UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI SCIENZE AGRARIE ED AMBIENTALI

Environmental impact of dairy farming systems in Denmark, Germany and Italy

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BACKGROUND

- Dairy producers will meet increasing environmental demands in the future (limits on GHG emissions etc.)
- Removal of milk quota might accelerate the process of intensification and specialization
- Best strategy for efficient and environmentally friendly dairy systems?

AIM OF THE STUDY

- To analyze the environmental impact of different dairy farming systems in Denmark, Germany and Italy performing an LCA

- To identify the most important parameters influencing the environmental sustainability

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LCA – FROM CRADLE TO FARM GATE

OFF-FARM

ON-FARM

Energy

Crop production

Enteric emissions

Storages

Stables

LCA: TOOL AND IMPACT CATEGORIES

OFF-FARM

ON-FARM

Global Warming Potential: kg CO_2 eq.

Eutrophication potential: g PO^{3-}_4 eq.

Land use: m^2

Non renewable energy use: MJ eq.

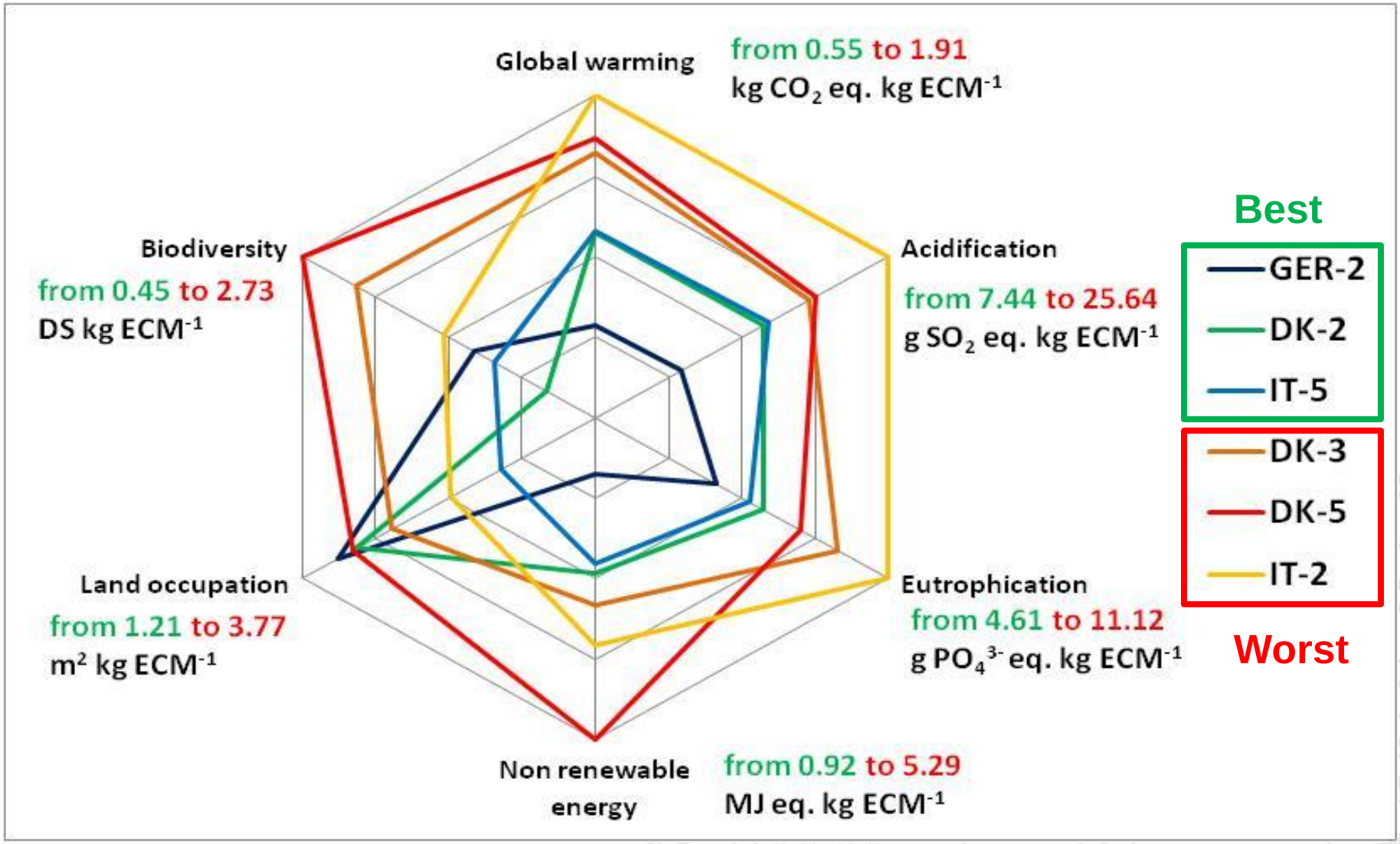
Acidification potential: g SO_2 eq.

Biodiversity: Damage Score (DS)

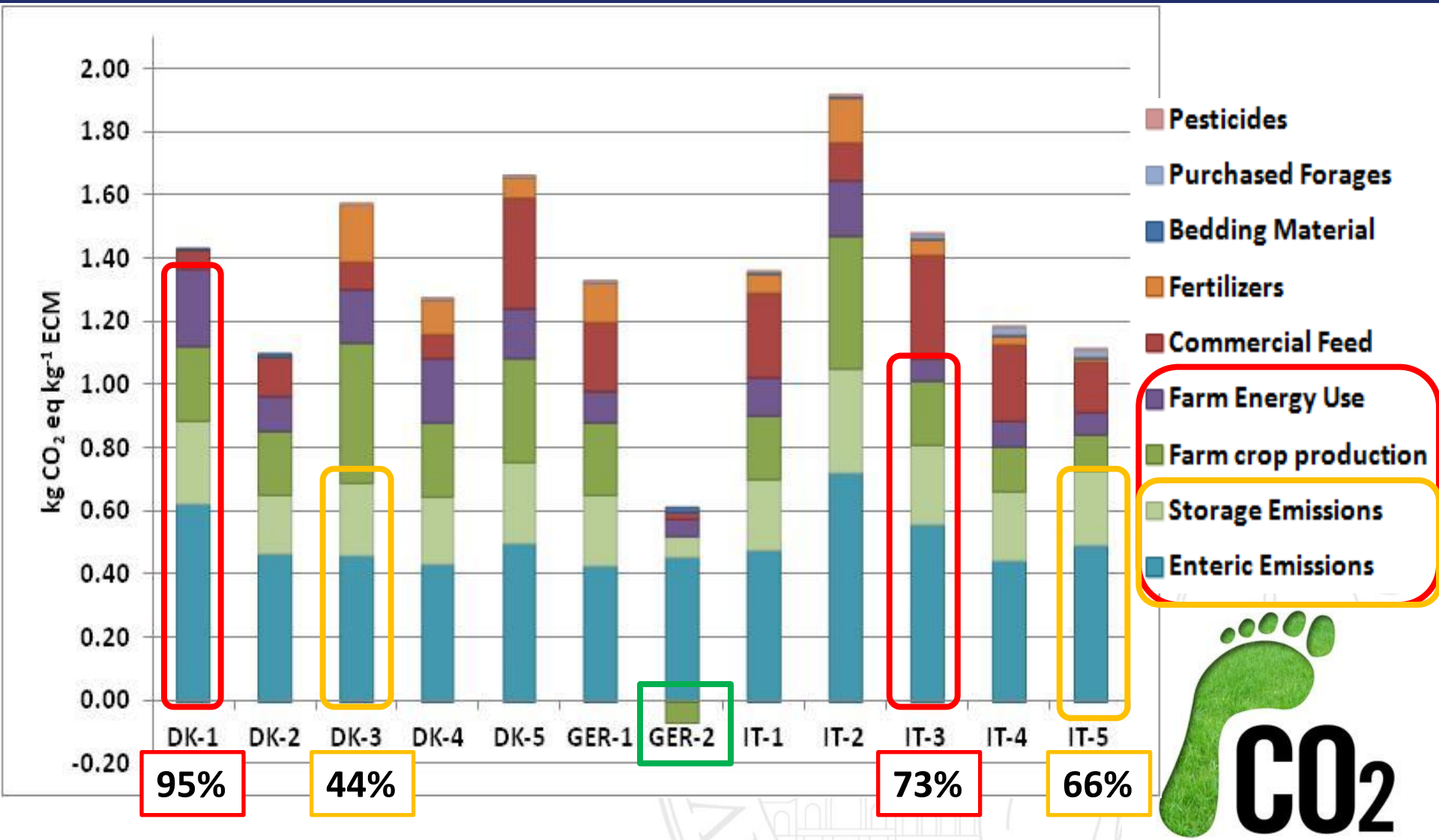
FARMS CHARACTERISTICS

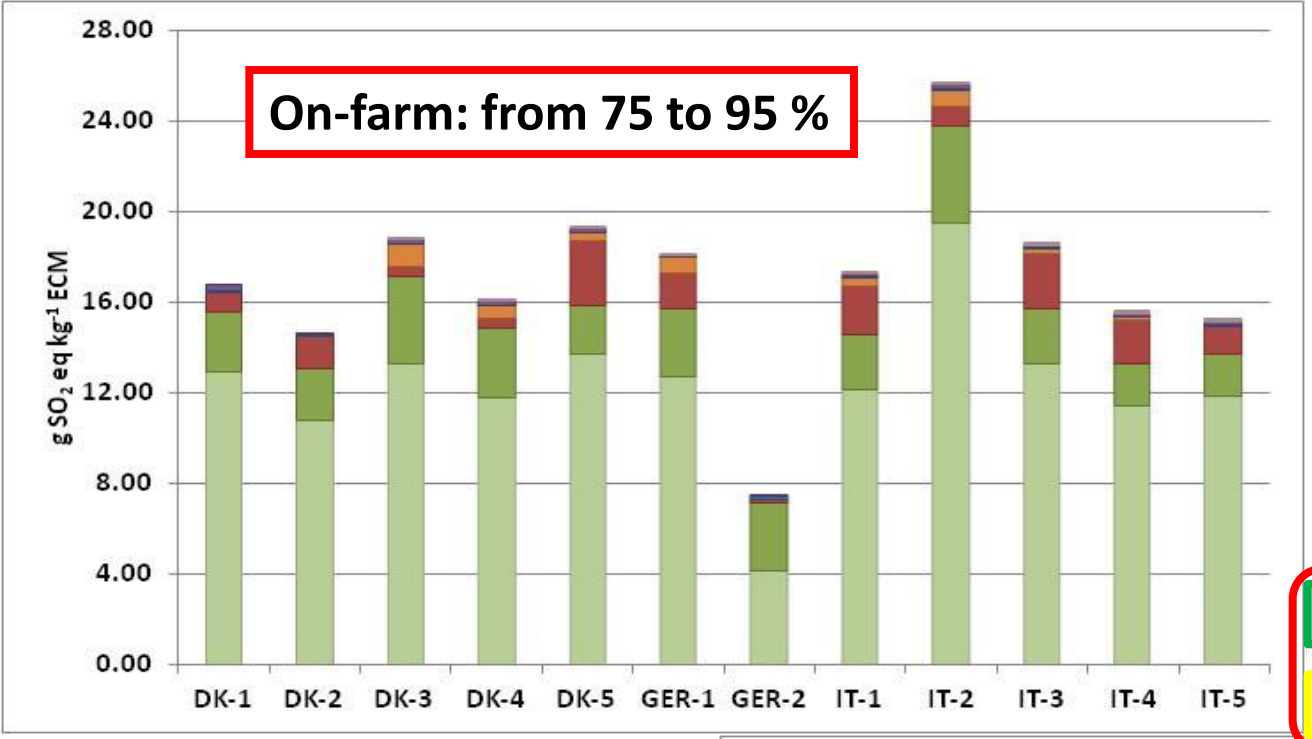
		DK-1	DK-2	DK-3	DK-4	DK-5	GER-1	GER-2	IT-1	IT-2	IT-3	IT-4	IT-5
HERD													
Cows	no	168	122	116	127	123	92	36	77	35	98	350	170
Milk production	**ton ECM cow^{-1}**	**6.27**	**7.72**	**8.53**	**10.43**	**7.98**	**10.96**	**6.28**	**10.22**	**6.33**	**9.39**	**10.48**	**7.89**
Concentrate	% of herd DMI	26.9	26.6	44.9	39.6	61.5	36.9	3.3	44.1	13.1	45.2	42.5	25.2
Pasture	% of herd DMI	21.9	24.8	6.2	6.5	0.0	0.0	71.2	0.0	0.0	0.0	0.0	0.0
Efficiency	kg ECM kg^{-1} DMI cow	0.91	1.18	1.22	1.34	1.19	1.40	1.34	1.31	0.82	1.16	1.40	1.19
N efficiency ex animal	%	18.2	19.7	20.3	22.6	21.9	23.7	18.7	23.3	16.3	21.7	25.6	23.7
LAND													
Crop area	ha	225.5	162.5	135.7	142.5	74.4	64.0	43.0	58.0	21.4	30.0	60.0	23.0
Maize	% farm land	2.3	0.0	16.3	31.8	32.5	50.7	0.0	36.2	38.0	53.3	25.0	26.1
Ryegrass+Maize II	% farm land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.8	75.0	26.1
Grassland in rotation	% farm land	47.1	40.9	14.2	44.2	0.0	8.6	90.0	0.0	0.0	0.0	0.0	0.0
Permanent grassland	% farm land	11.1	21.2	11.9	5.9	0.9	40.7	10.0	63.8	33.8	0.0	0.0	30.4
Lucerne	% farm land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4	23.9	0.0	17.4
Total grassland	**% farm land**	**58.2**	**62.0**	**26.1**	**50.1**	**0.9**	**49.3**	**100.0**	**63.8**	**42.2**	**23.9**	**0.0**	**47.8**
Crop yeld	ton DM ha^{-1}	6.37	5.18	6.06	7.17	6.83	8.56	5.26	8.84	13.29	19.48	29.07	16.39
FARM													
Stocking rate	**LU ha^{-1}**	**1.1**	**1.1**	**1.2**	**1.2**	**2.1**	**2.1**	**1.1**	**2.2**	**2.5**	**5.6**	**9.8**	**11.0**
Milk intensity	ton ECM ha^{-1}	4.66	5.52	6.72	8.69	11.86	15.69	5.25	12.69	10.34	30.69	61.14	58.32
Total N	kg N ha^{-1}	134	141	264	274	290	435	134	337	496	787	1273	1123
N surplus	kg N ha^{-1}	86	89	194	217	224	324	125	177	197	792	1001	498
feed self sufficiency (base on DM)	%	92.9	82.9	84.6	85.3	50.5	63.1	96.7	65.1	76.0	54.3	47.5	27.7

ENVIRONMENTAL IMPACT RESULTS



CONTRIBUTION TO GLOBAL WARMING

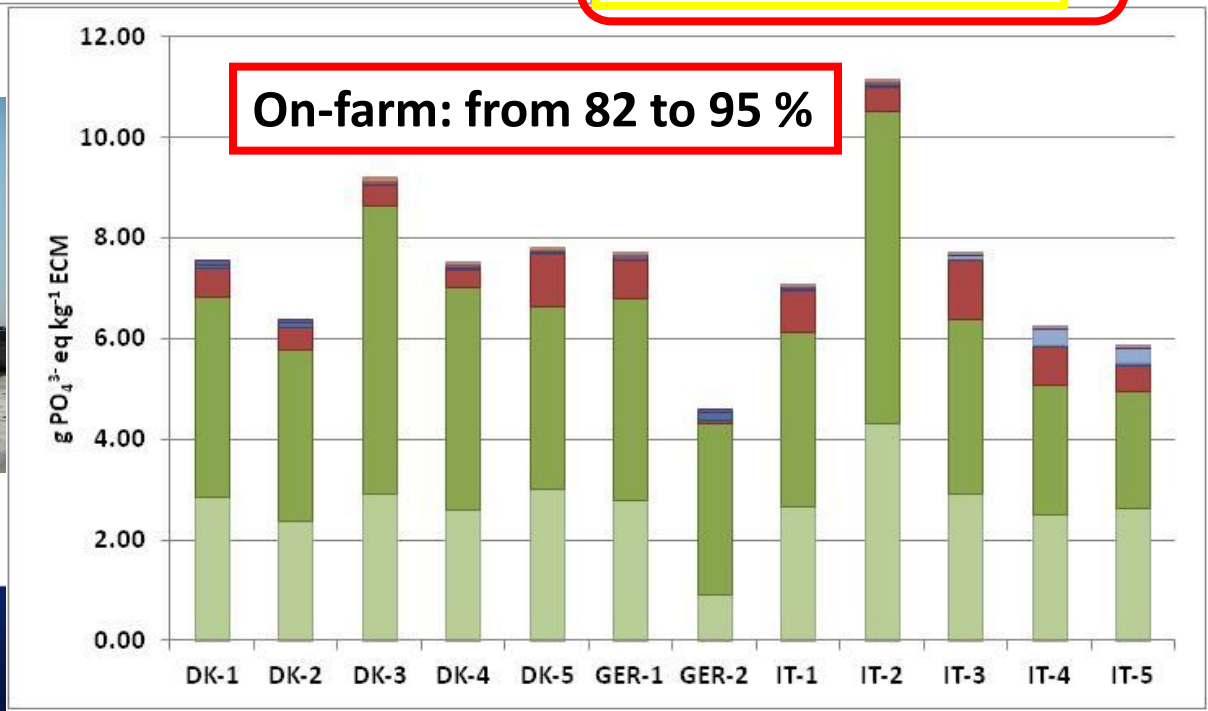




Pesticides
Purchased Forages
Enteric Emissions
Farm Energy Use
Bedding Material
Fertilizers
Commercial Feed
Farm crop production
Storage Emissions

Acidification

Eutrophication



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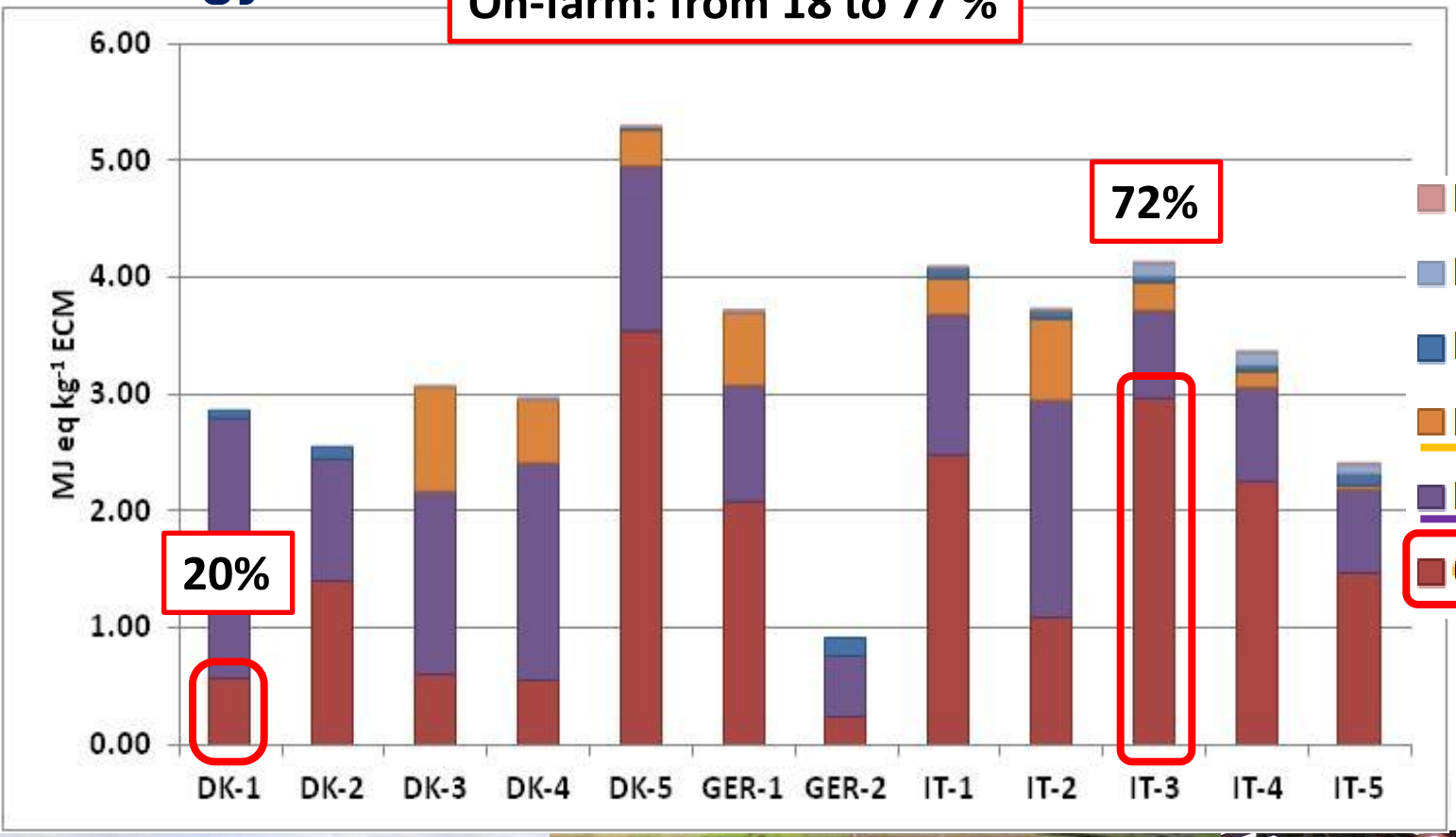
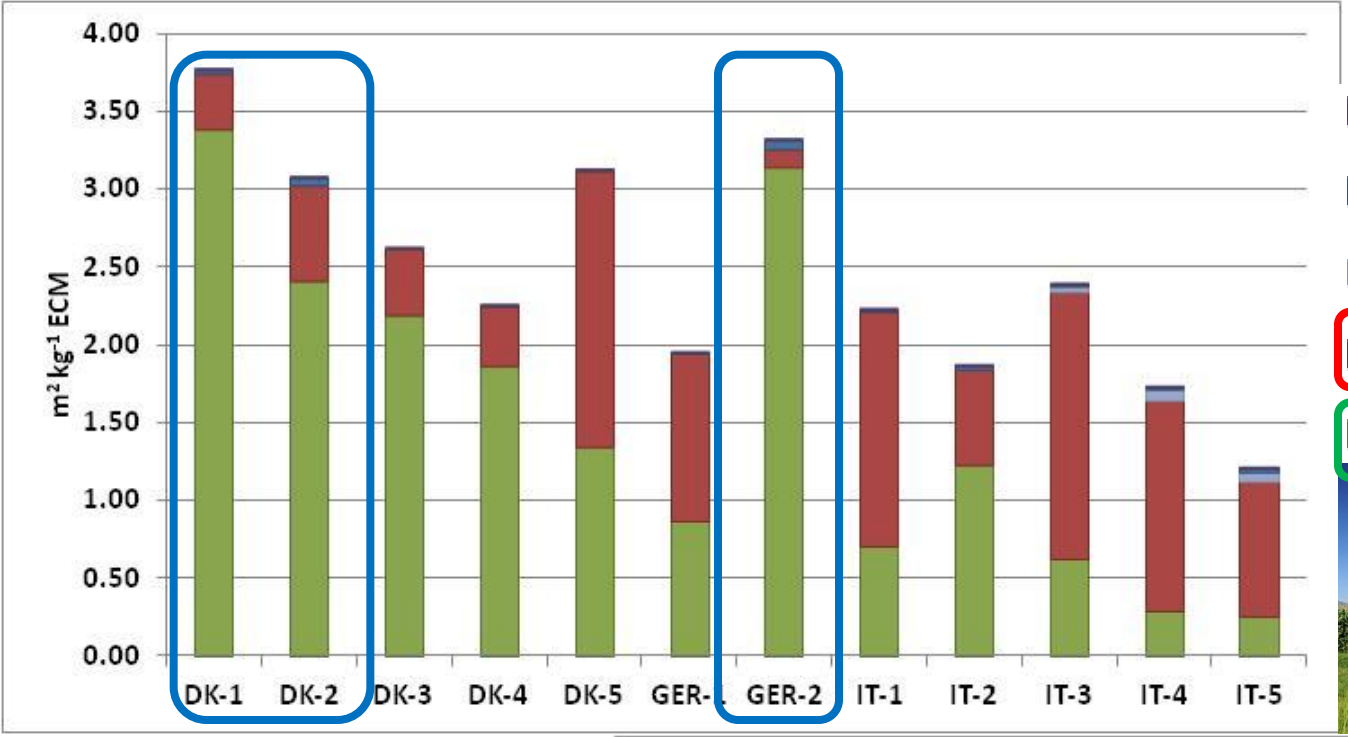
Energy use:

On-farm: from 18 to 77 %



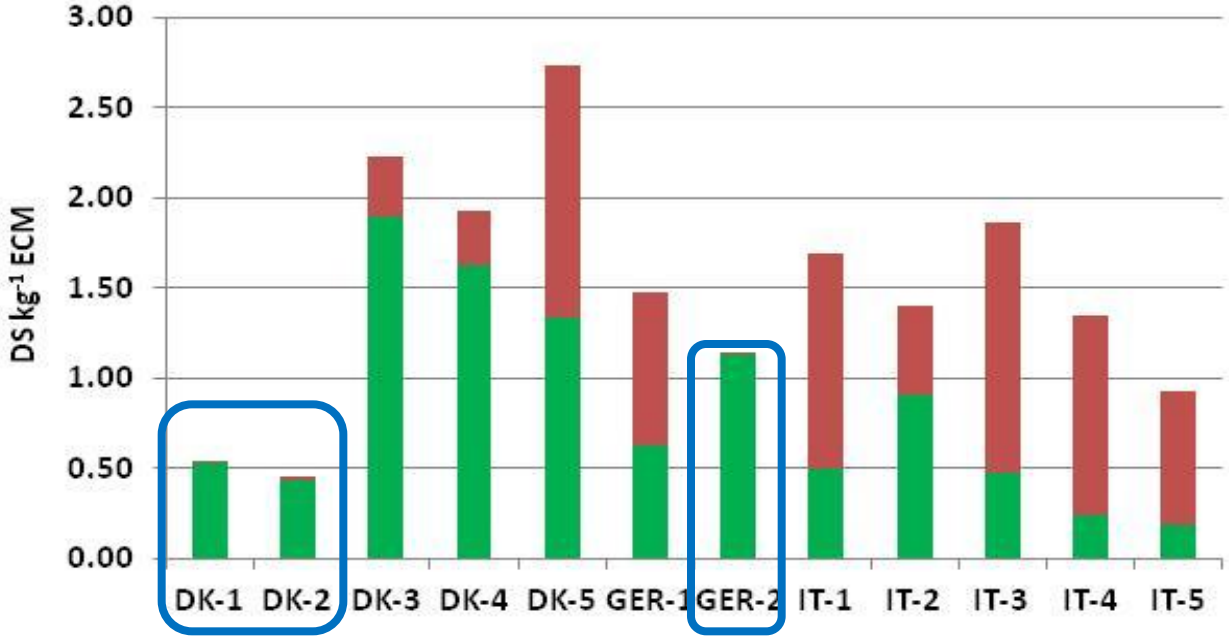


Land use:

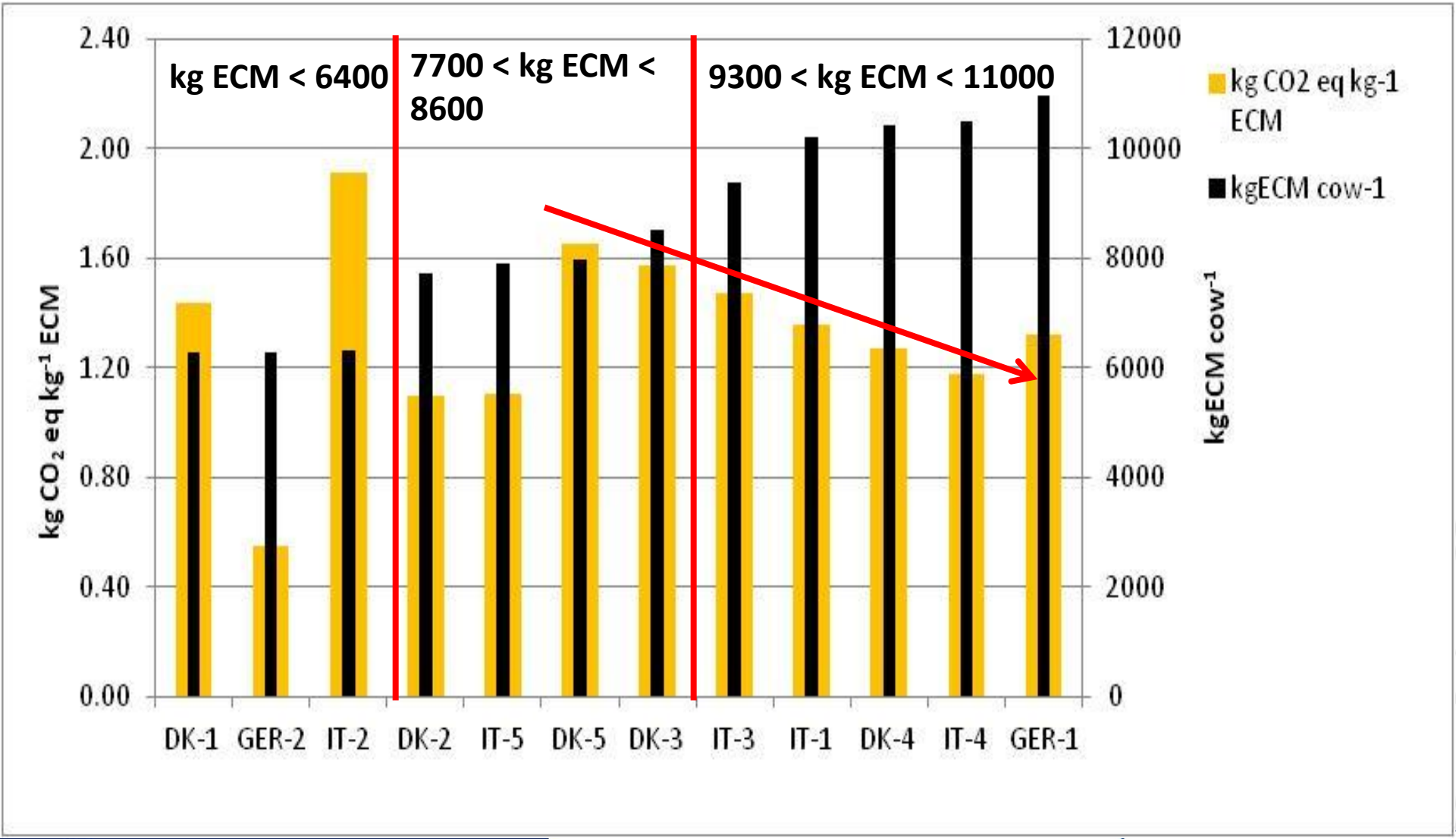
- Farm Energy Use
- Bedding Material
- Purchased Forages
- Commercial Feed
- Farm crop production

Biodiversity:

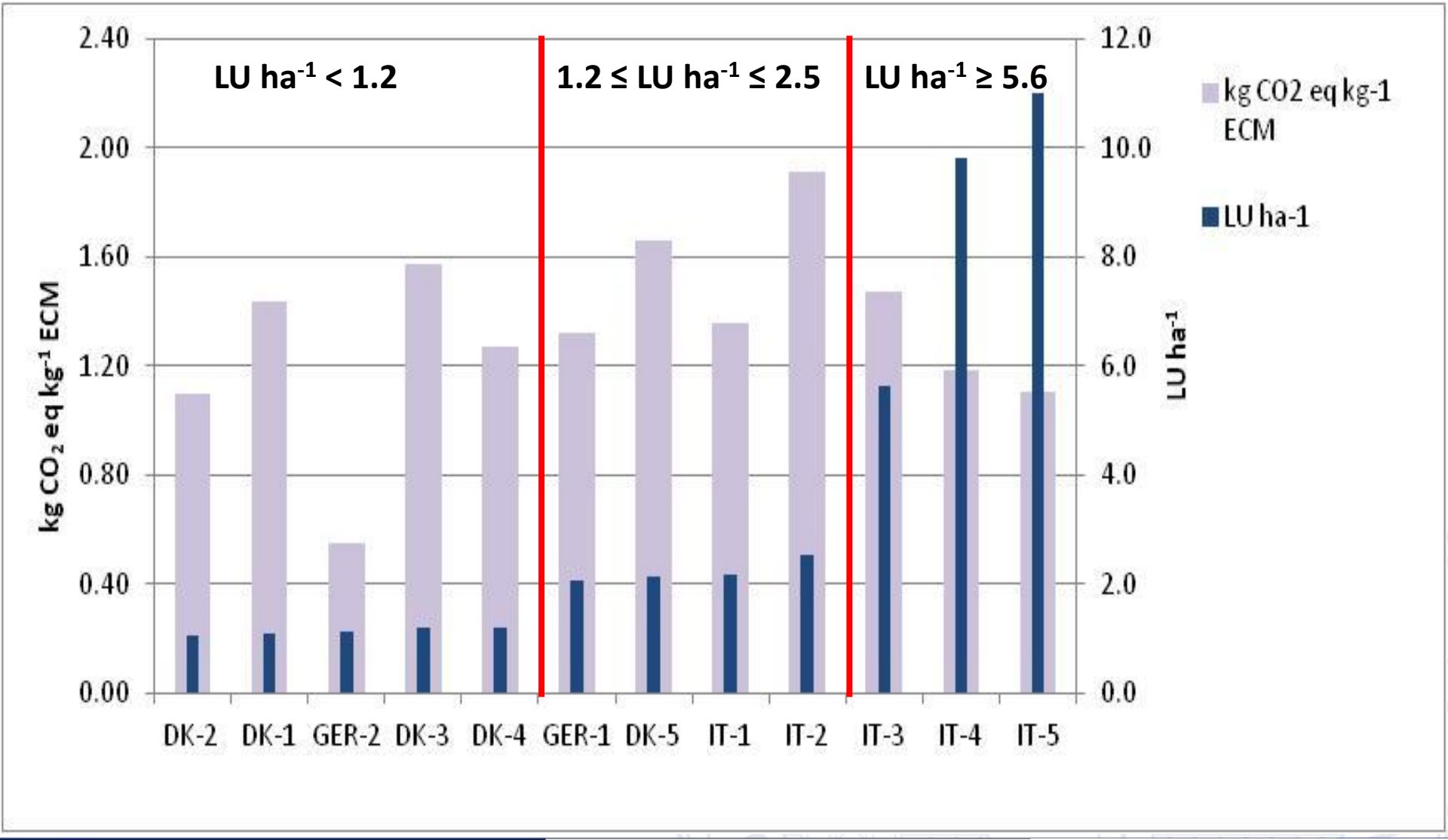
- DS off-farm
- DS on-farm



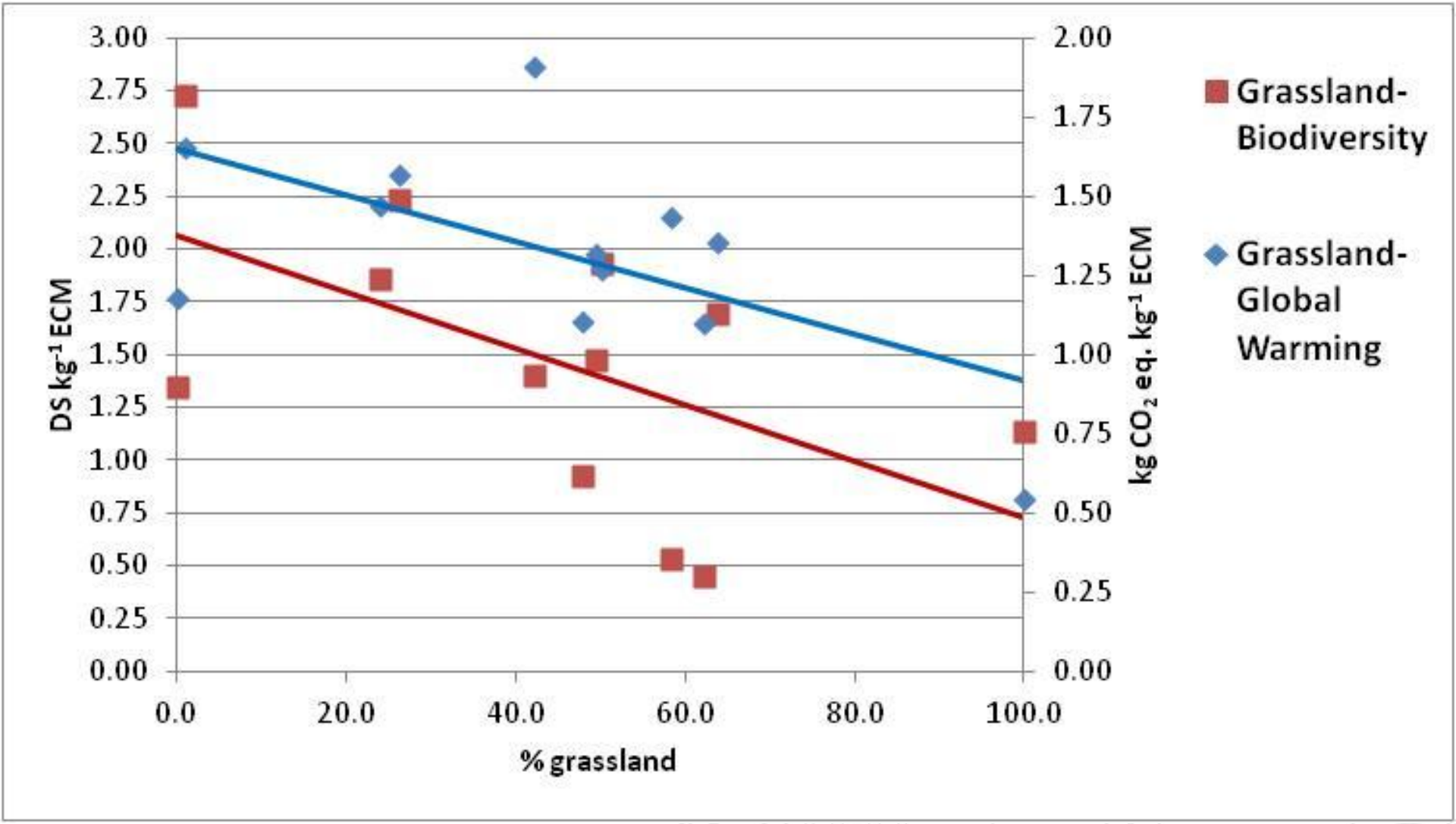
RELATION BETWEEN MILK PRODUCTION LEVEL AND GLOBAL WARMING



RELATION BETWEEN STOCKING RATE AND GLOBAL WARMING



RELATION BETWEEN SHARE OF GRASSLAND, GLOBAL WARMING AND BIODIVERSITY



CONCLUSIONS

- Huge variability among the systems: but generally high contribution of on-farm activities on global impact
- Relation among the impact indicators: improving one impact category means to improve the global environmental sustainability of the farm
- No relation in a product perspective between the environmental impact and the milk production (kg ECM cow^{-1}) and the stocking rate
- High proportion of grassland improves the environmental sustainability and reduces biodiversity losses

CONCLUSIONS

- LCA: a useful tool to quantify the global product orientated environmental impact - but uncertainty and some different basic assumptions make it difficult to compare with other works

- Farm specific conditions should be considered - and also local impacts should be analyzed (i.e.: eutrophication ha^{-1}) to better identify sustainable systems

- First “attempt” to estimate the biodiversity losses to produce 1 kg of milk - but it needs further improvements

THANKS

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