The effect of sheep genetic improvement programmes on methane emissions

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Sheep Breeders Round Table 2011

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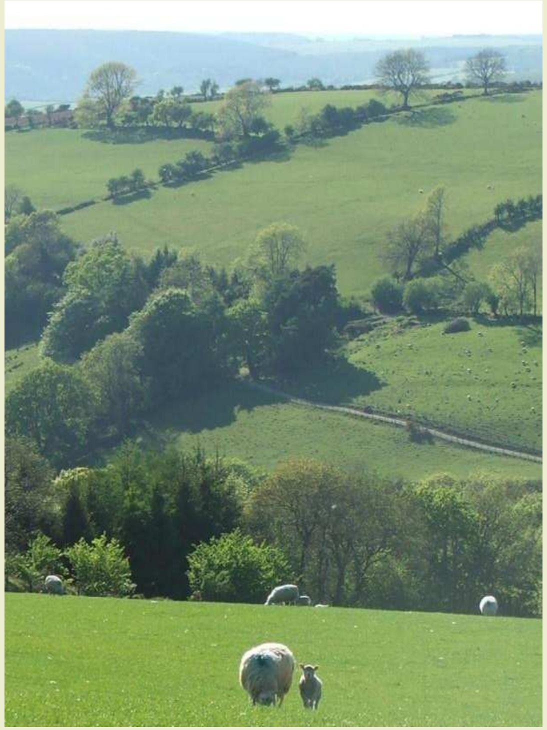
Greenhouses gases and agriculture

The Welsh Assembly Government has set out a commitment to reduce greenhouse gas emissions by 3% per year from 2011 (One Wales Agreement)

Ambitious UK targets have also been set that aim to cut emissions of all greenhouse gases by 80% by 2050 (Climate Change Act 2008)

Currently greenhouse gas emissions from primary agricultural production contribute around 9% of total annual Welsh emissions



Greenhouses gases and livestock

There are 3 main greenhouse gases;

- •Carbon dioxide (CO^2)
- •Nitrous oxide (N^2O)
- •Methane (CH^4)

Nitrous oxide and methane are the main products from agriculture

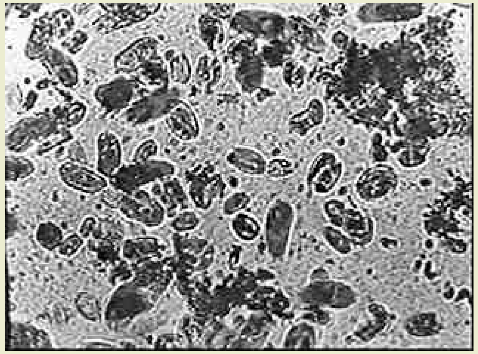
Nitrous oxide is produced from;

- •Nitrogen fertiliser applications
- •Soil cultivation
- •Manure storage

Methane is produced from;

- •Ruminant digestion
- •Manure storage

Greenhouses gases and sheep



The majority of methane output from lamb production is due to natural processes within the rumen

During digestion microbes present in the rumen ferment feed consumed by the animal

This process produces methane as a by-product which is 'burped or belched'

Methane has a 'global warming potential' 21 times higher than carbon dioxide

Reducing methane from the animal

The amount of methane produced by an animal depends on;

•Level of feed intake

•Feed quality

•Inherent differences in efficiency of feed conversion

Altering the diet can reduce methane emissions including;

•Grasses high in water soluble carbohydrates

•Plant extracts such as garlic

•New varieties of cereals such as high lipid content oats

Methane represents a loss of energy – reducing emissions can therefore improve animal performance

Reducing methane from the system

Another approach is to reduce the amount of methane produced from the overall farming system through;

- Maintaining methane output whilst increasing production
- Maintaining production whilst reducing methane output
- Reducing methane output while increasing production

These approaches focus on reducing methane emissions per kg of output

This is achieved by increasing efficiency of production through;

- Management improvements
- Genetic improvement

The project

Development of a model to predict changes in methane emissions through the use of genetic improvement in the Welsh flock

There were 2 elements within the model;

- Prediction of genetic improvement
- Changes in methane production

Changes in methane emissions were predicted per tonne of carcase produced

The model

The following traits were considered;

- Lamb growth rate
- Lamb muscle depth (and carcass weight)
- Lamb survival
- Ewe litter size
- Ewe longevity

The stratified nature of Welsh sheep production was considered and included;

- A hill flock with pure-bred hill ewes mated to a hill breed
- An upland flock with hill ewes mated to a crossing sire
- A lowland flock with crossbred ewes mated to a terminal sire

The impact of the following selection indexes were modelled;

- Welsh Hill Index
- Longwool Index
- Lean Index

The results: Hill flocks

For hill flocks, traits expressed in the ewes showed particular scope for improvement

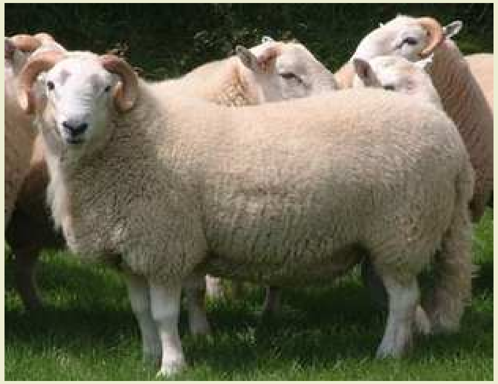
Performance trait	Percentage change in methane emissions over 10 years
Ewe litter size	-8.8%
Ewe longevity	-3.8%
Lamb muscle depth and carcase weight	-2.5%
Lamb growth (with no change in ewe weight)	-1.3%
Lamb survival	-0.3%
Lamb growth (with correlated increase in ewe weight)	+0.4%

The results: Lowland flocks

Similar results were obtained for lowland flocks

Performance trait	Percentage change in methane emissions over 10 years
Ewe litter size	-5.3%
Lamb muscle depth and carcase weight	-2.7%
Lamb growth rate (with no change in mature ewe weight)	-2.3%
Ewe longevity	-1.3%
Lamb growth rate (with correlated increase in ewe weight)	-0.7%
Lamb survival	-0.6%

The impact of genetic improvement: Hill flocks



Over a period of 10 years

Methane emissions per tonne of carcass were reduced by 0.5% (assuming no change in ewe weight)

Weight of lamb reared increased by 0.8kg

Days to finish per lamb was reduced by 6 days

The impact of genetic improvement: Upland flocks

Over a period of 10 years

Methane emissions from were reduced by 1.3% (assuming no change in ewe weight)

Weight of lamb reared increased by 0.7kg

The impact of genetic improvement: Lowland flocks

Over a period of 10 years

Methane emissions from were reduced by 1.8% (assuming no change in ewe weight)

Weight of lamb reared increased by 2.6kg

Days to finish were reduced by 1.4 days

The conclusion

Current genetic improvement programmes in Wales could reduce methane emissions by 0.03% per tonne of carcase produced per year

A reduction of 0.08% per year could be expected if changes in ewe weight were restricted

Of the traits examined those that are most likely to have a beneficial effect through genetic selection or breed substitution are;

- Ewe prolificacy
- Ewe longevity
- Muscle depth
- Lamb growth (if changes in ewe weight are restricted)

The message

Increasing efficiency of production;

•Reduces methane emissions per kg of lamb without negatively impacting on livestock numbers or profit margins

Genetic improvement can;

•Lead to permanent and cumulative reductions in methane emissions

Further improvements could be made if changes in nutrition and forage utilisation lead to better expression of superior genetics