

Simulation of strategies on ammonia and GHG emissions and economics

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Scenarios study with simulation tool Dairy Wise

1. Separate strategies

1. Production per cow
2. Young stock
3. Grass : maize
4. Clover
5. Grazing

2. Combination of strategies

1. Extensive
2. Extensive organic
3. Intensive



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DairyWise, A Whole-Farm Dairy Model

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Economics of environmental measures on experimental farm ‘De Marke’

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Output

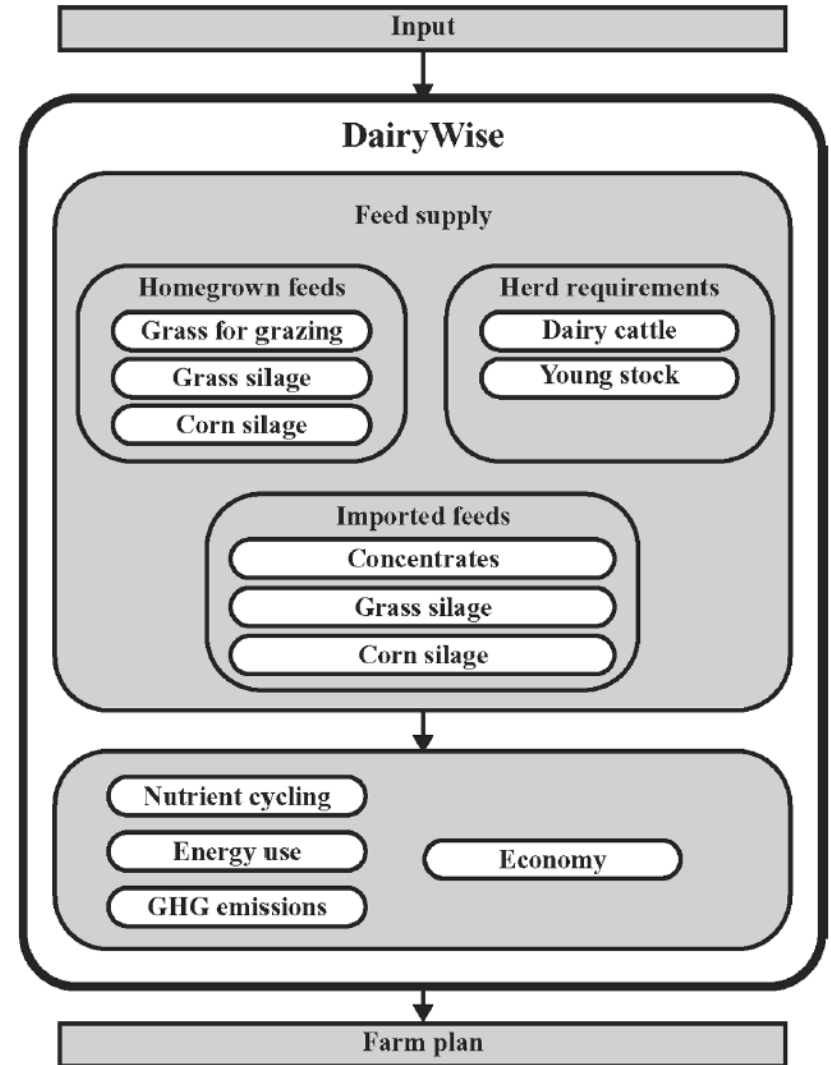
1. Technical

- fertilizing and crop production
- feeding and milk production

2. Environment

- nutrient cycle
- N-losses: ammonia and leaching
- GHG (CO₂-eq)
- energy use

3. Economics



Items	Unit	Baseline
Number of dairy cows	(number)	60
Number of heifers	(number)	21
Number of calves	(number)	20
Youngstock intensity	(Youngstock/10 cow)	6.70
Stocking rate	(cow/ha)	1.54
Milk production	(kg/cow)	8,500
Milk production	(kg/ha)	13,077
Milk production	(kg/farm)	510,000
Cultivation area	(ha)	39
grassland area	(ha)	33
maize land area	(ha)	6
Grazing intensity	(days/year)	180
Grazing intensity	(hours/day)	7
Milk price	(€/kg)	0.38
Cultivation of clover	(-)	no
Type of stall	(-)	harm with



Mitigation strategy	Unit	Low level	Medium level	High level
Increasing milk production	kg milk per cow	6,000	8,500	10,000
Increasing longevity	youngstock per 10 cows	5.0	6.7	10.0
Expansion of grassland	grassland area (ha): maize land area (ha)	20:20	33:6	39:0
Sowing clover on grasslands	(-)	NO	Yes	
Increasing grazing intensity	hours per year	900	1,620	3,600

Emissions (NH₃ and GHG) and economic



Turnover (€/farm)

direct costs and contract work and land



On-farm emissions (g CO₂-eq / kg FPCM)



Off-farm emissions (g CO₂-eq / kg FPCM)

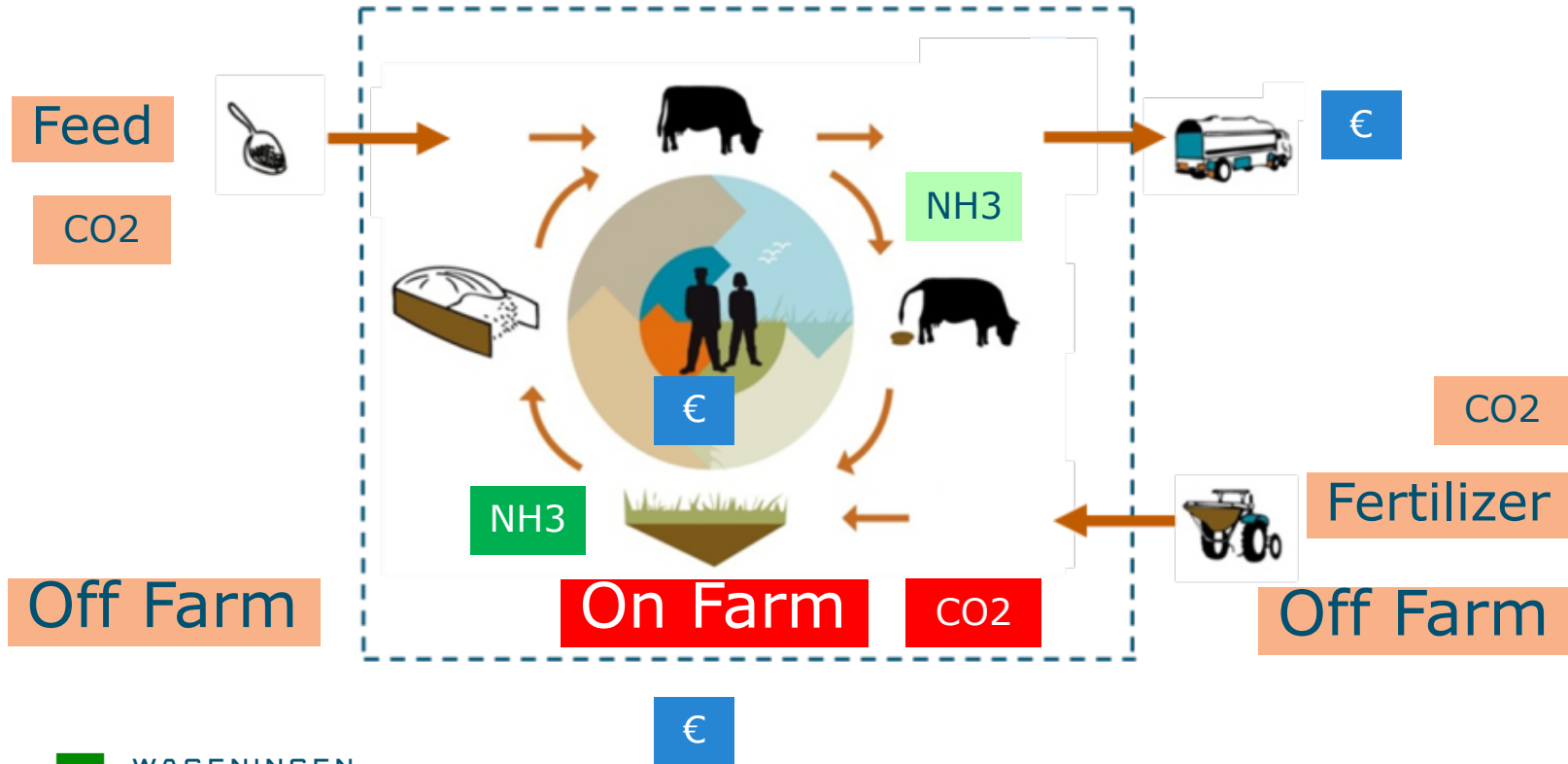


Total NH₃ emissions from stable and manure storage
(Indoor: kg NH₃ / Livestock Unit (LU))

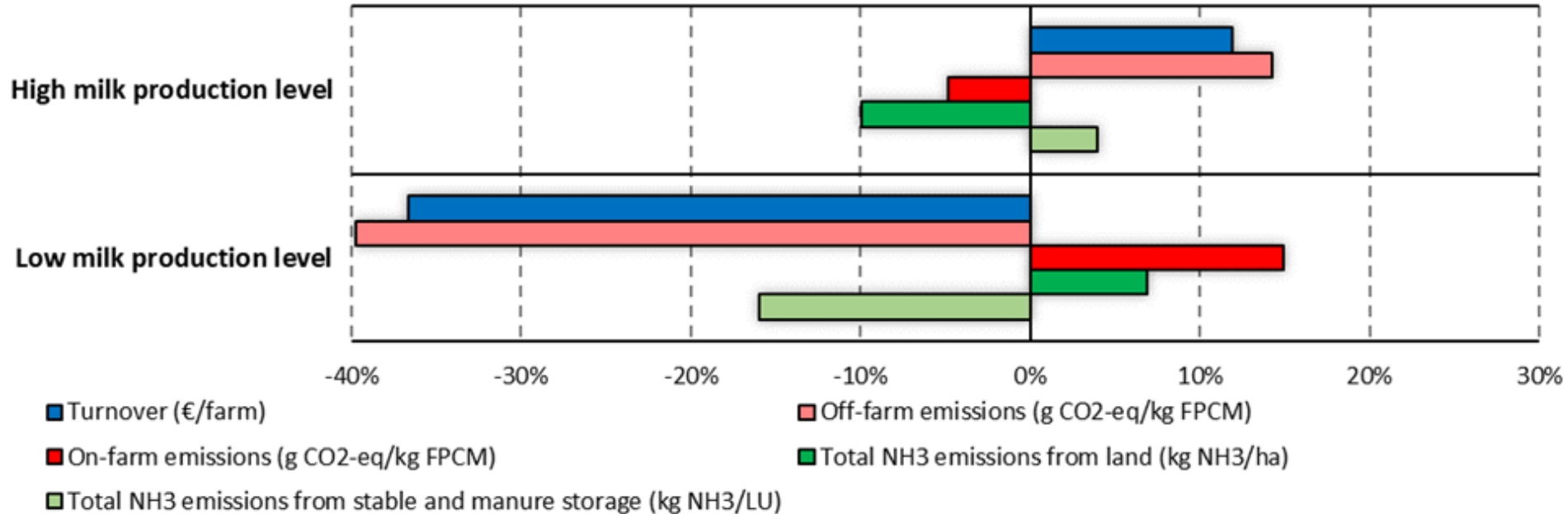


Total NH₃ emissions from land (kg NH₃ / ha)

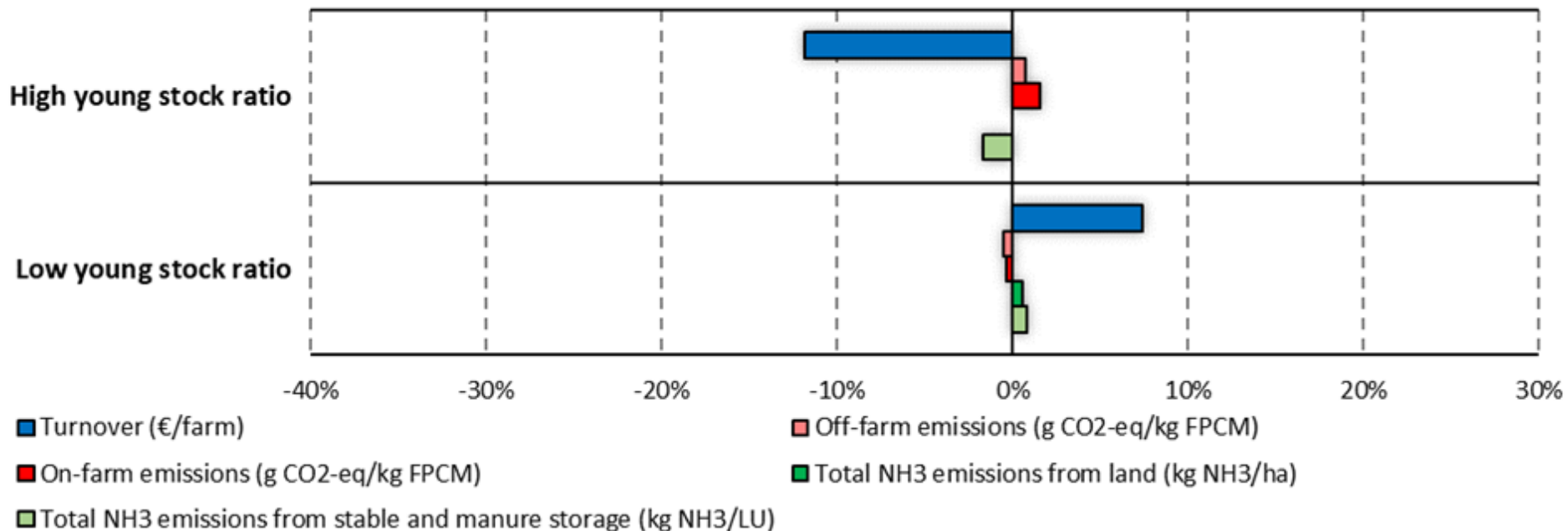
Nutriënt cycle and emissions (on- and off farm)



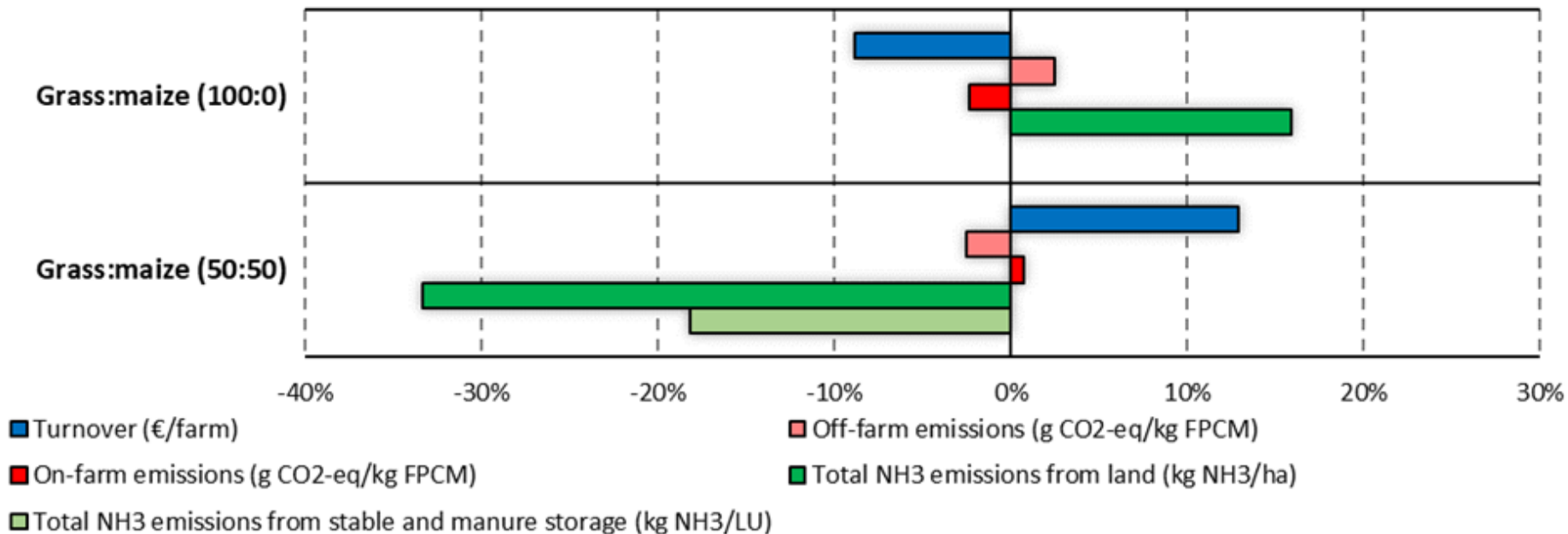
Increasing milk per cow (10.000 vs 6.000)



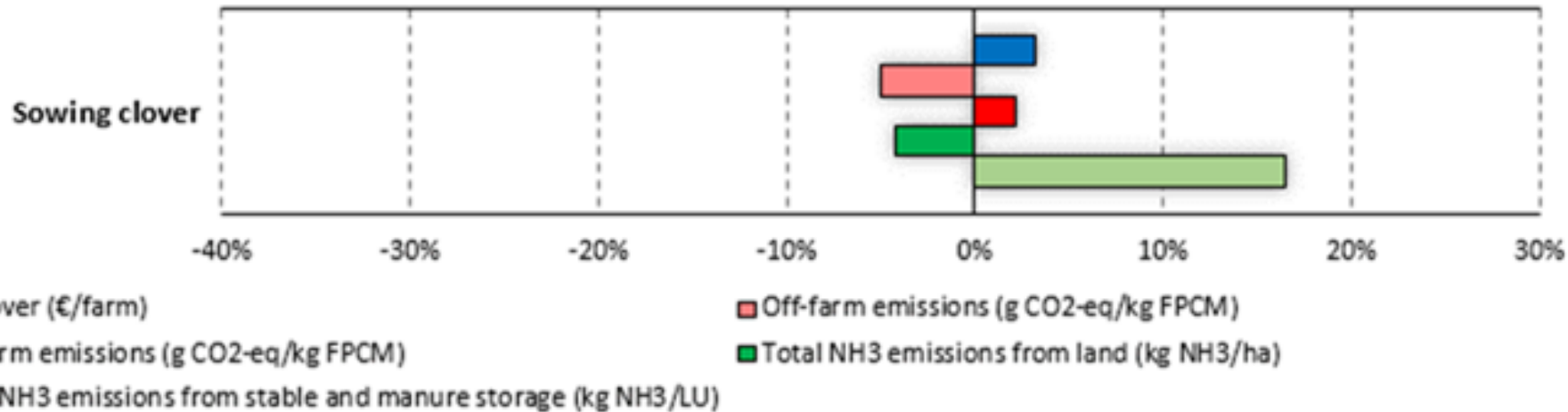
Less young stock per 10 cows (5 vs 10)



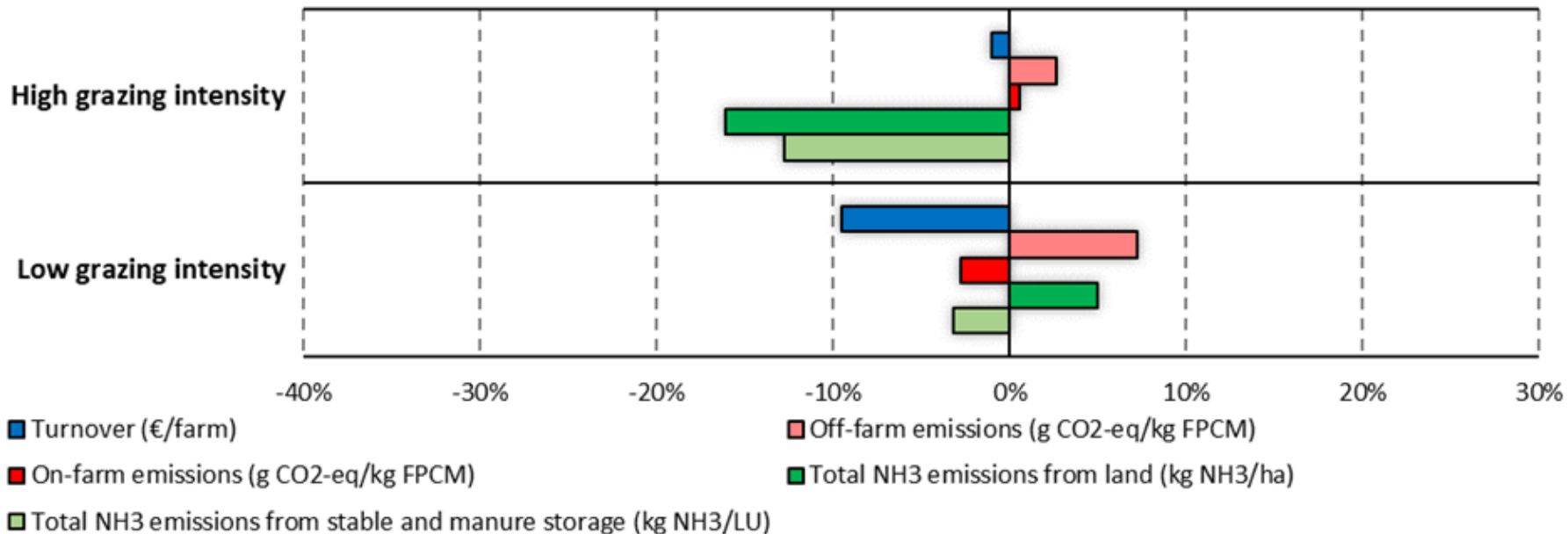
More grassland (100% vs 50%)



Clover



More grazing (3600 vs 900 hours per year)



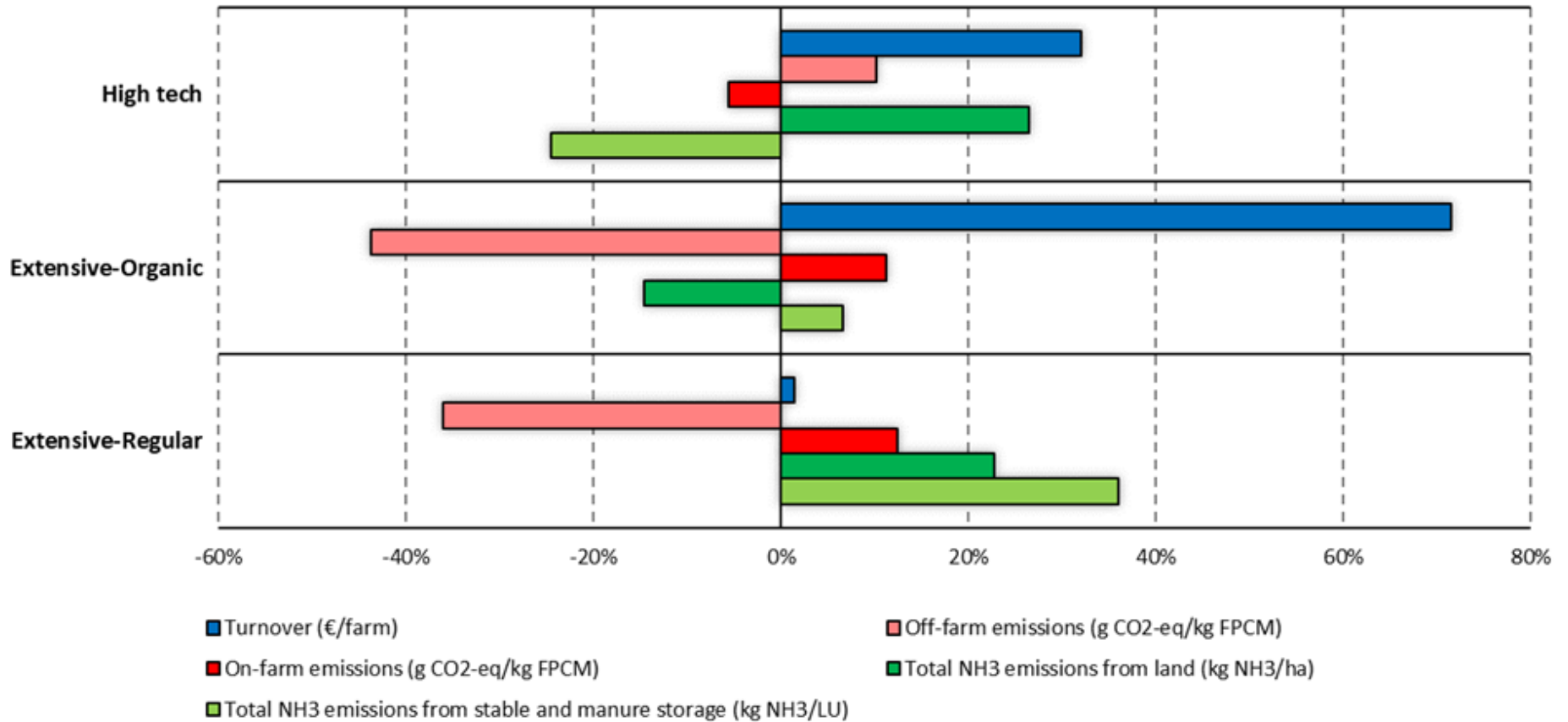
Scenarios study with simulation tool Dairy Wise

2. Combination of strategies

1. Extensive
2. Extensive organic
3. Intensive



Items	Unit	Base line	Extensive -Regular	Extensive-Organic	High-tech
Number of dairy cows	(number)	60	60	60	85
Number of heifers	(number)	21	21	21	29
Number of calves	(number)	20	20	20	28
Youngstock intensity	Young/10cows	6.70	6.70	6.70	6.70
Stocking rate	(cow/ha)	1.54	1.28	1.28	2.18
Milk production	(kg/cow)	8,500	7,000	7,000	11,000
Milk production	(kg/ha)	13,077	8,974	8,974	23,974
Milk production	(kg/farm)	510,000	420,000	420,000	935,000
Cultivation area	(ha)	39	47	47	39
grassland area	(ha)	33	40	40	33
maize land area	(ha)	6	7	7	6
Grazing intensity	(days/year)	180	179	178	0
Grazing intensity	(hours/day)	7	10	10	0
Milk price	(€/kg)	0.38	0.38	0.50	0.37
Cultivation of clover	(-)	no	yes	yes	no
Type of stall	(-)	slatted	slatted floor	slatted floor	Low emission



Summary

Strategy	Economic	GHG		NH3		Remark
	farm	on-farm	off-farm	indoor	land	
more milk per cow	++	+	--	-		more milk, more feed
less young stock per cow	+					less feed
more grass	-			-	--	more N feed-manure
clover				-		more N feed-manure
more grazing				+	+	less grass production
Farming systems						
Intensive-high tech	++		-	++	--	low emission floor
Extensive Organic	+++	-	+++		+	less input, milkprice
Extensive Regular			++	-	--	more N feed-manure

++	very positive	high income, low emissions
+	positive	
	no or small effect	
-	negative	
--	very negative	low income, high emissions

Conclusions and attention points

- Expression NH₃: barn and storage per LU, land per ha
- Expression CO₂-eq: per ha, be aware trade offs on farm vs off farm
- Extensive organic farming attractive: high income, low off farm CO₂
- Extensive farming may result in higher NH₃ emissions depending on protein in diet and manure
- Intensive: indoor, high cows per ha and high production per cow is economic attractive depending on investment high technology, but results in more feed (high off farm CO₂) and less grazing (more NH₃)

Thanks

Questions?

Paul Galama

