Developing baseline and optimal forage protein farm models

**Approach**

Using basic data from the Commercial Development Farms such as land area, cropping and livestock numbers we used software to create a ‘model farm’ for each farm type. Data collected at the beginning of the project was used to create a baseline, i.e. a ‘before forage proteins’ vision of the different farm types. Then, based on the farmer’s activities and experiences during the project, we worked together to create an optimal version of each farm type to reflect an increased, but realistic, use of forage proteins. Farm data were supplemented with typical economic values and greenhouse gas emission factors to estimate the economic and carbon footprint effects and then we compared the baseline and optimal scenario results to assess the potential effects of adopting the use of forage proteins at a farm system level.

**Economic effects**

Can forage proteins save a farm money?

By using forage proteins, a farm system should improve its financial performance through various effects:

- Adding or increasing the share of forage proteins in swards will produce forage with increased crude protein levels, requiring less or no additional protein feed such as soya or rapeseed meal.
- Many forage proteins also fix nitrogen through their roots, providing up to 250kg N/ha, so conventional farms can substantially reduce or eliminate mineral nitrogen (N) fertiliser. This legume-fixed nitrogen can also enhance the productivity of subsequent crops in a rotation, especially if used as a multi-year break crop in arable rotations, increasing output as well as reducing costs.

However, these forage protein crops need to fit within the whole farm system or rotation, e.g. red clover cannot be grown indefinitely on the same land, so the modelling process allowed us to assess the economic effects of incorporating forage proteins into farm systems, with realistic rotations. The economic effects have been assessed at both the farm and product (per kg lamb/beef or per litre milk) level.

**Carbon footprint effects**

Can protein forages reduce farm emissions?

Increasing forage proteins offers a number of potential savings in greenhouse gas (GHG) emissions:

- By replacing imported protein concentrate feeds such as soya (which can have high carbon footprints due to forest clearance and transportation from the tropics), with lower-emission home grown forages.
- On conventional farms mineral N fertiliser use can be reduced or eliminated, reducing GHG emissions associated with fertiliser N production and transportation, and the direct and indirect N2O emissions that occur when fertiliser N is applied to soil.

Reducing emissions overall depends on striking a balance between these savings and small potential increases elsewhere, such as some forage crops needing slightly higher inputs of other fertilisers (e.g. P and lime), with associated increased GHG emissions. Also, ploughing in the higher-N-content residues of protein forages at the end of a ley can release more N2O than from grass alone. At the same time, increased production efficiency (animals finishing faster, lower inputs per head) can significantly reduce your product emissions (kg CO2e per kg LW lamb or beef, or per litre milk) because your farm’s total emissions are shared across a greater quantity of output.