

# Multiscale influence of feedstuff availability on environmental impacts of feed

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(Méda et al., EAAP 2017 Session 4; Espagnol et al., EAAP 2017 Session 11)

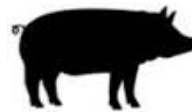


# Importance of feed in environmental impacts of animal products

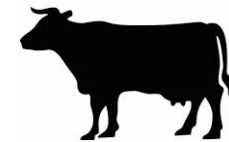
*% of concentrated feed in total ration*



100%



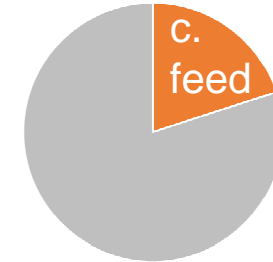
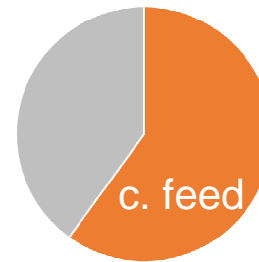
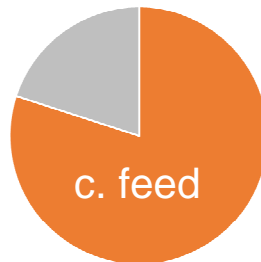
100%



3-20%

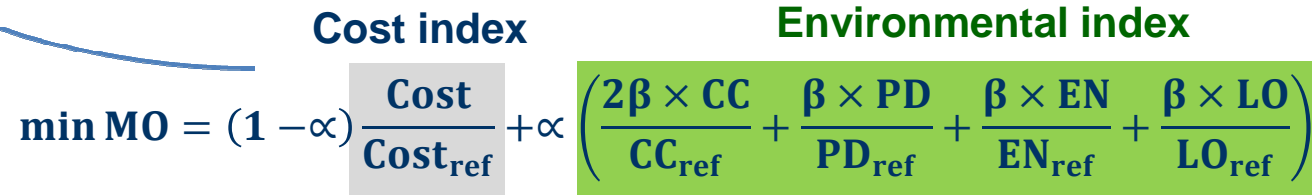
Rest = pasture, forage

*Responsability of compound feed in climate change of animal product (calculated by LCA / kg animal product at farm gate)*



Necessity to improve the environmental performance of feed in order to decrease final impacts of animal products

(Méda *et al.*, EAAP 2017 Session 4)



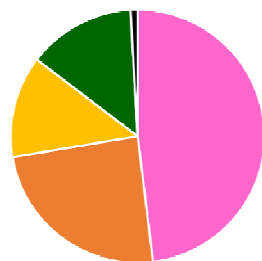
$LCA_{11} \dots LCA_{n1}$   
 $\vdots$   
 $\vdots$   
 $\vdots$   
**Environmental  
impacts of  
feedstuffs**  
 $\vdots$   
 $\vdots$   
 $\vdots$   
 $LCA_{1q} \dots LCA_{nq}$

(Méda *et al.*,  
EAAP 2017  
Session 4)

# A difficulty : same feedstuffs for different animal productions (case of the North West of France)

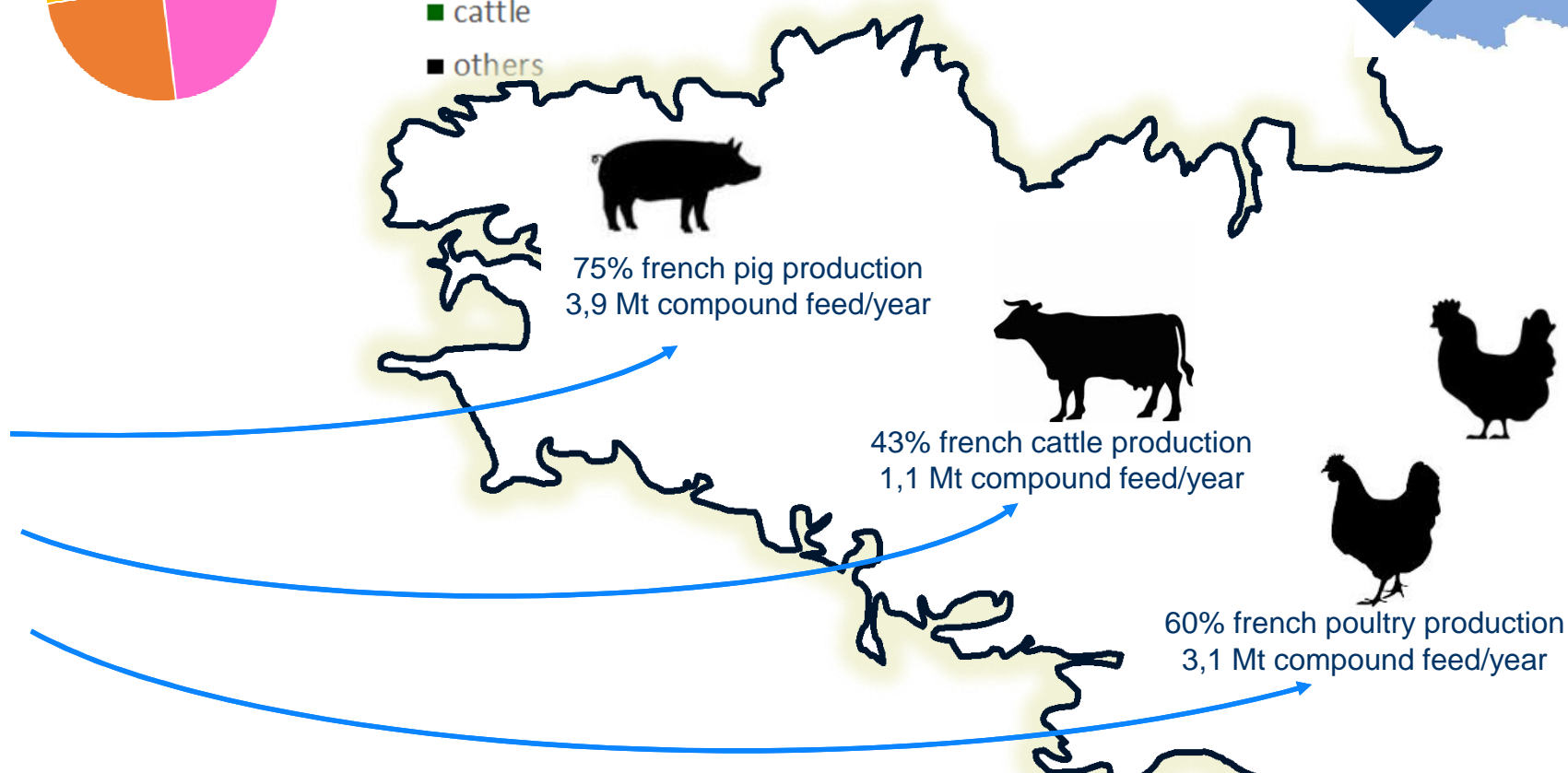
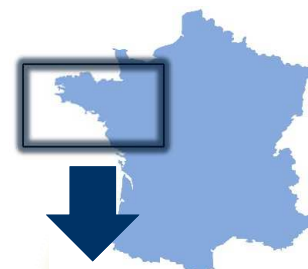
Feedstuffs	Mt
Wheat	2869
Maize	1245
Barley	512
Soybean meal	1173
Rapeseed meal	564
Sunflower meal	390
Cereal coproducts	611
Pea	91
Oilseeds	73
Oils	105
others	535

Quantity of feed produced



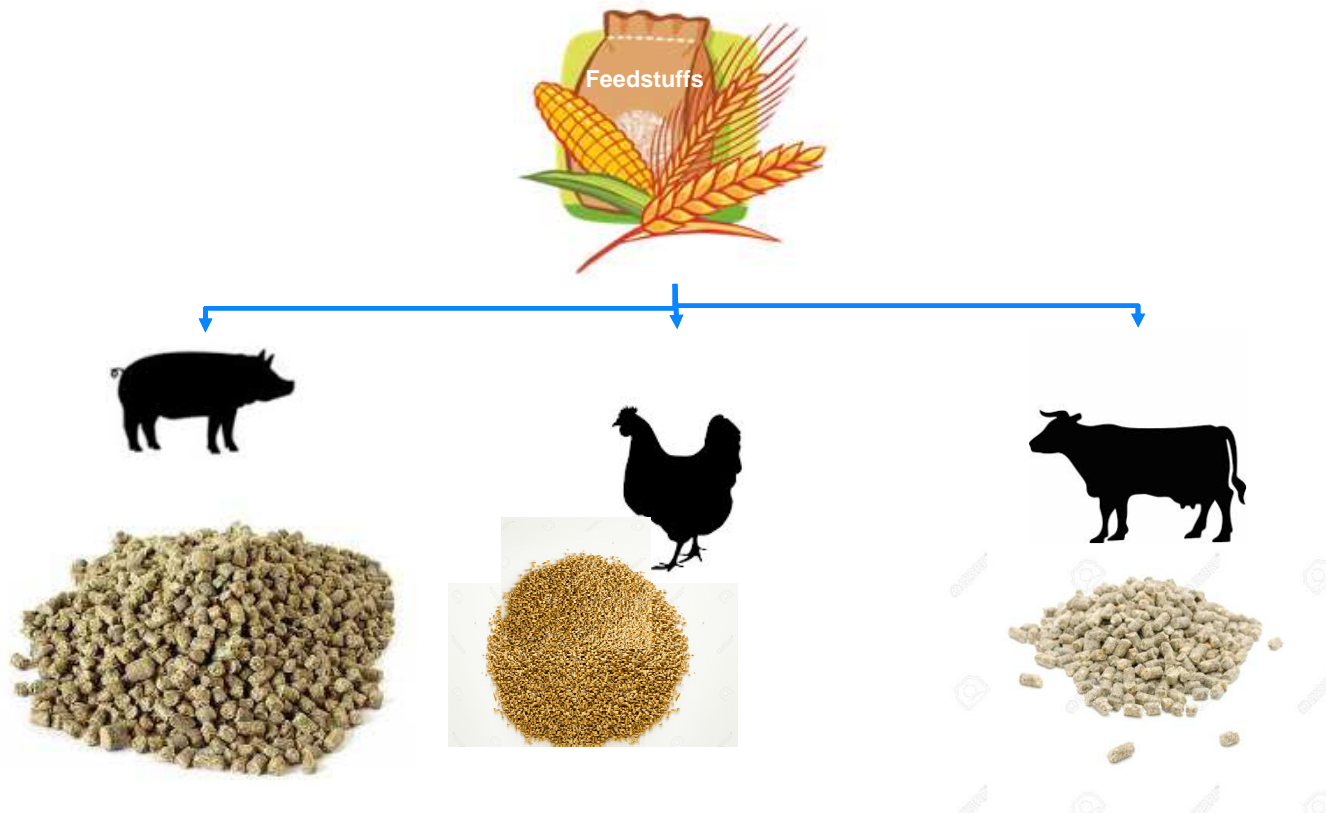
- pig
- broilers
- laying hens
- cattle
- others

Brittany :  
60% of the animal production in France  
8,2 Mt / year of feed



# Questions

- What is the possible decrease of the environmental impacts of feed using multiobjective formulation when considering common feedstuffs resources and different animal productions?



# Methodology : 3 steps

## ① MO formulation Individually

Large availability of feedstuffs (list of feedstuffs and limits of incorporation)

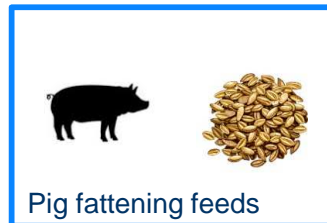


Ex : max 30% pea / t

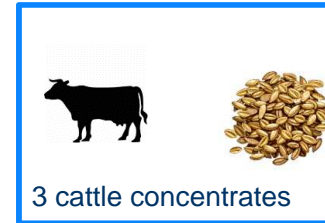


## ② MO formulation Individually

Restricted availability of feedstuffs (current incorporation rates)



Ex : max 10% pea / t



## ③ Common MO formulation for North West of France

Current availability  
of feedstuffs



All compound feeds  
for all animal in  
Brittany

Average eco-feeds for 4  
economic contexts

-Formulas

-LCA impacts / t

Climate change

Energy consumption

Phosphorus consumption

Land occupation

Acidification

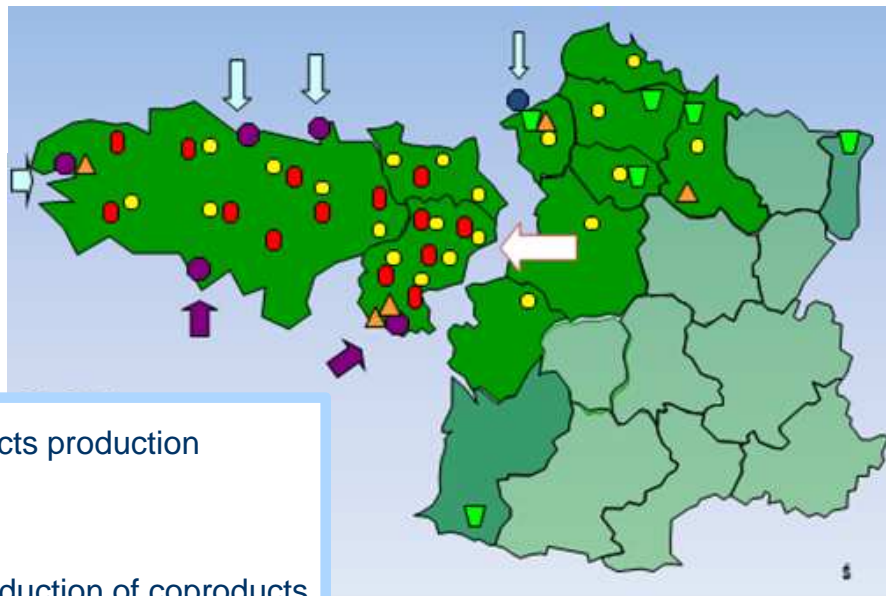
Eutrophication

The environmental  
benefit is obtained by  
comparing to the  
standard feeds  
formulated with least  
cost formulation

# Model used for the Brittany level

**FEEDSIM AVENIR**

Association pour la promotion de la Recherche  
et de l'analyse économique sur l'Agriculture  
et l'Agro-industrie du Grand Ouest



- ▼ Wheat coproducts production
- Feed firms
- Collect and production of coproducts
- Harbor
- ▲ Crushing unit

Current tonnage of  
feed for different  
animal productions

Current availability of  
feedstuffs

**MO formulation  
performed with  
a model**

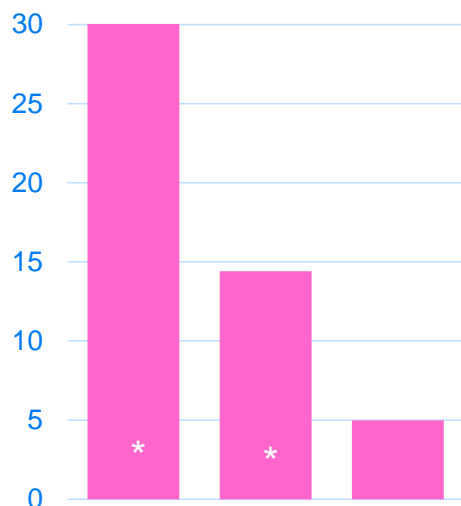
- Linear programming model
- Optimisation of the feedstuffs fluxes between locations of available feedstuffs and the feed firms
- 53 different feedstuffs, 52 feed formulas, 60 nutritional constraints, 14 collect locations, 10 firms of coproducts production, 6 harbours...

# Result : environmental impact / ton of compound feed – climate change

% reduction  
/ reference

PIG

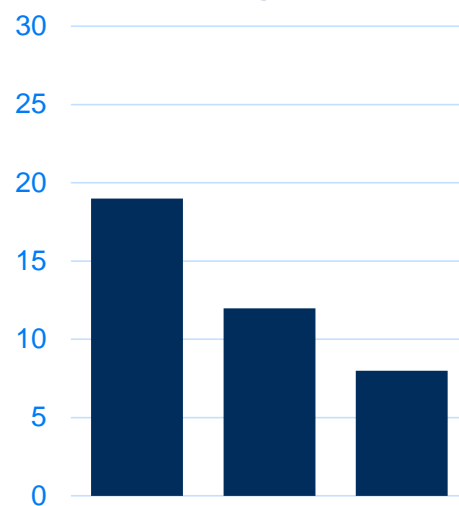
Ref  
546 kg CO<sub>2</sub>eq/t



All compound feeds

BROILERS

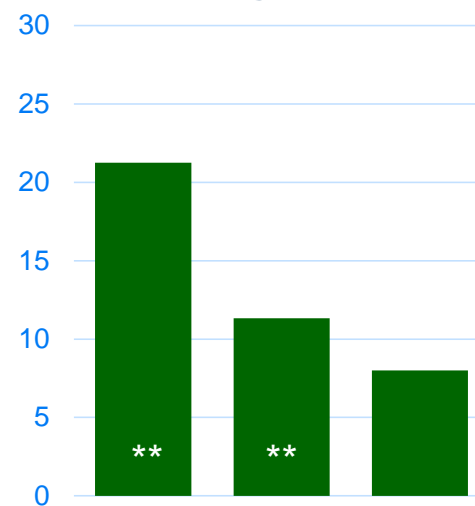
Ref  
791 kg CO<sub>2</sub>eq/t



All compound feeds

CATTLE

Ref  
835 kg CO<sub>2</sub>eq/t



All compound feeds

\* Only fattening feeds for individual assessments

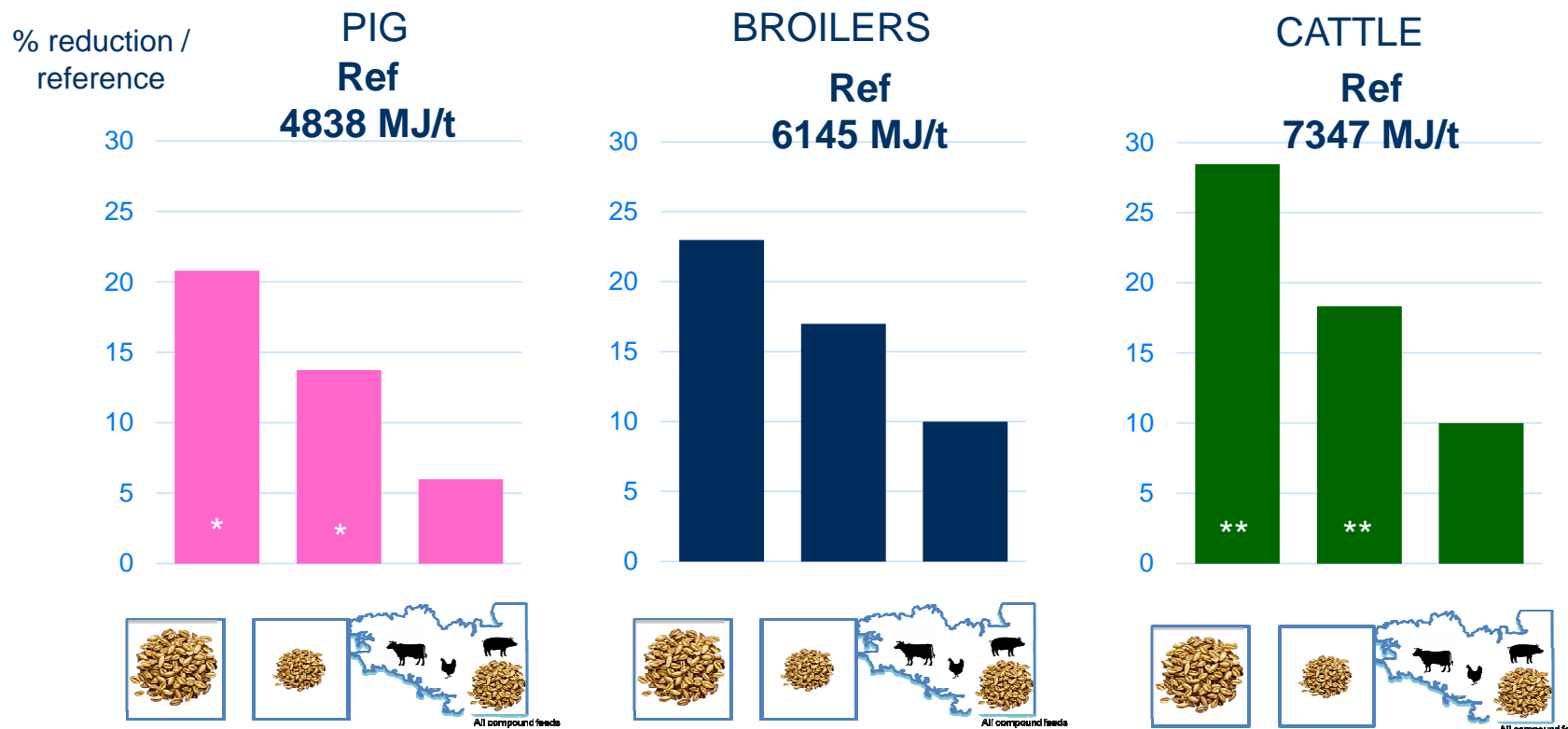
\*\* average of three types of cattle feed (18, 27, 40% of crude protein)

The higher reductions are obtained with the large availability of feedstuffs : prospective scenario. The potentiel of reduction is more important in pig production (-30%) / ton of feed but it depends of the initial value

The availability of feedstuffs decreases considerably the possible environmental benefit (/6 for pig ; /2-3 in broiler and cattle production)

At territory scale priority is given to broiler and cattle production (-7%) compared to pig production (-5%). Higher initial impacts

# Result : environmental impact / ton of compound feed – energy consumption



\* Only fattening feeds for individual assessments

\*\* average of three types of cattle feed (18, 27, 40% of crude protein)

The potentiel of reduction is more important in broiler and cattle production / ton of feed.

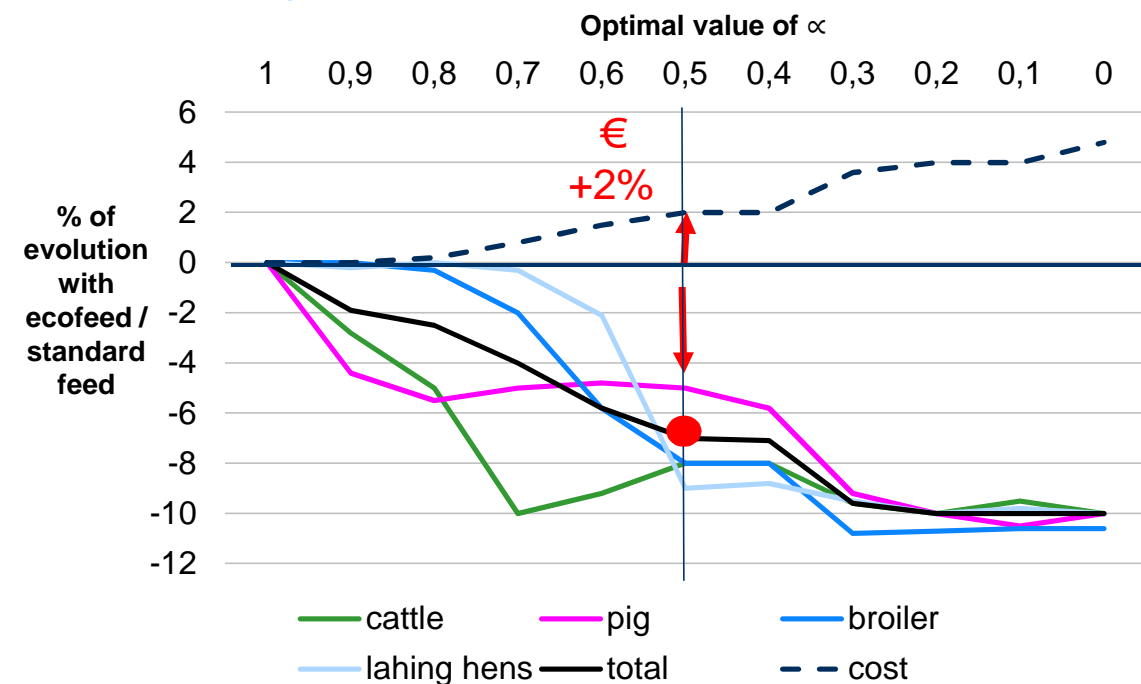
Again, the availability of feedstuffs decreases considerably the possible environmental benefit (/2-3) among the three steps

At territory scale priority is given to broiler and cattle production (-10%) compared to pig production (-6%)

# Reduction of the impacts at territory scale

Evolution of the impacts and cost at territory scale with the different values of  $\alpha$  in the multi-objective function

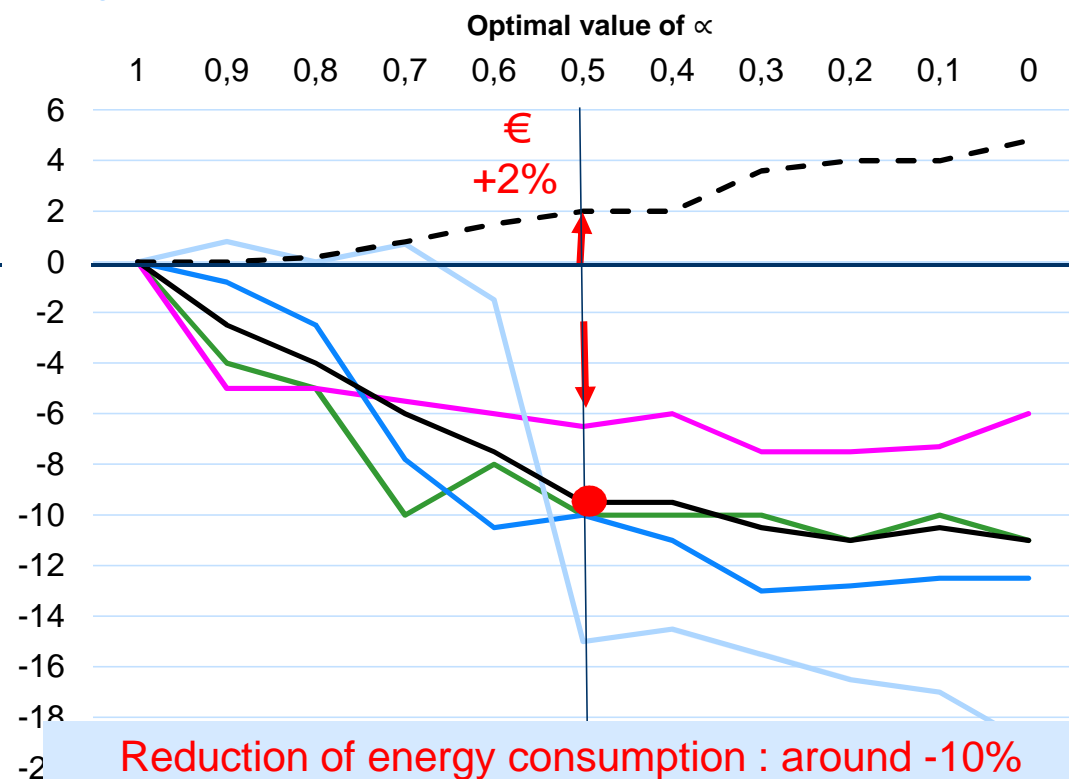
## Climate change



Reduction potential among different animal productions changes with the  $\alpha$  values

Selection of the optimal reduction of impact for the minimal increase of cost => **Reduction of climate change = -7%**

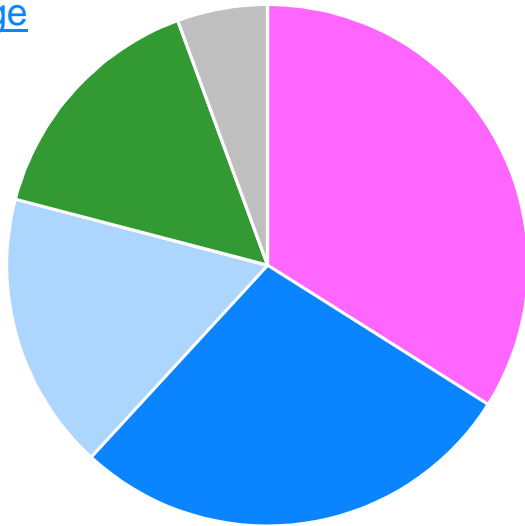
## Energy consumption



**Reduction of energy consumption : around -10%**  
The average overcost of +2% is considered quite high by the commercial firms and this overcost differs between animal productions

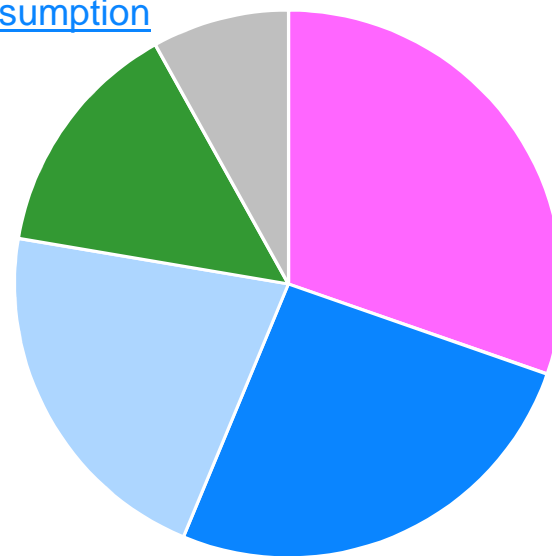
# Contribution of the different animal productions to the reduction of impacts at Brittany scale

Climate change



■ pig ■ broiler ■ laying hens ■ cattle ■ other

Energy consumption



Main reduction for climate change and energy consumption due to pig production which has the lowest reduction at feed scale but the largest amount of feed produced

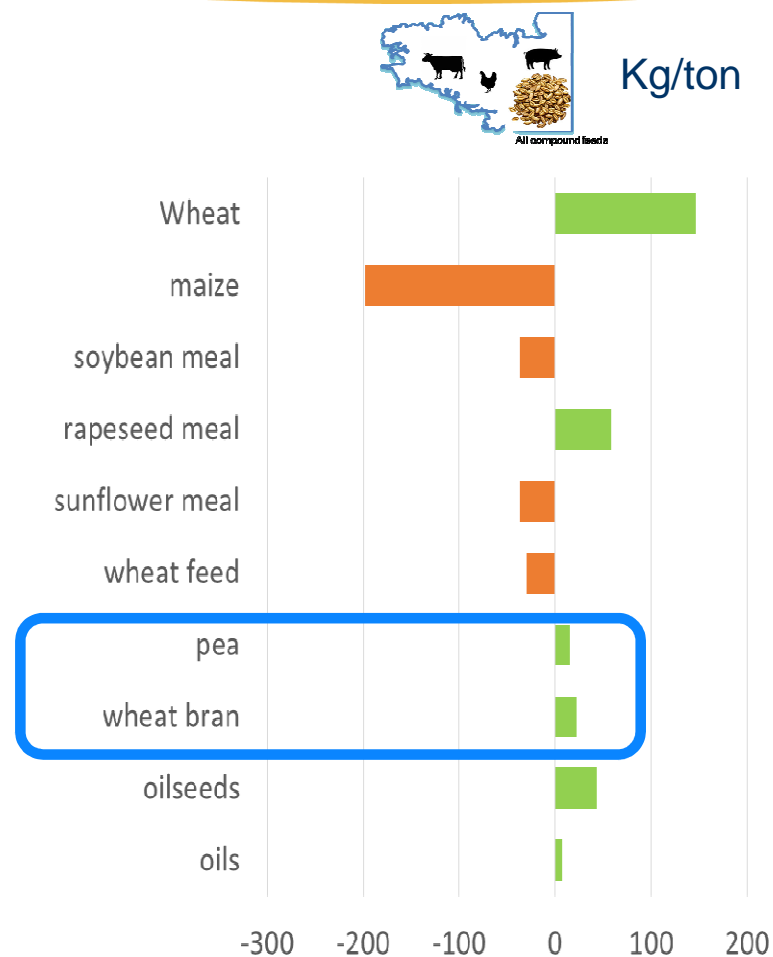
# Feedstuffs evolution in Eco-feeds

With Eco-feeds :

- Substitution of maize by wheat
- Partial replacement of the soybean meal by rapeseed meal
- Increase of wheat coproducts, pea, oils, in regards to the energetic level of the feeds

Ceiling due to low availability are linked with specific interesting feedstuffs :

- Pea (in the context of large availability : 30% in pig fattening feed)
- Wheat feed flour (in the context of large availability : 20% in pig fattening feed)
- Wheat middlings



Evolution of the incorporation of feedstuffs in formulas at territory scale (kg/ton)

# Conclusion

- The potential reduction of environmental impacts of feed changes a lot among the different scenarios of feedstuffs availability
  - => The limited availability of feedstuffs leads to a high competition among the animal productions
- The potential of impact reduction measured at territory scale concerns different feed firms.
  - => To implement it on territory, all those firms would have to work together with a same goal of environmental improvement
- The result we obtained at Brittany scale led to an increase of environmental impacts per ton of feed for close territory (Pays de la Loire) because all the interesting feedstuffs have been used
  - => The global benefit is not so obvious.
- A complementary level of improvement would be to reduce the impact of feedstuff by changing the production practices or to develop the introduction of pea in crops rotations.

# Thank you for your attention!

## Any questions?

With the financial support of:

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[http://rmtelevagesenvironnement.org/bd\\_ecoalim.htm](http://rmtelevagesenvironnement.org/bd_ecoalim.htm)

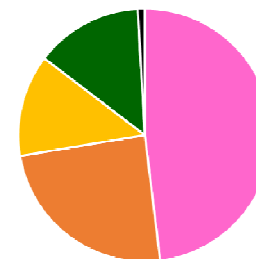


# Initial impact of feed for Brittany

Average impact of feed formulated at least cost (years 2011-2014)

/ ton of feed	Pig	Broiler	Laying hens	Cattle
CC (kg CO <sub>2</sub> eq)	546	791	637	<u>835</u>
P (kg P)	5,3	<u>9,8</u>	7,8	5,6
EG (MJ)	4838	6145	5396	<u>7347</u>
LO (m <sup>2</sup> .an)	1399	<u>1504</u>	1286	1487
AC (molc H <sup>+</sup> )	9,7	<u>11,4</u>	10,4	8,5
EU (kg eqPO <sub>4</sub> -)	3,7	<u>4,3</u>	3,7	3,9

Quantity of feed produced



- pig
- broilers
- laying hens
- cattle
- others

Distribution of the impacts of feed for different animal productions at Brittany level

