Cattle health and GHG emissions in sub-Saharan Africa (and super-Saharan Scotland)

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Animal Health and Greenhouse Gas Emissions Intensity Network Webinar

2/10/2017

Leading the way in Agriculture and Rural Research, Education and Consulting

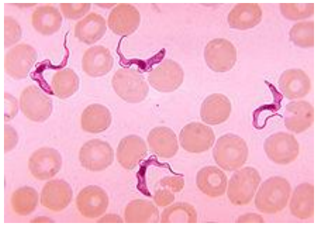
Overview of talk

1. Update on the analysis of the GHG effects of removing trypanosomosis in African cattle.
2. Brief overview of work on parasites in Scottish ruminants.

Developing a method for quantifying the mitigation potential and CE of trypanosomosis treatment

Disease caused by tsetse-borne parasitic protozoans

"Probably more than any other disease affecting both livestock and people, Trypanosomosis threatens human and livestock health and agricultural production, and, thereby, rural development and poverty alleviation in sub-Saharan Africa."
(http://www.fao.org/ag/againfo/programmes/en/paat/home.html)



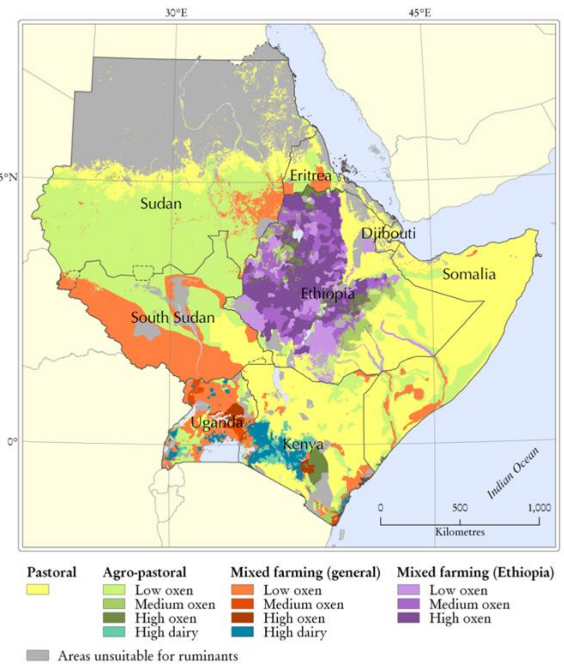
http://en.wikipedia.org/wiki/Trypanosoma

Annual African Animal Trypanosomosis losses within smallholders has been estimated to be $1166m (Nkrumah 2014).

Shaw *et al.* (2014) quantified the economic benefits of removing tryps in East African cattle

The analysis indicated that intervening could lead to a total benefit for the whole of the study area of nearly US$ 2.5 billion – an average of approximately US$ 3,300 per square kilometre of tsetse-infested area.

So, what **effect** does intervening have **on the emissions intensity** of the meat and milk produced by these systems?



Study area (Shaw et al. 2014)

Quantifying the GHG effects of intervening against tsetse and tryps

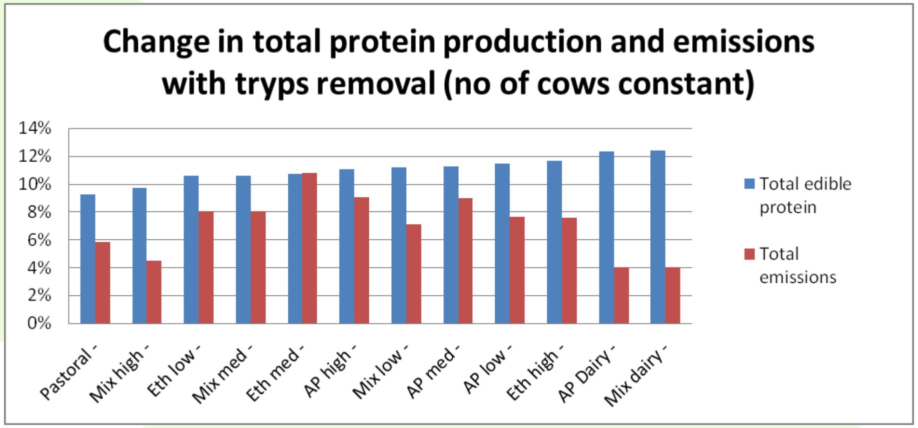
- The GHG emissions are quantified using an excel version of GLEAM (FAO's Global Livestock Environmental Assessment Model – see MacLeod *et al.* 2017a). Scope: cradle to farm gate.
- Impacts of tryps removal on production and economic performance quantified in Shaw *et al.* (2014). Primary effects (see table). Secondary effects included: % of adult males used for work; no of days oxen work; cow replacement rates; slaughter ages and offtake rates; herd growth rate.

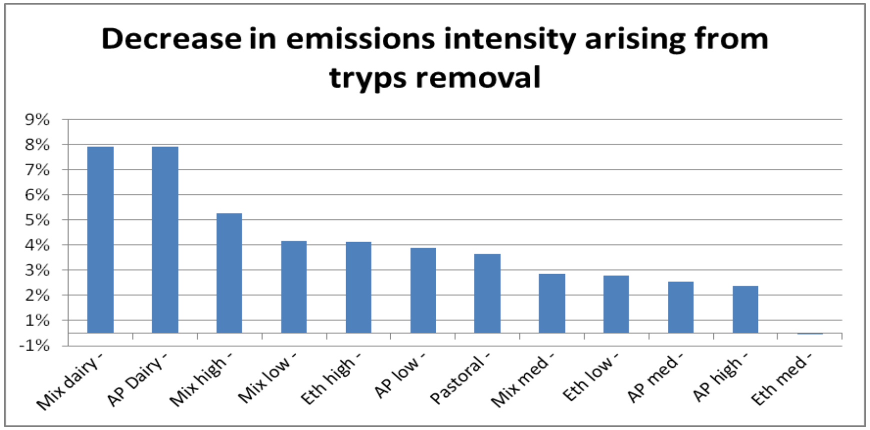
Parameter	Cattle production systems									
	Pastoral		Agro-pastoral		Mixed farming (general)		Mixed farming (Ethiopia)		Grade Dairy	
	T+	T-	T+	T-	T+	T-	T+	T-	T+	T-
Mortality (% per year)										
Female calves	20	17	18	15	16	13	24	20	21	18
Male calves	25	22	20	17	18	15	26	22	26	23
Adult females	7.5	6.5	7.0	6.0	8.0	7.0	9.0	7.5	12	10
Work oxen	9.0	7.2	8.5	6.8	9.0	7.2	10.0	8.0	–	–
Fertility and milk										
Calving rate (% per year)	54	58	52	56	51	55	49	54	53	57
Lactation offtake (l per year)	275	296	285	306	300	322	280	301	1 900	2 042

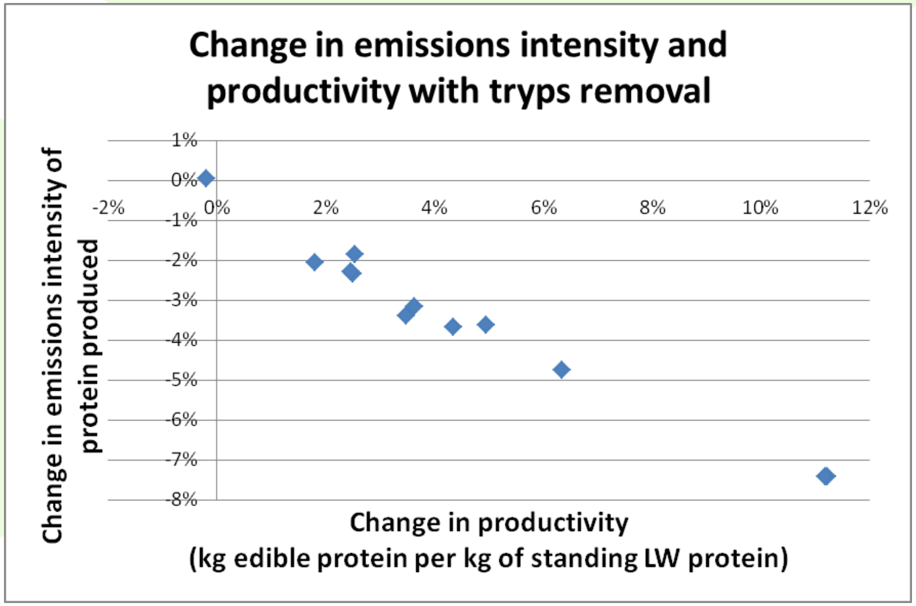
Note: T+ with trypanosomosis present; T- if trypanosomosis were absent. Source : Shaw et al. (2014)

Effect of removing tryps on emissions intensity (EI)

MacLeod *et al.* (submitted)



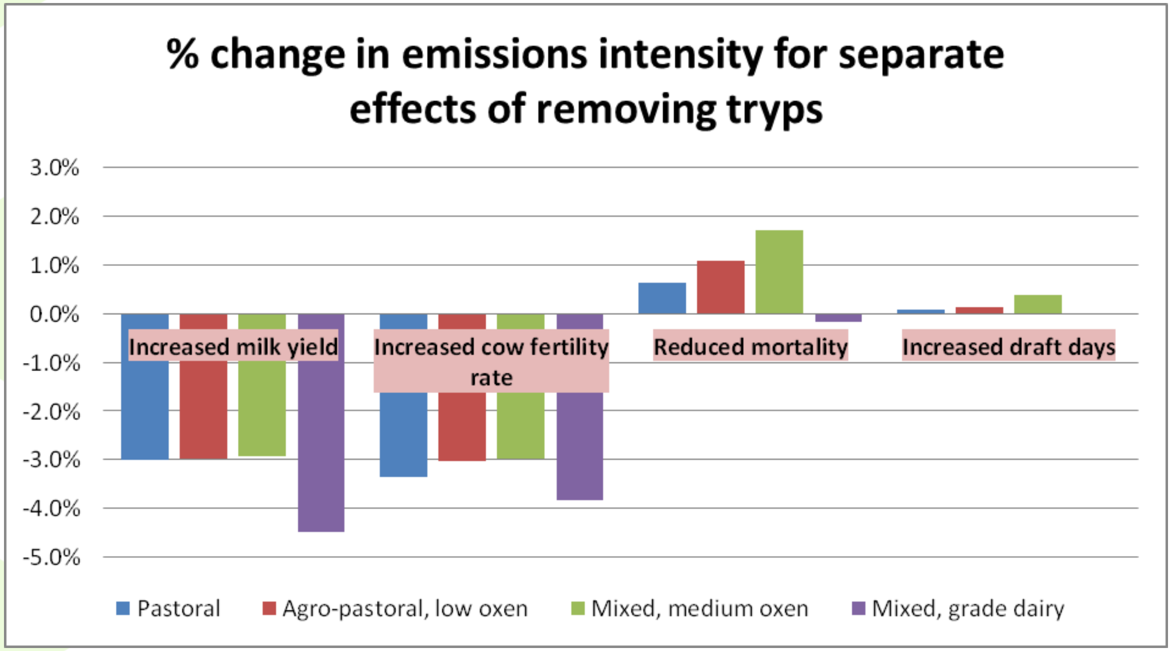




- There are significant increases in production and emissions across all the systems.
- Production increases by more than emissions so EI decreases
- The biggest decrease in EI is in the high yield dairy systems
- There appears to be a link between improving productivity and decreasing EI.
- What is driving the changes in EI?

Drivers of emissions intensity reduction

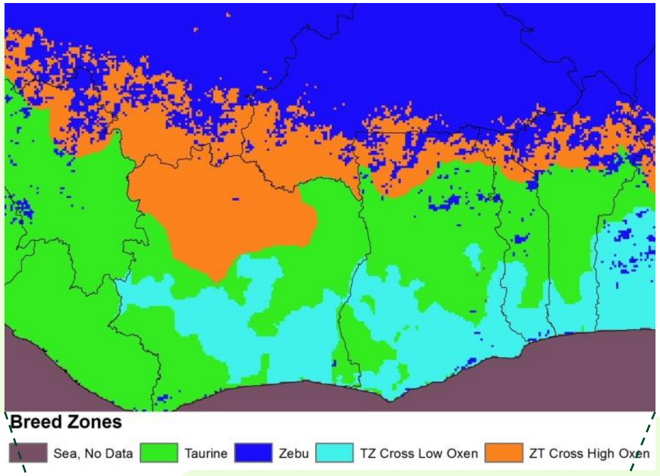
- Ration and manure management do not change with tryps status.
- Changes in EI arise from changes in (a) productivity of the individual animals, and (b) herd structure, i.e. the proportion of each cohort in the herd.



MacLeod *et al.* (submitted)

- Increased milk yield reduces the GHG per kg of milk secreted by the cow.
- Increased fertility rate means a greater % of the cows are lactating (and potentially an increase in the productive share of the herd).
- Reduced mortality leads to an increase in the % of the herd used for work.

Tryps and GHG emissions in West Africa

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Mapping the benefits: a new decision tool for tsetse and trypanosomiasis interventions

La mise en carte des bénéfices : un nouvel outil de prise de décisions pour la lutte contre les glossines et les trypanosomoses

Alexandra Shaw, Guy Hendrickx, Marius Gilbert, Raffaele Mattioli, Victorin Codjia, Balabadi Dao, Oumar Diall, Charles Mahama, Issa Sidibé & William Wint

Shaw et al. 2006

Comparing the West and East African systems

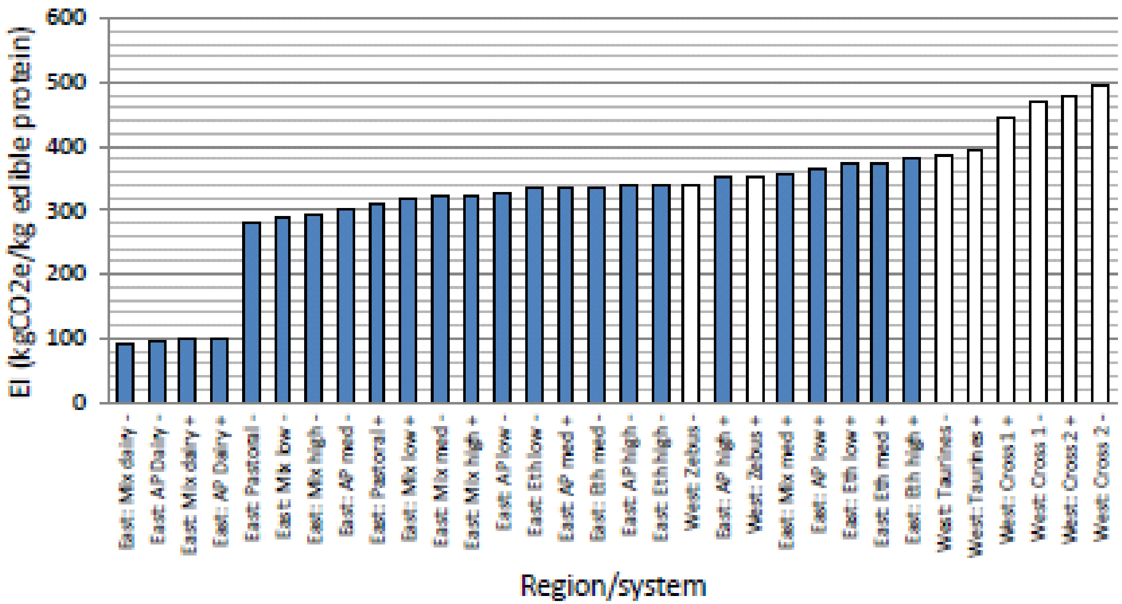


Figure 1 Comparison of the emissions intensity (EI) of the systems in East (blue) and West (white) Africa (assuming dying/culled not eaten, draft changes with tryps status)

EI for the W. African systems is a bit higher:

- Lower fertility
- Lower milk yields
- Greater use of draft animals

Change in EI with tryps removal

MacLeod *et al.* (2015)

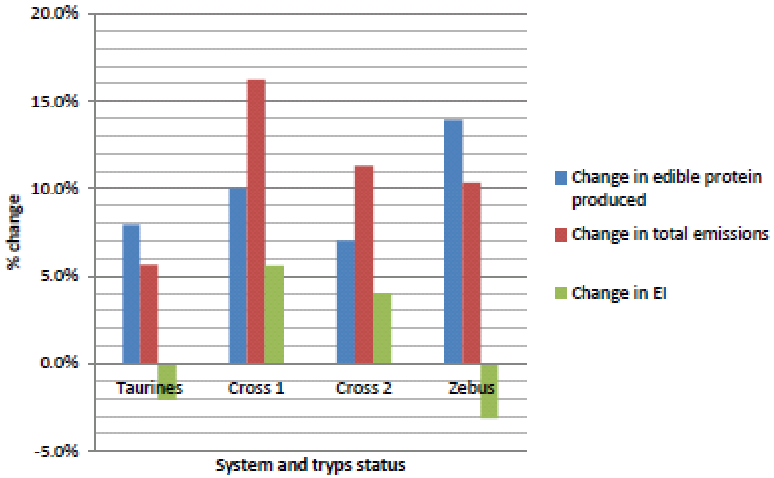


Figure 3. Change in edible protein production, total emissions and emissions intensity with tryps removal (draft animals change with tryps, culled/dying animals not eaten).

1. Removal of tryps leads to increases in protein production.
2. Also lead to increases in emissions.
3. Effect on EI is mixed – effects of increased milk yield and fertility offset by increased use of draft animal power (DAP).
4. If farmers choose not to increase the use of DAP, then tryps removal leads to greater reductions in EI.

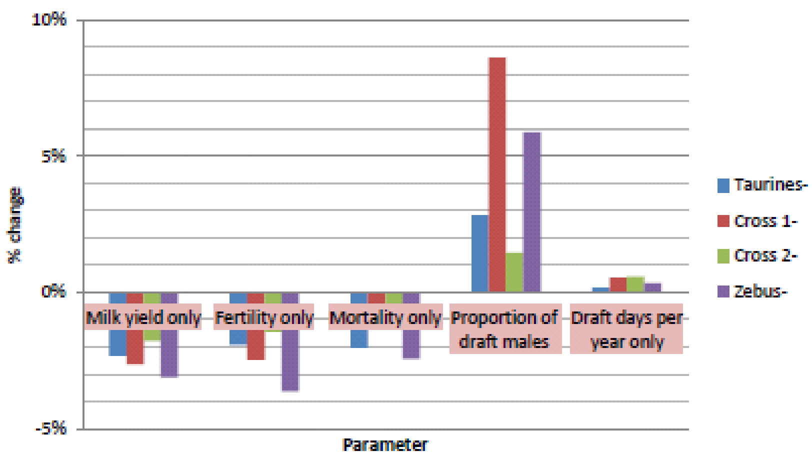


Figure 4. Results of the sensitivity testing (EI measured in terms of kg CO_2e/kg edible protein, dying/culled animals not eaten).

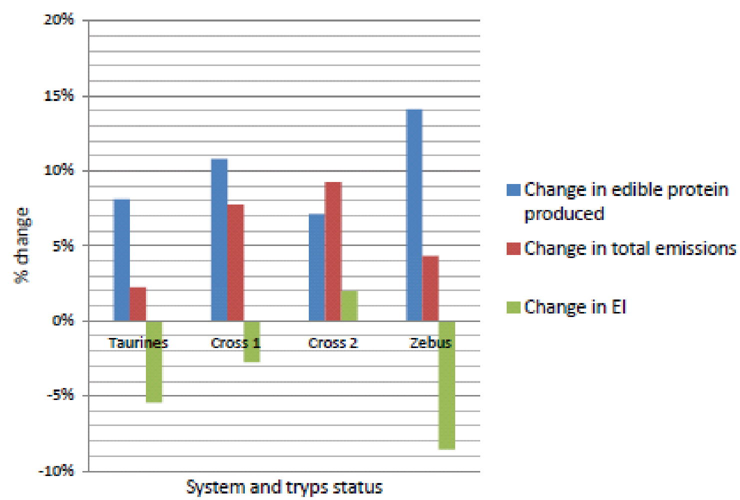


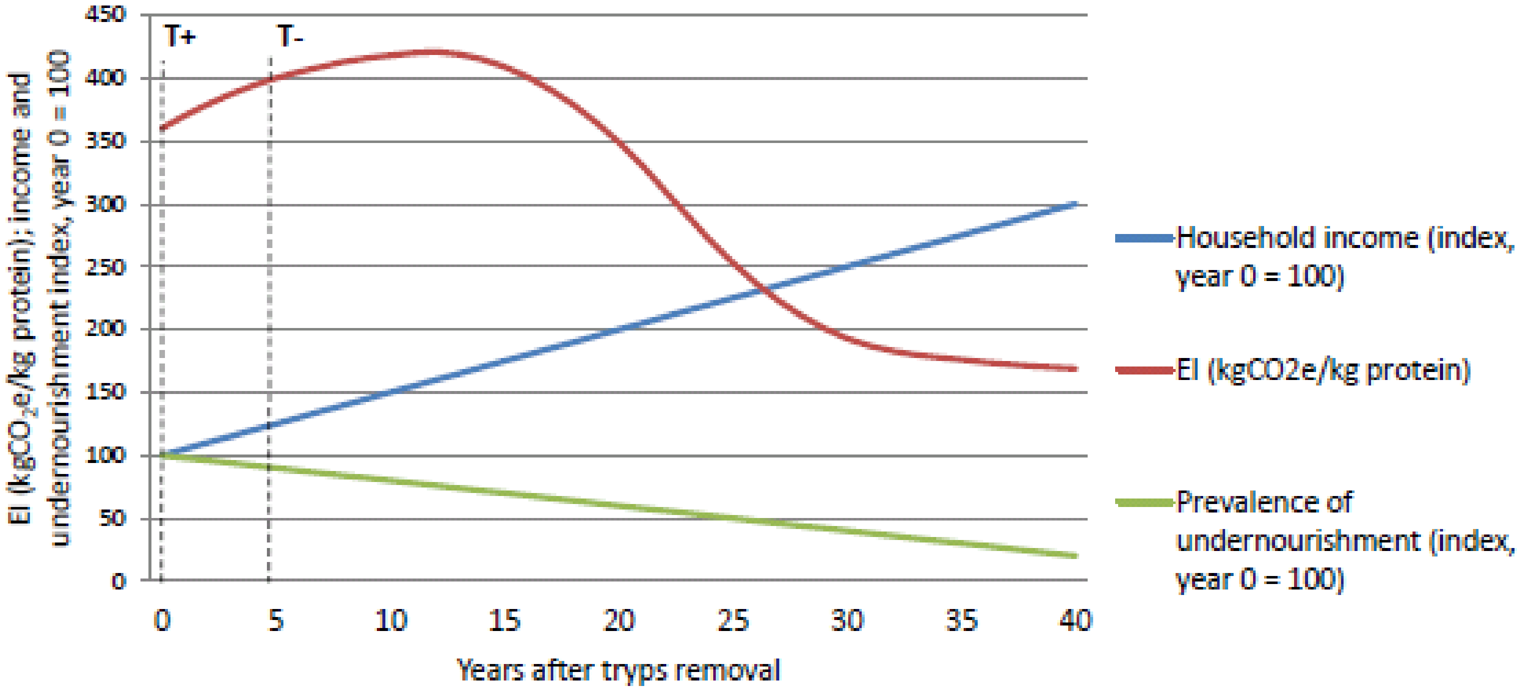
Figure 6. Change in edible protein production, total emissions and emissions intensity with tryps removal (draft animals constant with tryps, culled/dying animals not eaten).

Effect of draft animal power (DAP)

- So is DAP a bad thing?
- No! In fact DAP can have significant benefits that are <u>not captured in the current analysis</u>, i.e.:
  - Increased food availability and household income.
  - Wider economic effects
- Sims and Keinzle (2006, p20) note "the use of draught animals is severely restricted by the presence of the tsetse fly (Glossina sp.), the vector of trypanosomiasis". Decreasing the prevalence of trypanosomosis is therefore one way to enable increased use of DAP, and thereby improved food security.

Kuznets curve for agricultural GHG?

- Perhaps in order to achieve "climate smart farming" we will sometimes have to accept short term increases in emissions?



MacLeod *et al.* (2015)

Drivers of Scottish ruminant emissions

% change in the EI of 5 Scottish ruminant systems types when each parameter is increased by 10% (MacLeod *et al.* 2017b)

	EF1	EF3	Grass N/ha	Grass DE%	Growth rate	Fertility rate	Rep. rate	Milk yield
Upland suckler cattle	1.0	1.0	0.4	-4.5		-5.1	-0.7	
Grass finished cattle	1.1	0.7	0.7	-7.8	-6.0			
Upland sheep	0.9	1.2	0.6	-4.3		-4.0	0.3	
Store lambs	1.7	0.9	1.8	-13.6	-4.1			
Dairy cattle	1.4	0.4	0.4	-4.0		-3.5	1.0	-4.8

EF1: The amount of applied fertiliser N that is converted to N2O-N.
EF3: The amount of N deposited by grazing animals that is converted to N2O-N.

Relationship between liver fluke disease (fasciolosis) and growth rate

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- Data from an abattoir in UK, cattle slaughtered July-December 2016 (N=26347).
- Presence of historic and active fasciolosis recorded.
- When all cattle are compared, the average daily LWG without fasciolosis is 4% higher, but what happens when we start to disaggregate?

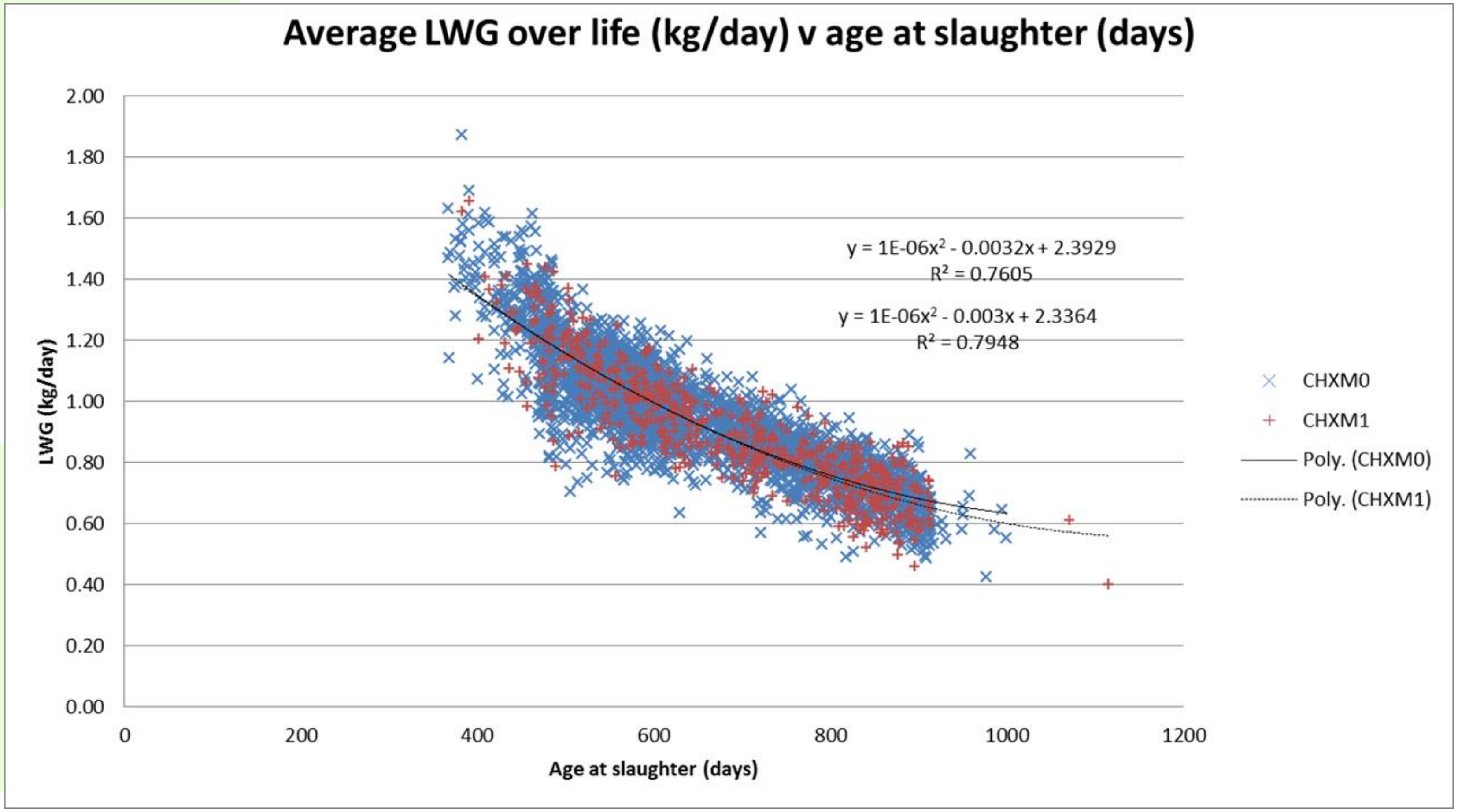
LWG and LW of Charolais cross with historic fasciolosis only by sex and age class.

Charolais cross - with historic fasciolosis					Difference with and without fault	
Cohort	Av. LWG (kg/day)	LW at slaughter (kg)	N		LWG	LW
F, 1-2yo	0.85	539	273		1.5%	-0.5%
M, 1-2yo	1.02	639	250		2.9%	-0.1%
F, 2-3yo	0.63	570	120		0.5%	0.7%
M, 2-3yo	0.72	650	154		2.8%	1.5%

- So there still appears to be an effect, but a bit weaker.

Relationship between liver fluke disease (fasciolosis) and growth rate

Average LWG over life (kg/day) v age at slaughter (days) for male charolais cattle.
CHXMO: Charolais cross, male, no faults. CHXM1: Charolais cross, male, with historic fasciolosis only



Relationship between liver fluke disease (fasciolosis) and growth rate

- Preliminary results indicate that there are no significant differences in LWG between the cattle with fasciolosis and those with no detected faults, once differences between the groups (in terms of age, sex and breed) are taken into account.
- However, this does not mean that fasciolosis is not leading to a significant increase in GHG:
  - The effect on LWG may exist but be hidden by confounding factors (e.g. if there is a correlation between fluke populations and cattle genetic merit).
  - There are other impacts, such as: reduced carcass quality, increased liver condemnation, increased FCR, reduced fertility, reduced milk yield
- So, we need to interpret data carefully.

Informing policy development

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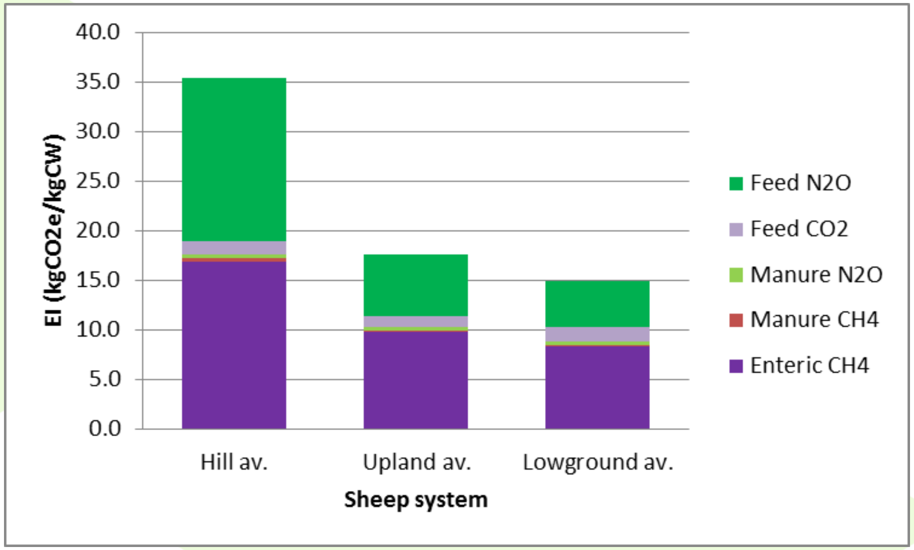
Emissions intensity of 3 Scottish sheep systems



Analyse problem

What might be driving this variation, i.e. which parameters?

- Feed energy or protein content
- Feed conversion ratio
- Lamb growth rates
- Maternal fertility
- Lamb or ewe mortality
- Environmental conditions

Identify policy options

Which parameters can we control and how might we change them?

- Feeding
- Genetics
- Health status

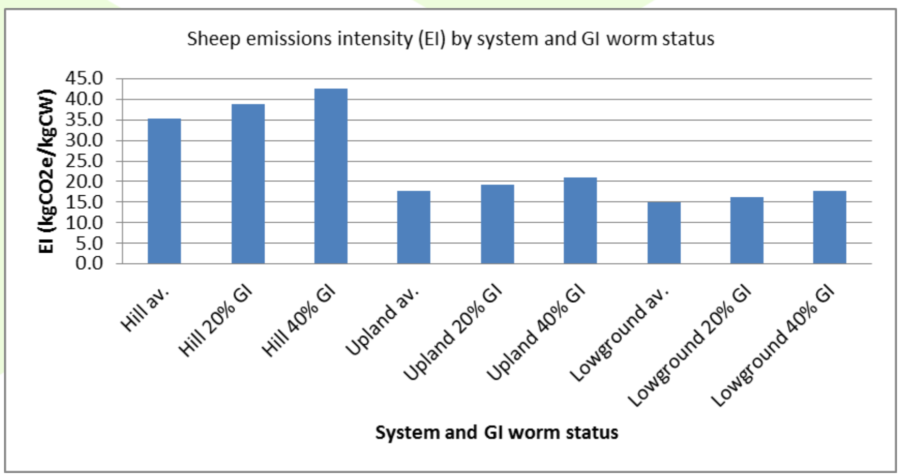
By answering questions such as:

- What are the financial and GHG benefits?
- Unintended consequences, e.g. pathogen resistance, wider economic effects?

Refine options

Evaluate options

Emissions intensity of 3 Scottish sheep systems, with different levels of gastro-intestinal worms (Skuce et al. 2016)



Acknowledgements

Project	Team	Resources
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