Lowering the carbon and ammonia footprints of dairy production in Ireland

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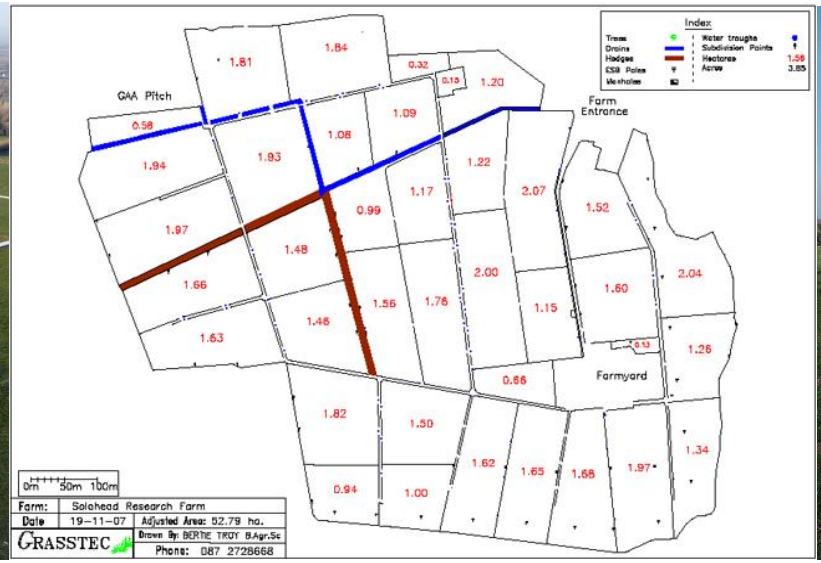
Solohead Research Farm

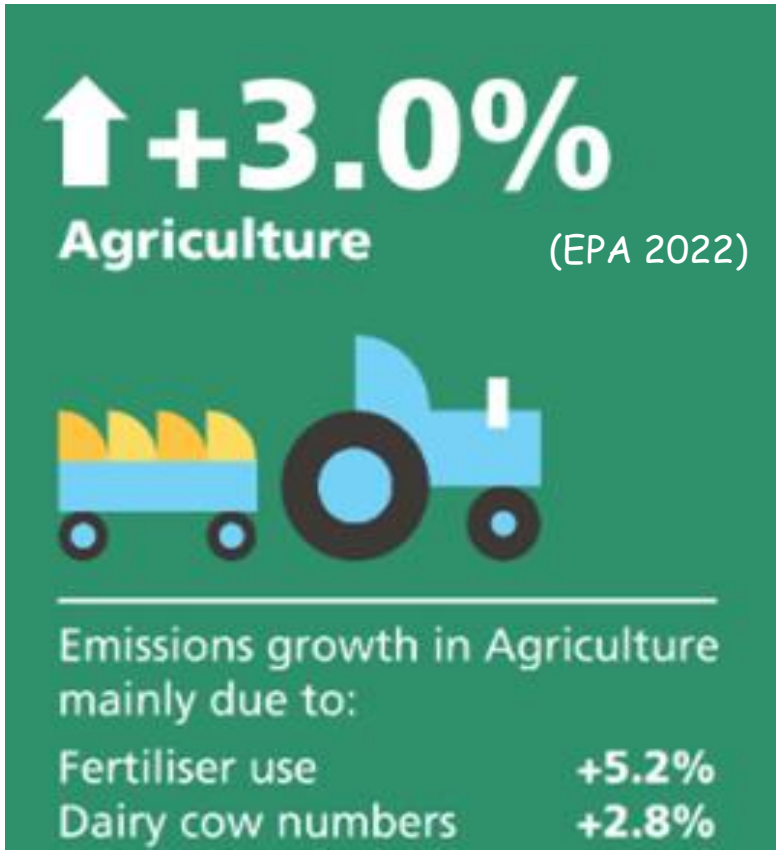
Location: Co. Tipperary, Ireland. (52°51'N, 08°21'W)

140 cows on 52 hectares

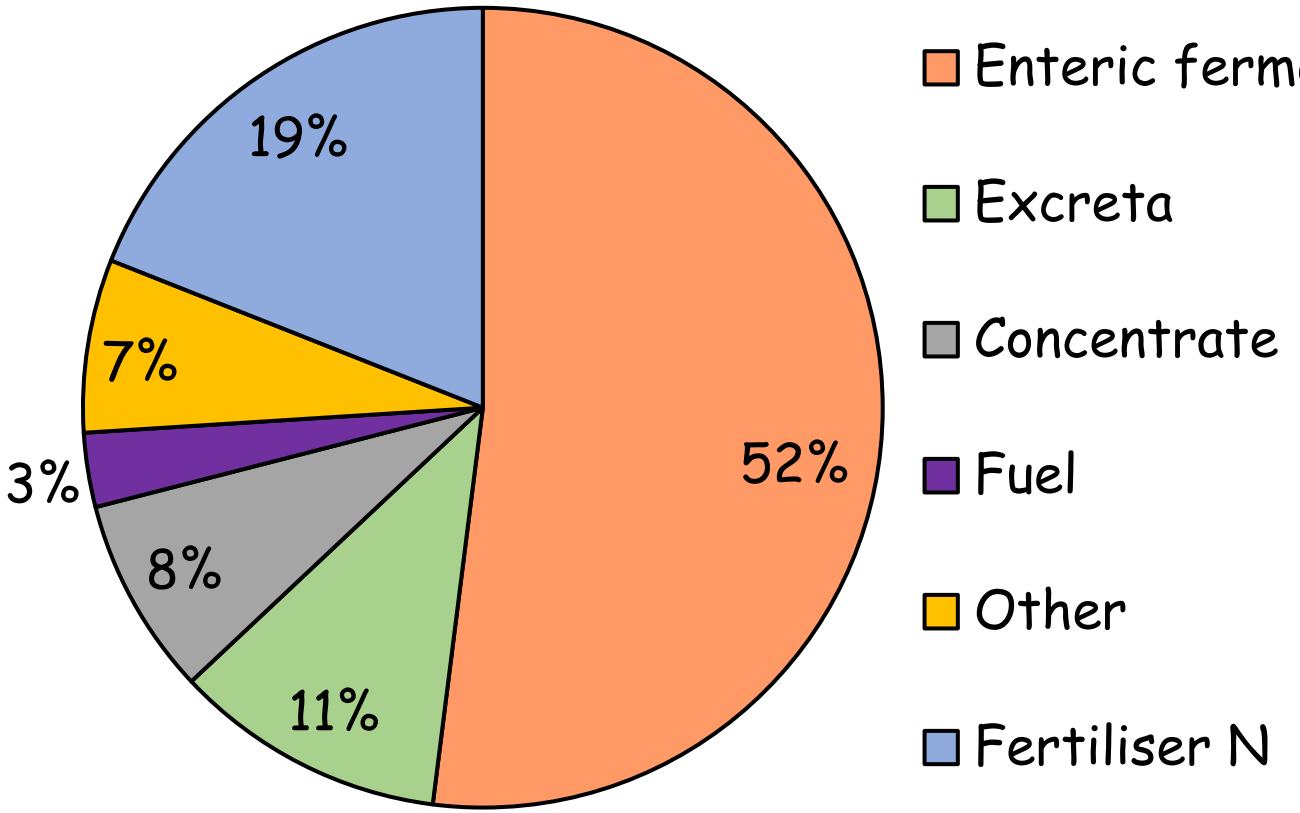
Long term research on the environmental impact of dairy systems



Background


+3.0%
Agriculture
(EPA 2022)
Emissions growth in Agriculture mainly due to:
Fertiliser use +5.2%
Dairy cow numbers +2.8%

The carbon footprint of intensive dairy farms in Ireland
(Sorley et al. 2022)



Farm Characteristics	
Stocking rate (LU/ha)	2.42
Fertilizer N (kg/ha)	272
C Footprint ($kgCO_2$/kg FPCM)	1.18

Base line for the present study

Objectives

Investigate the impact of "off the shelf" technologies to lower GHG emissions from Irish pasture based dairy production

Assess the impact on production and profitability

"Off the shelf" technologies

White and red clover

Protected urea

Low emissions slurry spreading

High genetic merit cows (Economic Breeding Index)

Characteristics of three dairy systems at Solohead Research Farm

2019-2021: Stocking Rate 2.5 cows/ha; 27 cows per system

System	FN-260	FN-108	FN-0
N fertiliser (kg /ha)	260	108	0
N fertiliser type	Urea and CAN	NBPT urea	
Clover contents (%)	11	23	30
Slurry application	Splash plate	Trailing shoe	Trailing shoe
Herd EBI (€)	145	145	185

Pasture production 2019-2021

System	FN-260	FN-108	FN-0	SEM & P-value
Total herbage (t DM/ha)	15.7	15.2	15.2	0.15*
Clover (t DM/ha)	1.6	3.1	4.1	0.40*
Biological Nitrogen fixation (kg/ha)	20	164	267	35***

*** P < 0.001; * P < 0.05

Modelled scenarios 50 ha farm

System	FN-260	FN-108	FN-0
Fertiliser N (kg/ha)	260	108	0
Herbage production	15.7	15.2	15.2
Stocking rate (LU/ha)	2.54	2.47	2.47
Concentrate (kg/cow)	550	550	550

Modelled results

System	FN-260	FN-108	FN-0	SEM & P-value
GHG (kg CO_2eq/kg FPCM)	0.90	0.78	0.69	0.014***
GHG emissions (t CO_2eq./ha)	12.8	11.2	9.8	0.27***
Ammonia (kg/t FPCM)	3.60	2.71	2.16	0.35*

* P < 0.05; *** P < 0.001

Nitrous oxide emissions factors at Solohead Research Farm

Solohead 2009-2013 (Li et al, 2011; Burchill et al, 2014)

Treatment	Background	Clover-BNF	FN-205	P-value
Fertiliser nitrogen (kg N/ha)	0	0	205	
Annual N_2O emissions (kg N/ha/yr)	2.38	2.45	7.82	1.5*

Solohead 2020-2022

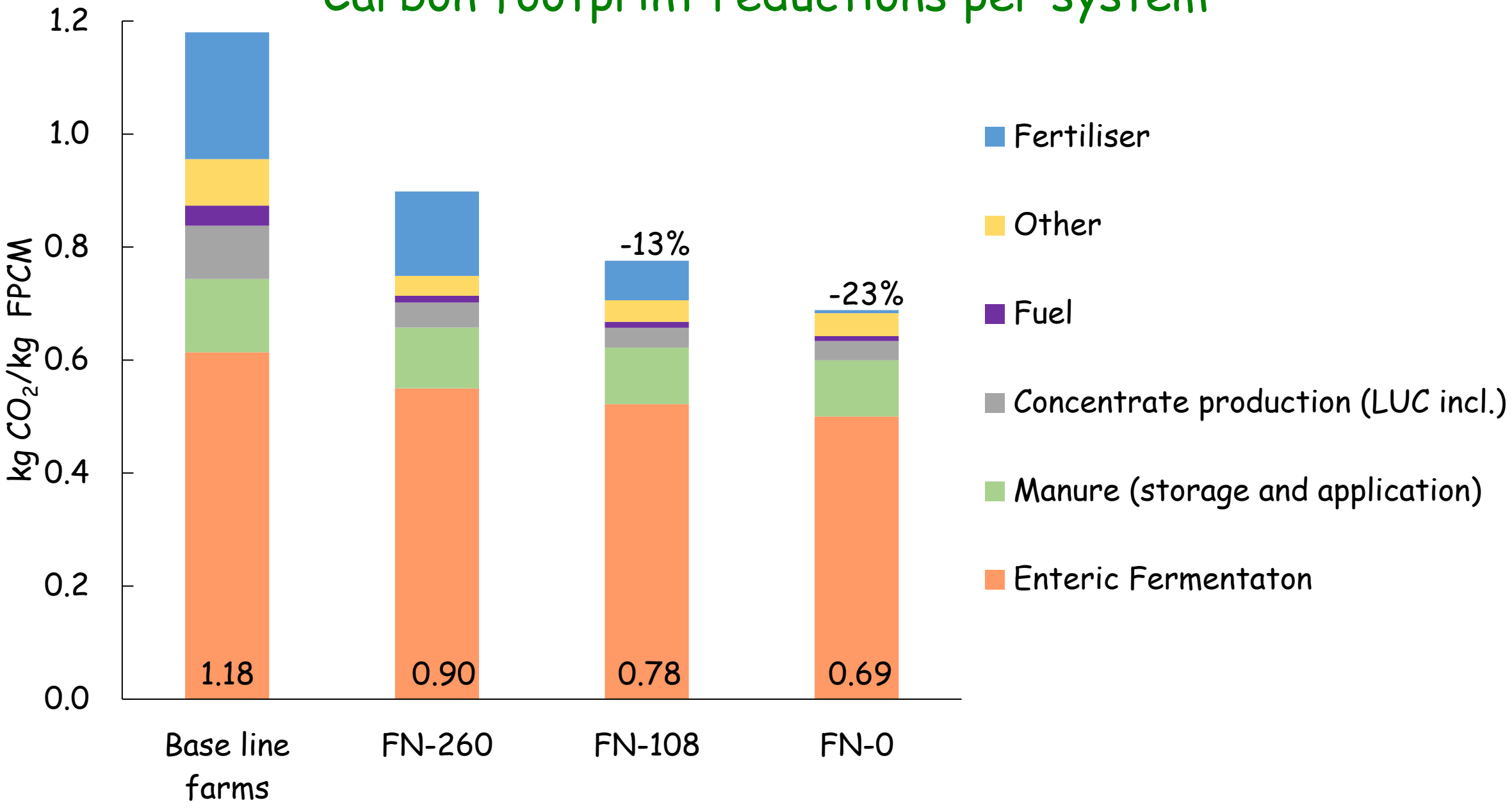
Treatment	Background	Clover-BNF	FN-250	SEM
Fertiliser nitrogen (kg N/ha)	0	0	250	
Annual N_2O emissions (kg N/ha/yr)	2.59	1.82	9.98	0.94***
Herbage production (tDM/ha)	8.1	14.9	15.4	1.9***

* P<0.05; *** P < 0.001

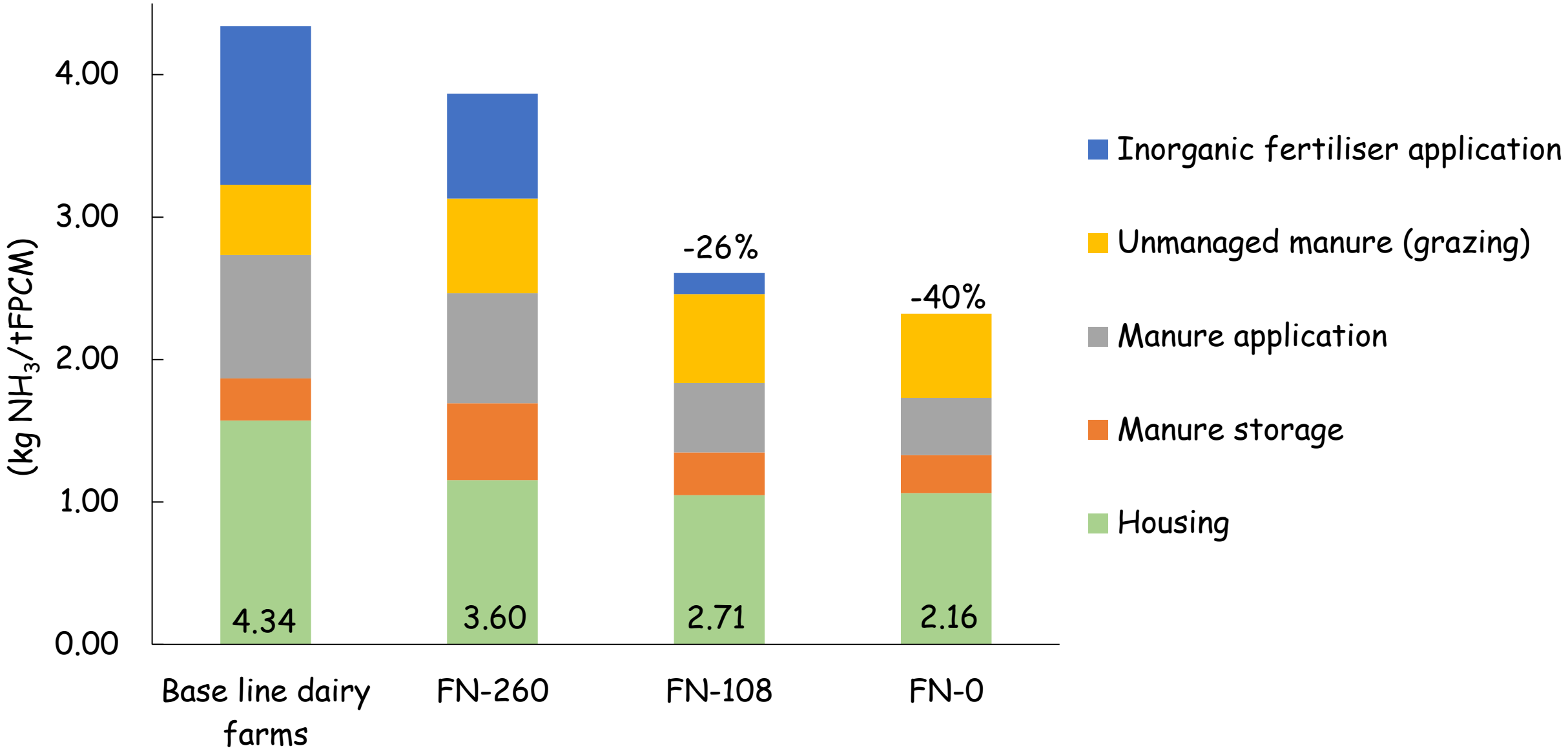
Economic performance of the three systems

System	FN-260	FN-108	FN-0	SEM & P-Value
Milk Sales (€)	253,728	251,802	253,795	
Total Sales (€)	277,746	275,180	277,135	
Fertiliser Nitrogen (€)	12,967	5,355	0	
Total Variable costs (€)	96,561	92,033	87,049	
Total Fixed costs (€)	107,685	105,097	105,336	
Net margin (€)	73,500	78,050	84,750	
Net margin per hectare (€/ha)	1,470	1,561	1,695	P=0.066

Carbon footprint reductions per system



Ammonia emissions (kg/tFPCM) reductions per system



Conclusions

Maintain profitability with lower carbon & ammonia footprints per litre and per hectare

Replacing fertiliser nitrogen with BNF was the single biggest mitigation technology

Lower stocking rate and higher EBI also lowered carbon & ammonia emissions

LESS lowered ammonia emissions & increases herbage production

Protected urea was redundant in this study

Scope to lower emissions & maintain net margin using existing technologies

The challenge will be to get adoption of these technologies on farms

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