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N-efficiency and ammonia emission reduction potential through dietary adaptations in Swiss pig production

Annelies Bracher
Edith Sollberger
Peter Spring
SHL Zollikofen

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e-mail: annelies.bracher@bfh.ch

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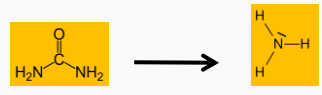
Ecological background



Ammonia emissions are linked to the N-cycle and affect ecosystems:

- **Eutrophication**
  - **Reduction in biodiversity**
  - **Reduction in plant resistance**
  - **Increased nitrate losses into ground water**
- **Acidification of soil and water systems**
- **Increased fine dust formation**

<u>At farm level:</u>

- **N-loss to agriculture, reduced N-efficiency**
- **Negative effects on animal health, performance**

Political background

Goeteborg protocol

- **Goals: abate acidification, eutrophication and ground level ozone**
- **Measures: emission ceilings for ammonia**
- **Long term target: reduce emissions below critical N-loads**

Implementation in Switzerland

National targets and regional implementation by Kantons (states). Time limited financial support of on-farm measures.

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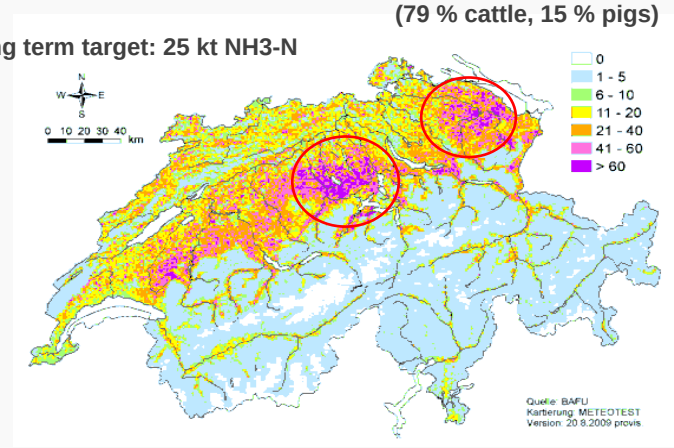
Ammonia emission inventory in CH

Total approx. 51 kt NH3-N → 85 % from animal production (79 % cattle, 15 % pigs)

Long term target: 25 kt NH3-N

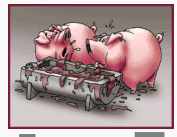


Kupper et al, 2009

Ammonia emission reduction strategies

‚begin of pipe' measures: feeding

N-flow in fattening pigs



15-25 %

Fecal-N

30-40 %

45-55 %

Urinary-N
Urea

NH_{3Gas}

Slurry-N
Urease
$[NH_3/NH_4^+]$

‚end of pipe' measures: spreading technique

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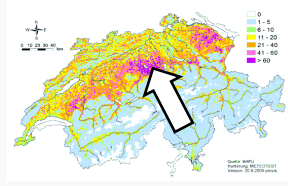
Objectives



1. Estimate existing ammonia reduction potential through adaptations in pig feeding.
2. Analyze the actual pig feeding practices in the Kt. Lucerne (region with highest ammonia emission in Switzerland).

Methods and data bases

1. Evaluation of Import-Export balances (N) from 1665 farms of Kt Lucerne

2. Survey of nutrient content and sales volumes of compound feed for pigs (data from leading Swiss feed mills)
3. Verification of declared nutrient composition based on data from the Swiss feed control
4. Calculation of emissions with the model Agrammon (http://agrammon.ch)

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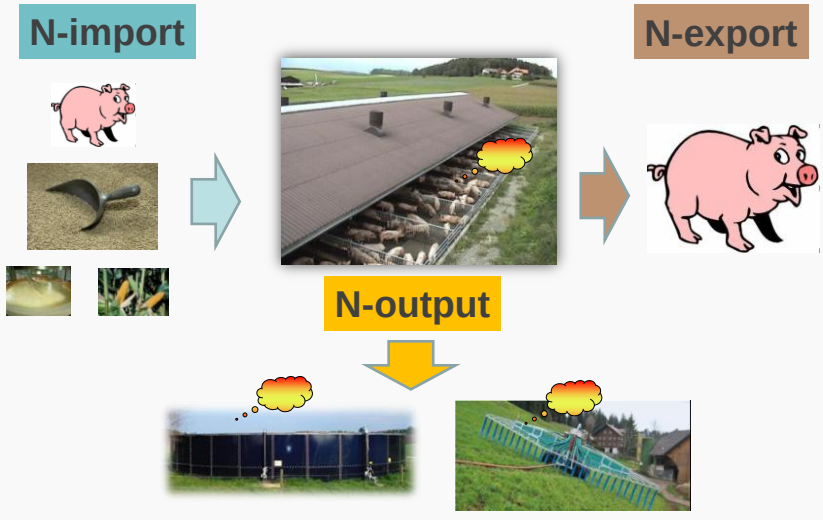
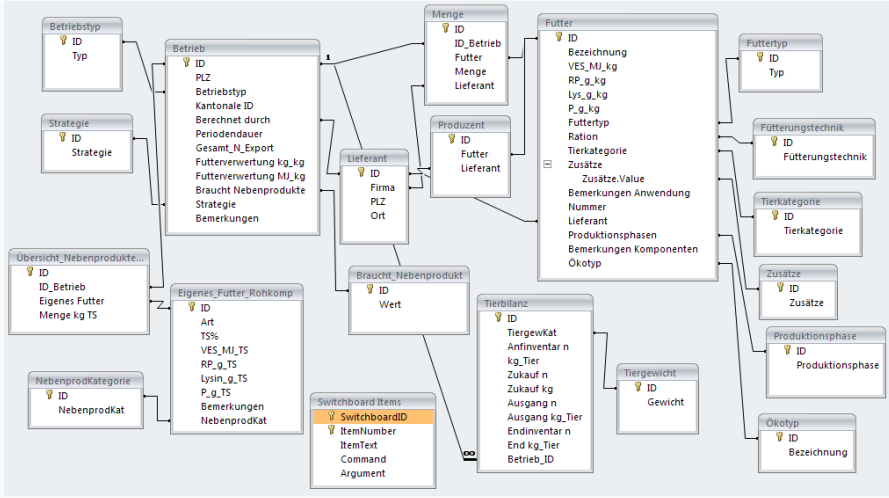
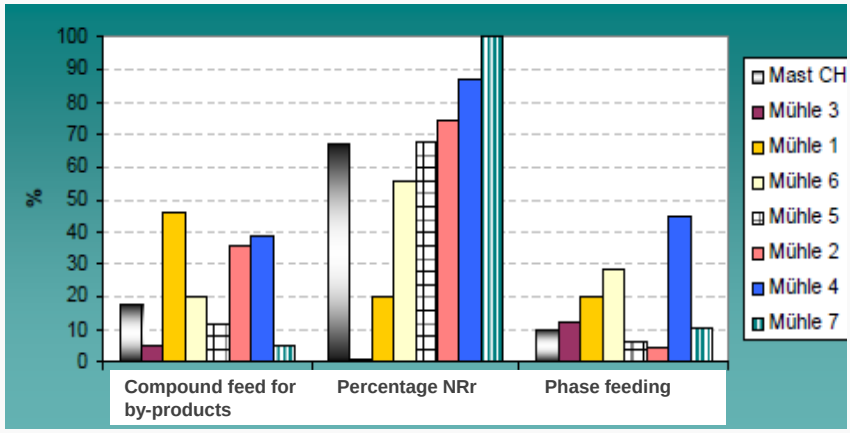
IMPEX Data: N-efficiency = N-export/N-input



Information processing by Access-DB



Percentage of feed with reduced P and N concentrations (NPr) in fattening feeds (feed mill survey 2008)



- ~ 70 % of sold fattening feeds are NPr with regional differences
- > 90 % of sold fattening feeds are NPr in the Kt. Lucerne
- phase feeding is not established

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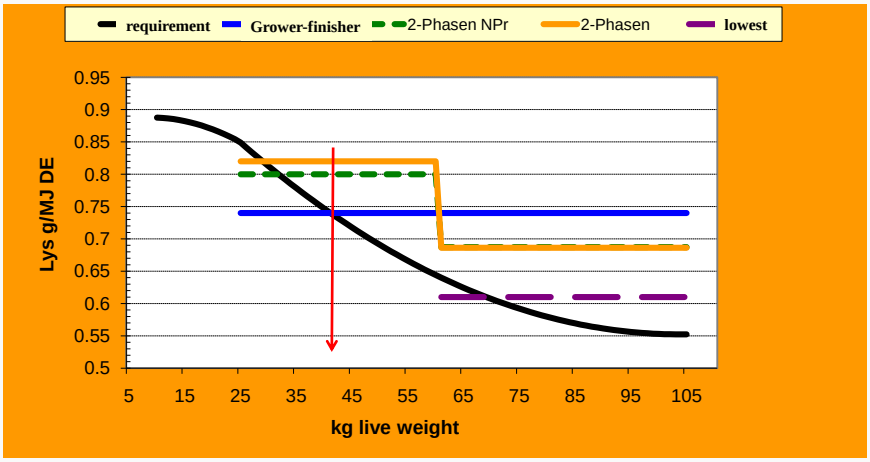
Average nutrient content in standard and NPr grower-finisher diets as the dominant feed type (feed mill survey 2008)

Feed	DE MJ/kg	CP g/kg	Lys g/kg	P g/kg	CP/ DE g/MJ
Standard feed	13.57	172.95	9.97	5.15	12.76
NPr feed	13.72	158.04	10.12	4.01	11.52

- Reduced CP and P-content
- Higher DE content
- Lysine identical on energy basis

Age dependent Lysine requirement for fattening pigs



Lysine content in grower-finisher diets is overformulated for finishing pigs

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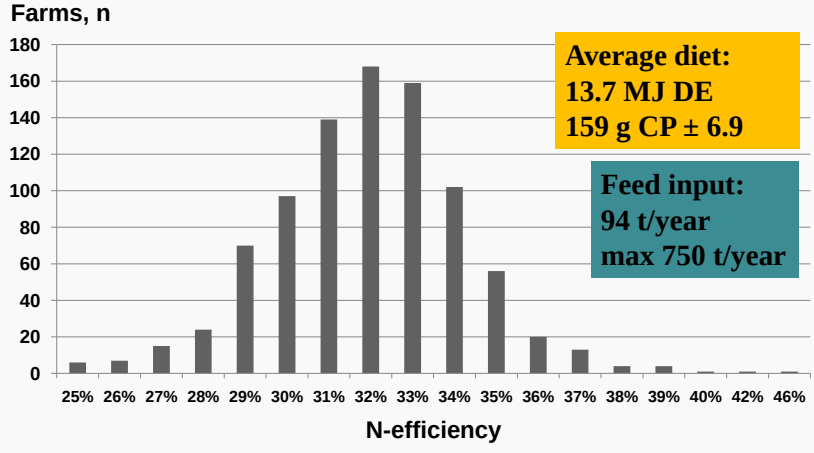
N-efficiency in fattening farms

(IMPEX-data)



Effect of feeding strategies

	n	Ø N-efficiency	Ø- CP concentration
All fattening farms	887	32%	159 g
1- phase feeding	134	31%	158 g
Starter and 1-phase feeding	343	32%	159 g
2 or 3-phase feeding	149	31%	161 g
Whey + compound feed	191	33%	156 g
Other by products than whey + compound feed	70	32%	163 g

➢ **No distinct differences, small superiority of farms feeding whey**

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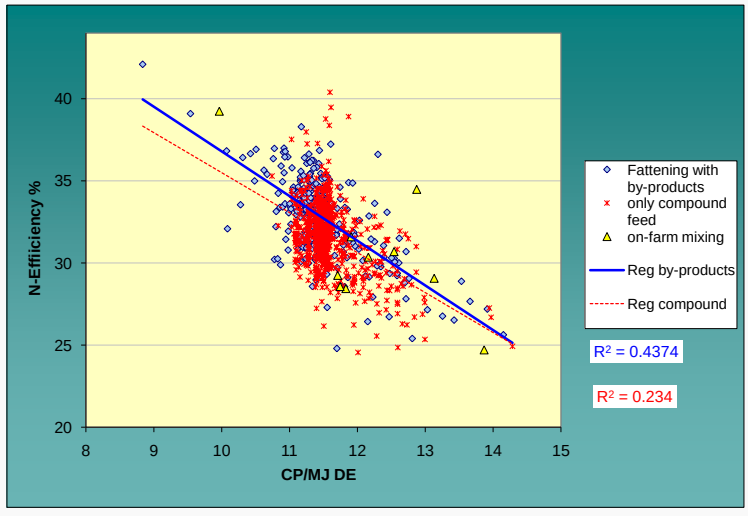
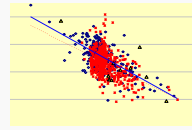
Effect of protein concentration (g CP/MJ DE)



Large variation in N-efficiency between farms with comparable feeding



An important part of the variation must be due to non dietary factors:

- **Genetic potential of animals**
- **Herd health status**
- **Hygiene**
- **Management**
- **Production system**

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Estimation of reduction potential with model **Agrammon** (Session 40, Poster 11)

	Conventional barn no measures*		Conventional barn measures*		Open barn no measures*		Open barn measures*	
	std	NPr	std	NPr	std	NPr	std	NPr
Grower/finisher per 100 places								
Total kg N /y	589	526	429	376	731	650	595	522
Ammonia reduction	**----**	**16%**	**----**	**13%**	**----**	**17%**	**----**	**13%**
Farrowing unit per 100 sows								
Total kg N /y	1248	1176	845	785	1522	1430	1168	1084
Ammonia reduction	**----**	**11%**	**----**	**8%**	**----**	**11%**	**----**	**8%**

Conclusions

1. **The declared nutrient values are correct.**
2. **70% (over 90% in animal dense regions) of Swiss farms are using NPr compound feed.**
3. **Average N-efficiency on grower-finisher farms is 32%.**
4. **The variability in N-efficiency is large and can only partially be explained by dietary CP concentration or feeding strategy.**
5. **Consequent implementation of phase feeding programs can further help reduce N-emissions even under NPr-conditions.**
6. **Genetic, health and managemement factors play a major role and pose a large potential to improve N-effciency and thus reduce ammonia emissions.**