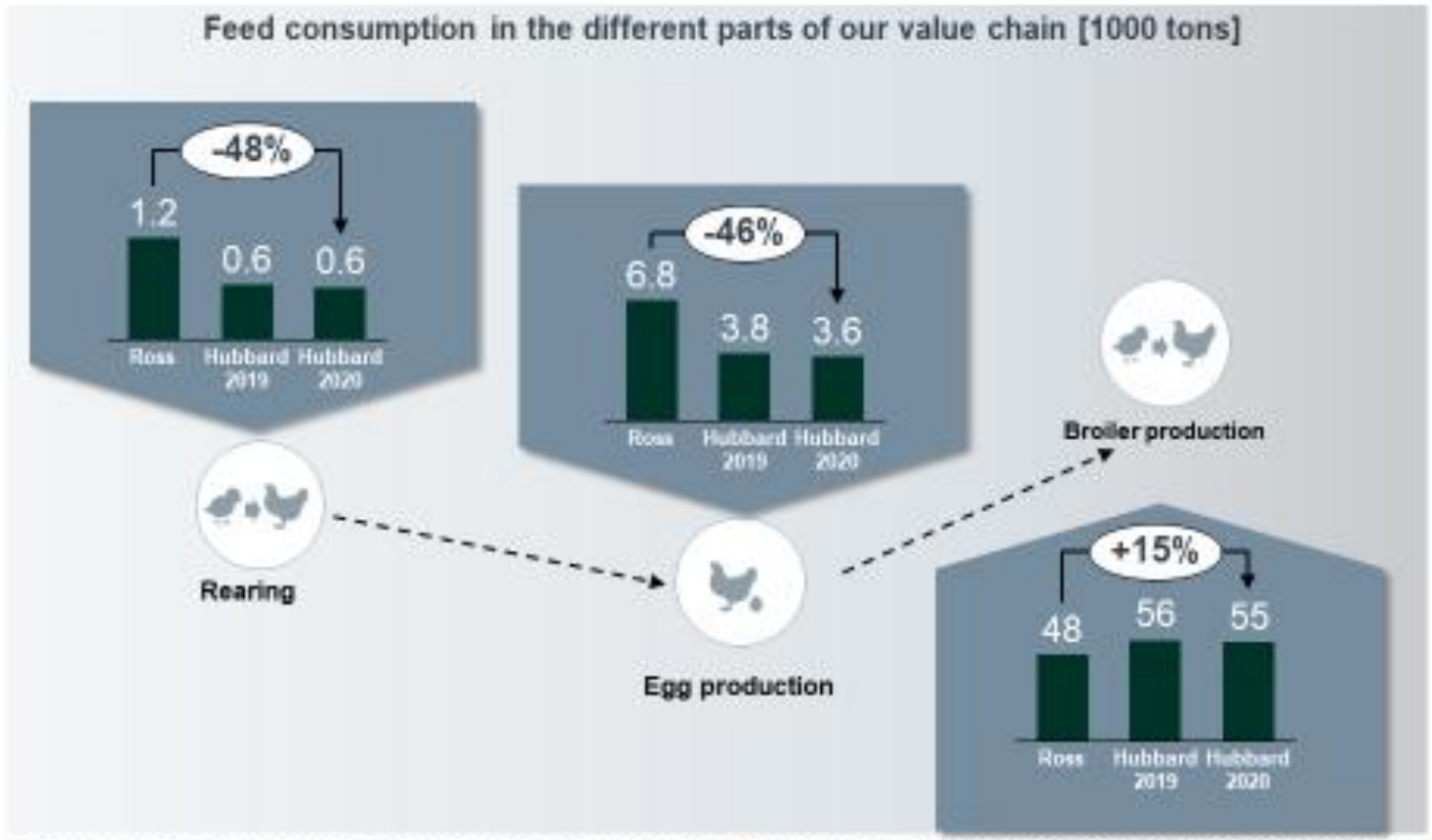
Substitution of soya bean with home-grown protein sources in conventional systems

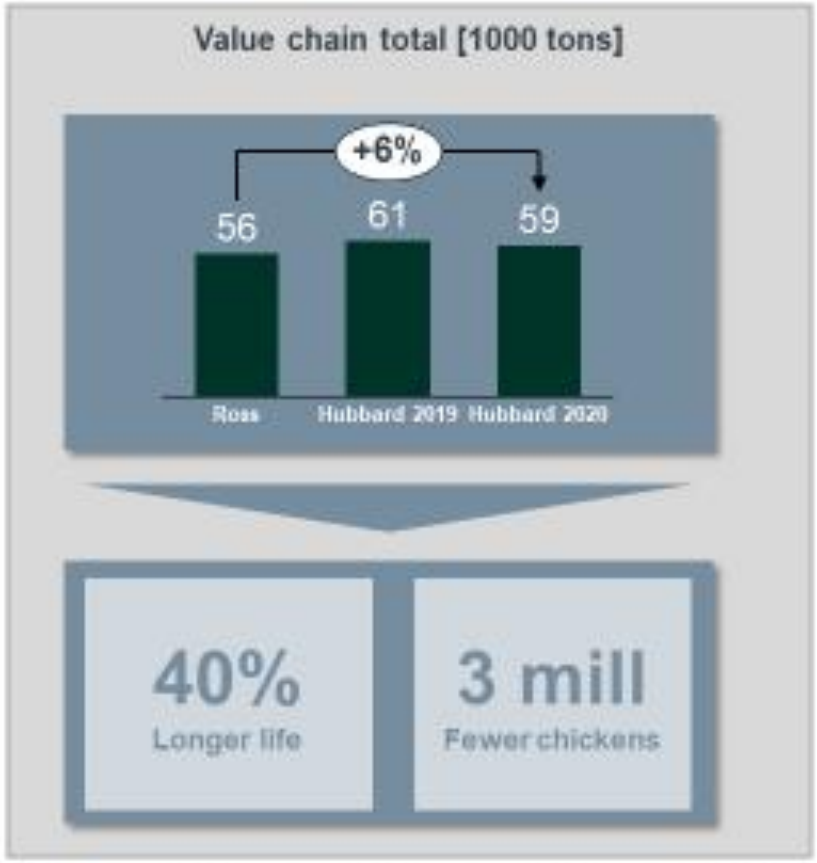


The effect of faba bean inclusion on fast and slow growing broilers

Faba Bean (%)	d35 BW (g)		FCR d0-d35	
	Ross 308	Hubbard JA787	Ross 308	Hubbard JA787
0	2757	1799	1.342	1.501
10	2723	1810	1.350	1.524
15	2790	1816	1.353	1.527
20	**2713**	1845	**1.371**	1.515
25	**2771**	**1783**	**1.371**	**1.561**
30	**2695**	**1757**	**1.376**	**1.550**
s.e.d.	37		0.012	

Total feed consumption has only increased b 6% *
Hubbard needs less protein resulting in an unchanged climate footprint





Lower feed consumption in rearing and egg production because we get more chickens from each female, and therefore need fewer females. The females are dwarf hens, and therefore eat less feed.

Lower mortality and less disease** in the broiler production reduced losses result in increased feed exploitation.

Because Hubbard is slower growing it **needs 7,9% less soy in the feed** compared to Ross***

* Produksjonstall fra NKs Rossproduksjon i 2018

**Produksjonsdata jan-okt 2020: Sykdomskassasjoner = 0,62%, Totaldødelighet = 2,04%

***Sammenligning fôrresepter Hubbard og Ross mai 2020

Norsk Kylling

Consequences of removing cages for layers

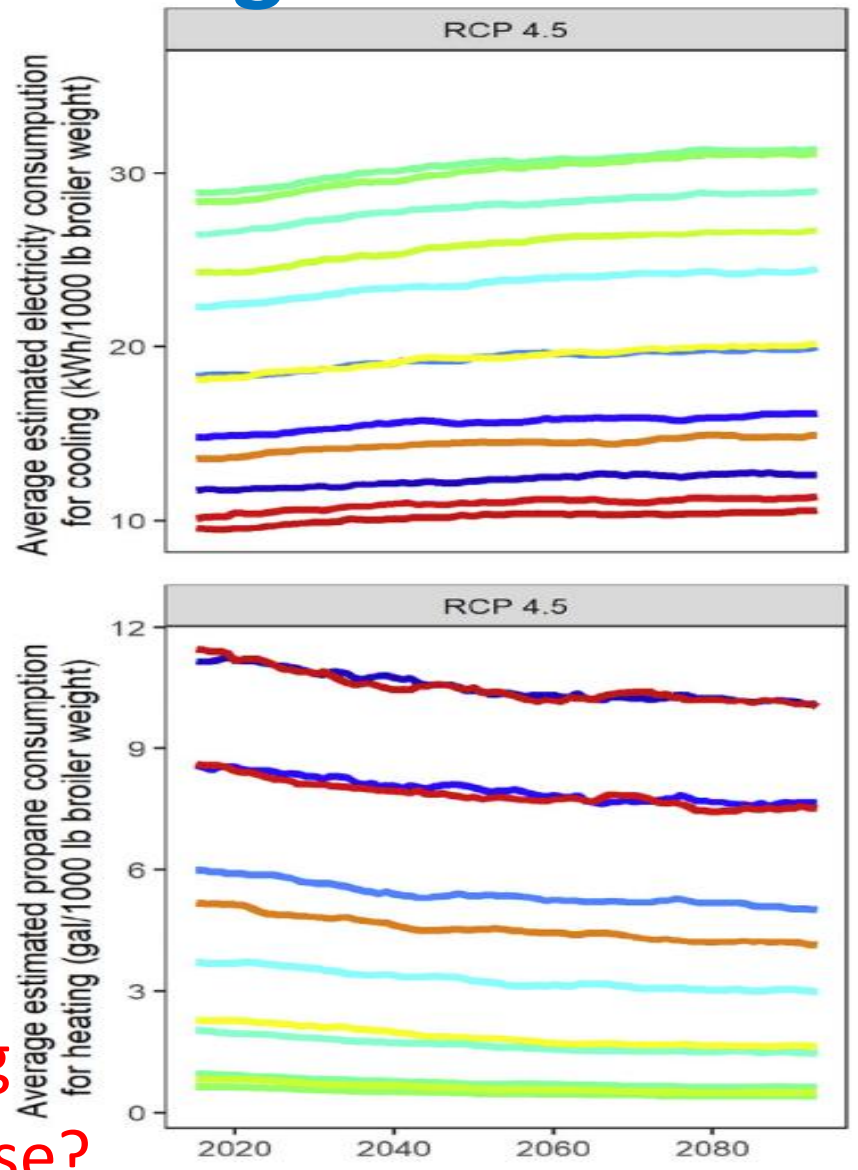
Environmental Category	Conventional GWP (kg CO_2 eq)	Colony GWP (kg CO_2 eq)	Conventional AP (kg SO_2 eq)	Colony AP(kg SO_2 eq)
Feed + water	2.10	2.10	8.24	8.21
Farm electricity	0.24	0.17	0.96	0.68
Farm gas + oil	0.09	0.08	0.16	0.14
Housing	0.38	0.38	19.42	19.36
Manure + bedding	0.11	0.11	26.72	26.63
TOTAL	**2.92**	**2.83**	**55.50**	**55.02**

Consequences of increasing stocking density in conventional systems on GWP (kg CO_2 eq/ kg BW)

Environmental Category	High Density	Low Density	Low Density + Heat exchanger
Feed + water	3.08	**2.95**	**2.94**
Farm electricity	0.16	0.18	0.18
Farm gas + oil	0.43	**0.68**	**0.68**
Housing	0.54	0.49	0.49
Manure + bedding	0.14	0.13	0.13
TOTAL	**4.35**	**4.42**	**4.22**

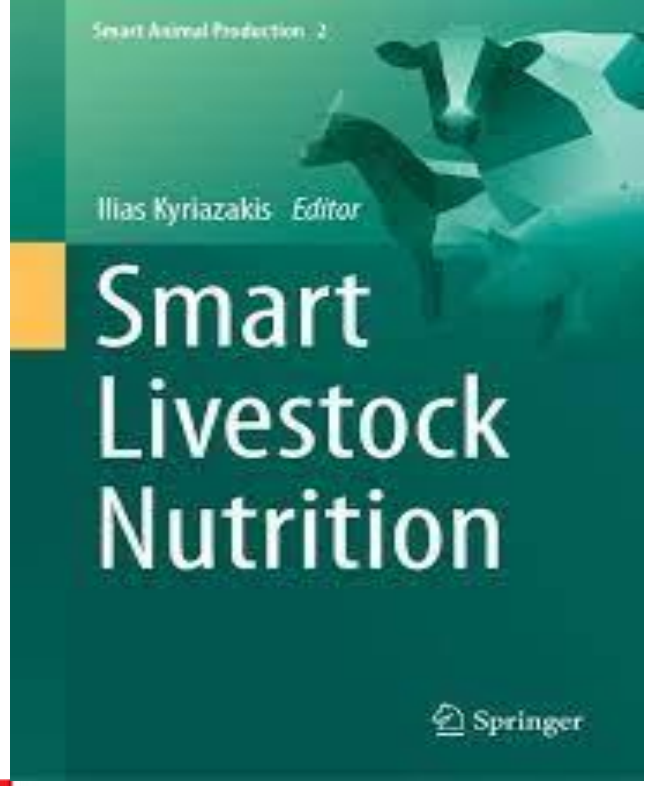
Some comments about stocking density effects

- A decrease in stocking density is **consistently** associated with a decrease in GWP
- The effect of ‘thinning’ counterbalances the higher energy inputs and using more birds to achieve the same functional unit
- The change is a good example of the complexity of considering within system changes on environmental impact
- What are the consequences of reducing stocking density when environmental temperatures increase?



Suggestions (instead of Conclusions)

- Comparisons between poultry systems are not always helpful. Some systems will always fare better than others depending on their sustainability metrics.
- A range of practices within a production system can enhance both environmental impact and animal welfare **(win-win)**
- When considering such practices emphasis should be on the consequences across the production chain (the example of stocking density)
- Transparency over the assumptions and calculations when considering the relationship between environmental impact and bird welfare are imperative, especially as we are moving to the consideration of novel metrics.



Thank You!

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Athena Swan Gold Award

Gender Charter

Prediction is very difficult,
especially if it is about the future!

Niels Bohr