North Wyke Farm Platform

Case study no. 10

Life cycle analysis of pasture based beef production systems

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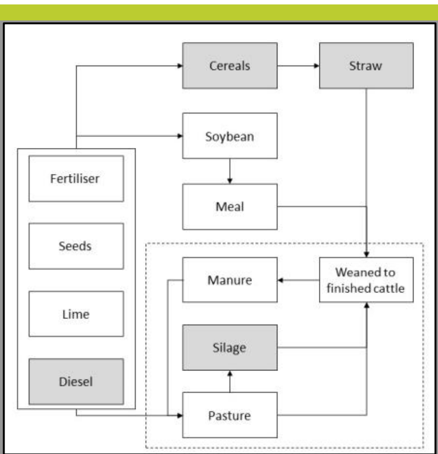
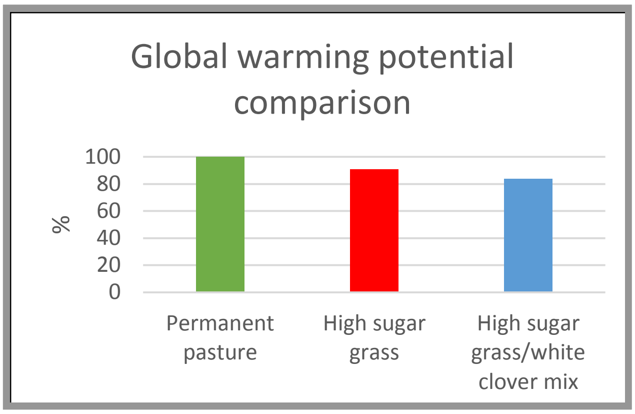
The North Wyke Farm Platform (NWFP) is comprised of three hydrologically isolated “farmlets” with different pasture-based livestock systems: the “green” system based on a permanent pasture (ca. 60% *Lolium perenne*) that has not been ploughed for at least 15 years; the “red” system based on high sugar perennial ryegrass (*Lolium perenne cv.* Abermagic) that was reseeded between 2013 and 2015; and the “blue” system based on a high sugar perennial ryegrass and white clover (*Trifolium repens cv.* Aberherald) mix, also reseeded between 2013 and 2015. Conventional strategies for the application of inorganic nitrogen fertiliser are used for the “green” and “red” farmlets, while the “blue” pasture receives a reduced amount of nitrogen predominately in the form of farmyard manure. Every year, 30 Charolais x Hereford-Friesian calves enter each system after weaning.

Using life cycle analysis (LCA), this project aims to identify the most environmentally, economically and socially sustainable method of beef production. LCA is a process based modelling tool to estimate the performance of different systems, including activities that take place elsewhere to support them. This tool is particularly useful for comparing different methods of production and marketing for a same product or service which, in the present case, is beef consumed at home or a restaurant. Work to date has established environmental comparisons between the three systems in terms of the global warming potential, a parameter commonly known as the carbon footprint. The performance of each system was expressed in the unit of kg carbon dioxide (CO_2) equivalent emitted to realise kg of animal growth.



System boundary of the present study



The three pasture-based beef production systems resulted in different animal growth rates, and this difference was found to affect the resultant carbon footprint. The “blue” legume-based system generated the lowest CO_2 emissions per kg liveweight gain, a result that primarily stemmed from the lower amount of fertiliser required to support the production. If animal growth efficiency can be further improved on the “blue” treatment after the establishment of white clover, this system could be promoted as an economically *and* environmentally suitable method of beef production under British soils and climate. However, the economic and environmental costs of frequent reseeding need to be accounted for before accurate conclusions can be drawn.

Going forward, the internationally unique set of rich primary data from the NWFP will be gradually incorporated into the model to improve its accuracy. For example, snip samples of pastures (in summer) and “grab” samples of silages made from them (in winter) are collected on a regular interval, and chemical analysis quantifies the modified acid detergent fibre (MADF) content of these forages. The use of this information, in turn, allows more reliable estimation of metabolisable energy intake for each individual animal, and thus the resource use efficiency of the farmlet. The NWFP’s automated systems that continuously monitor methane (CH_4), nitrous oxide (N_2O) and CO_2 fluxes will further add accuracy to the system-wide evaluation of greenhouse gas emissions, compared with the present method of equation-based calculations. Finally, the meat produced from each system will be analysed for their nutrient contents and tested for general consumer preference, in order to account for different economic values of the final products coming out of the three farmlets. These data will contribute to a highly detailed LCA of beef production systems that is expected to contribute to the sustainable intensification of UK agriculture.