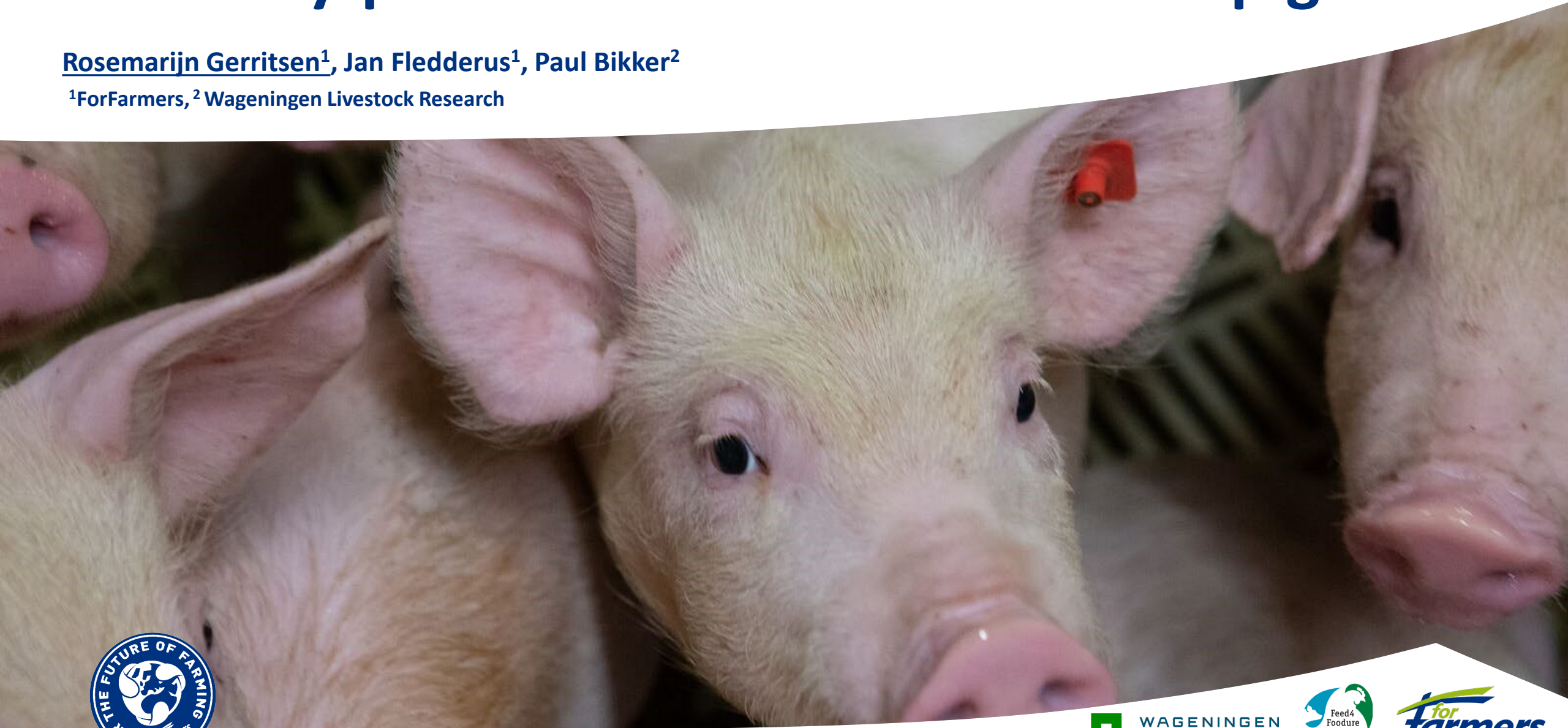


Cereal by-products in diets for weaned piglets

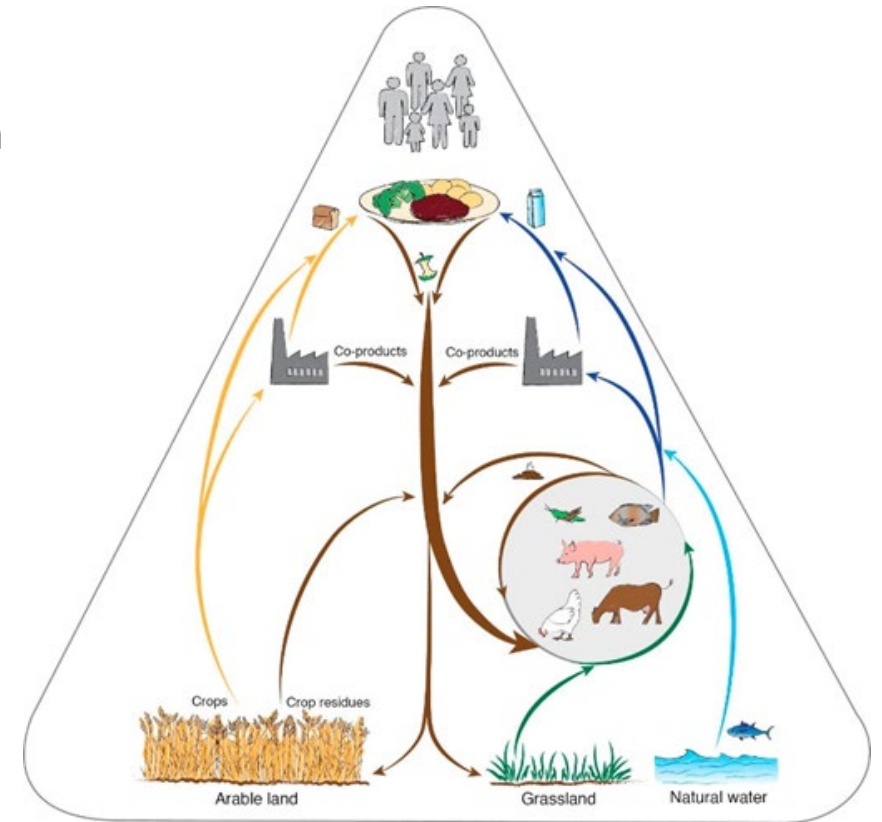
Rosemarijn Gerritsen¹, Jan Fledderus¹, Paul Bikker²

¹ForFarmers, ² Wageningen Livestock Research



Introduction (1)

- Food production has a major impact on sustainability parameters, such as environmental emissions, climate change and land-use (Bikker and Jansman, 2023)
- The competition between land-use for human food and animal feed production is reduced when less human edible raw materials are included in animal feed
- Major ingredients in pig feed are cereal grains. Replacing these by circular feed ingredients will reduce the competition for resources between food and feed production



Introduction (2)

- Circular feed ingredients are defined as:
 - > Co-products from human food industry
 - > Non-human edible raw materials
 - > Former food
- **Aim of this study:**
 - > to determine the effect of replacing human edible cereal grains (especially wheat) by human non-edible alternative raw materials in the feed
 - > This was realized by gradually replacing wheat by a high content of cereal by-products, like maize-DDGS and other co-products from the production of flour, starch, glucose, and ethanol



Experimental treatments

- 4 experimental treatments

Treatment	Description
1	Control (39.2% wheat)
2	33% replacement of wheat with cereal by-products
3	67% replacement of wheat with cereal by-products
4	100% replacement of wheat with cereal by-products

- Cereal by-products: Maize DDGS, maize feed meal, wheat gluten feed meal



Material & Methods

- Animals: Weaned piglets
- Genotype: TN70*Tempo
- Number of piglets: 660
- Weaning age: 27 days
- Housing: Pens with 11 piglets/pen at 0.4m² per piglet; litters stay together
- Experimental period: D7-D28 post-weaning
- Observations:
 - ADG, ADFI and FCR were calculated per pen
 - Faecal consistency recorded by same observer on D9, 12, 21, 28 (score 1-4)
 - Fresh faecal grab samples were collected in week 4 to determine total tract digestibility of nutrients
- Statistical analysis:
 - ANOVA with pen as experimental unit
 - Covariate: initial body weight at D7 post-weaning
 - Factors: treatment linear and treatment quadratic



Diet composition: raw materials

Replacement Wheat	0%	33%	67%	100%
Wheat	39.2	26.0	12.9	-
Wheat gluten feed meal	-	5.0	10.0	15.0
Maize feed meal	-	3.8	7.6	11.4
Maize DDGS	-	5.5	10.9	16.4
Soybean oil	0.4	1.0	1.6	2.2
Soybean meal	9.5	7.9	6.3	4.7
Barley	28.0	28.0	28.0	27.7
Toasted soybeans	7.0	7.0	7.0	7.0
Potato protein	2.0	2.0	2.0	2.0
Wheat bran	7.5	7.5	7.5	7.5
Coconut oil	0.3	0.3	0.3	0.3
Molasses	1.0	1.0	1.0	1.0
Premix	3.4	3.3	3.2	3.0
Amino Acids	0.7	0.7	0.7	0.8
Acid	1.0	1.0	1.0	1.0



Diet composition: nutrients

Replacement Wheat		0%	33%	67%	100%
Crude protein	g/kg	175	176	178	179
Crude fat	g/kg	45	58	70	82
Crude fibre	g/kg	36	41	45	50
Starch	g/kg	377	342	306	272
NE swine	MJ	9.68	9.68	9.68	9.68
SID lysine	g/kg	10.3	10.3	10.4	10.4
Phosphorus	g/kg	5.1	5.2	5.4	5.6
Digestible P (STTD)	g/kg	3.6	3.6	3.6	3.6
CFP incl LUC	g CO2 eq	865	882	901	919
CFP excl LUC	g CO2 eq	614	631	650	667

- Diets met CVB (2020) requirements for amino acids and minerals; energy and lysine levels were kept similar
- Cereal by-product diets higher in fat, crude fibre and phosphorus (P)
- Cereal by-products diets higher in CO2 footprint both incl and excl LUC



CO2 footprint based on Nevdi 2022 (list version 5). LUC= Land Use Change



Results: piglet performance

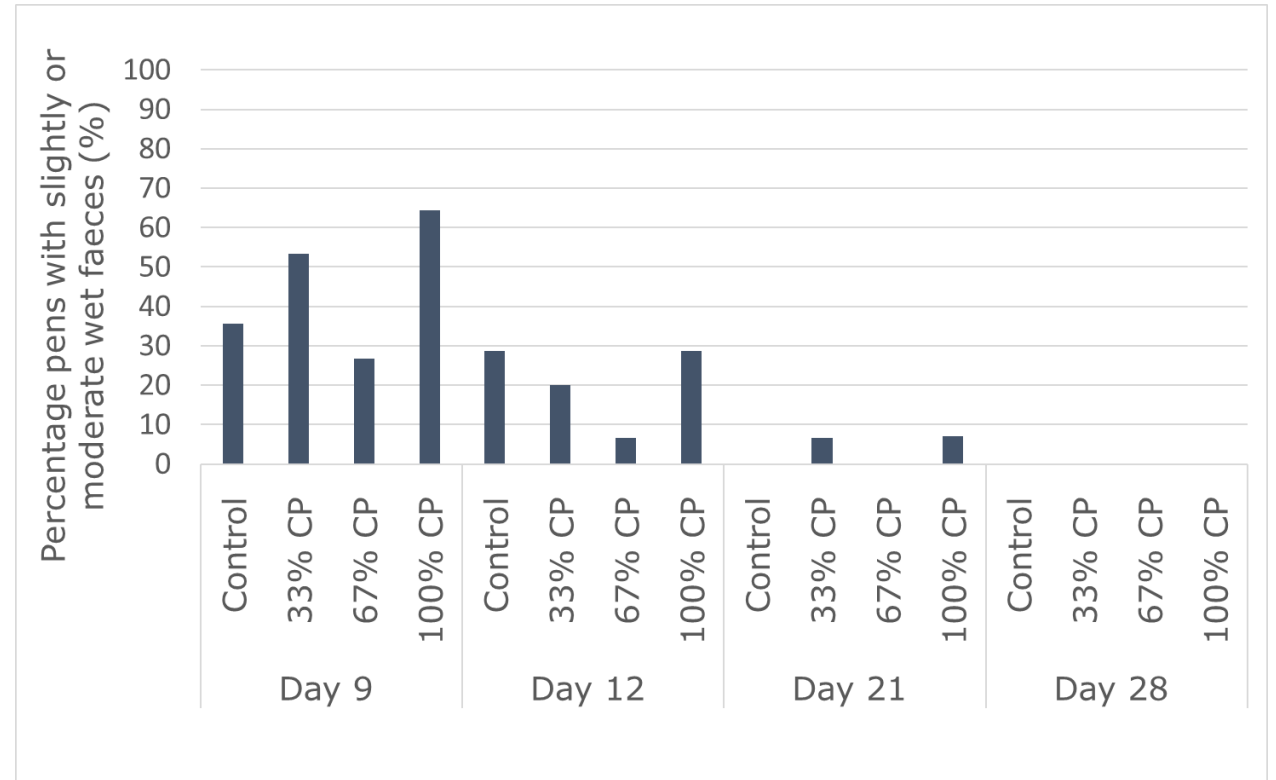
D7-28	Control	33% CP	67% CP	100% CP	SEM	P-value	
						Linear	Quadratic
ADFI (g/d)	611	591	609	580	22.3	0.462	0.84
ADG (g/d)	443	424	412	403	15.5	0.062	0.744
FCR	1.38	1.40	1.48	1.44	0.021	0.009	0.135

- D7-28
 - > Replacement of wheat with cereal by-products tended to linearly decrease ADG
 - > A significant linear effect was found on FCR
- D7-14
 - > Significant linear effect ADG -> replacement costs approx. 30g/d
 - > Tendency linear effect FCR -> 0.1-0.16 increase
 - > D14-D28 -> no effects on performance observed



Results: faecal consistency

- Faecal consistency was affected by the time post weaning and improved during the trial, with nearly all pens having the required optimum faecal consistency (score 4) from day 21 onwards
- Replacing wheat by cereal by-products did not significantly affect faecal consistency throughout the experiment
- No difference found compared to control in % pens with slightly or moderate wet faeces



Results: total tract digestibility (ATTD)

ATTD (%)	Control	33% CP	67% CP	100% CP	SEM	P-value	
						Linear	Quadratic
Dry matter	80.3	75.1	75.6	75.0	0.6	<0.001	0.150
Organic matter	84.1	82.1	79.8	79.0	0.5	<0.001	0.219
Crude ash	62.8	61.9	58.9	58.9	1.1	0.006	0.648
Crude protein	78.7	75.9	72.6	71.9	0.7	<0.001	0.152
Crude fat	70.3	73.6	74.8	77.2	0.8	<0.001	0.554
NSP	47.6	44.2	45.8	51.7	1.7	0.085	0.012

- A significant linear decrease was found for digestibility of dry matter, organic matter, crude ash and crude protein
- A significant linear increase was found for digestibility of fat
- A tendency towards a linear increase in NSP digestibility was found



Results: CO2 footprint, N- and P- efficiency

	Control	33% CP	67% CP	100% CP	SEM	P-value	
						Linear	Quadratic
CO ₂ footprint incl. LUC (g CO ₂ -eq/kg gain)	1194	1233	1336	1320	18.9	<0.001	0.149
CO ₂ footprint excl. LUC (g CO ₂ -eq/kg gain)	843	883	969	957	13.3	<0.001	0.137
N-efficiency (%)	65.4	63.9	59.9	61.4	0.9	<0.001	0.087
P-efficiency (%)	76.1	73.6	66.9	66.4	1.0	<0.001	0.316

- Replacing wheat by cereal by-products resulted in significant linear increase of CO2-footprint per kilo of body weight gain, for excluding as well as including LUC,
- A significant linear reduction of nitrogen and phosphorus efficiency was found when replacing wheat with cereal by-products



CO₂ eq based on Nevedi (2022) version 5;
N and P efficiency based on calculated N and P content in the diets and standard values for N and P content in pigs at start and finish of 0.0244 and 0.0248 kg N/kg BW and 0.0122 and 0.0122 kg P₂O₅/kg BW. Source: Table 5 "Stikstof en fosfaat in dieren" from RVO (2020).

Discussion

- **Effects on piglet performance**
 - > Processing may have reduced the content of intact lysine, and the realized ileal amino acid digestibility in the products used in this study
- **CO2 footprint**
 - > The increased CO2 footprint values of the wheat-free diet (100% CP) are related to the intensity of the production process by the food industry.
 - > All technological treatments, like drying or mixing, after separation of the cereal by-products from the main product add to the -value of these by-products. This explains the relative high CFP-values for raw materials like wheat gluten feed meal and maize DDGS.
- **N- and P-efficiency**
 - > Effects can be explained by the effects on FCR and relatively high N and P contents in the diets



Conclusions



(Complete) replacement of wheat by cereal by-products as used in this study:
negatively affects piglet performance, carbon footprint and N- and P- efficiency
does not affect faecal consistency



The effects are largely caused by the lower digestibility and high total N and P content of the by-products





Questions?

