Should food form part of the farm AD recipe?

Richard Tomlinson looks at whether farmers and the food industry could partner in a symbiotic relationship whereby the food supply chain, from farm to table, could be managed on a closed loop basis.

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In 2007, Wrexham-based organic dairy farmer Richard Tomlinson set up fre-energy to deliver an on-farm AD system as "the next step in sustainable farming"

BIOWASTE, IN particular food waste, is now high on the political agenda in the UK and is subject to a growing raft of legislative and regulatory controls across the regions by the country's devolved administrations.

By far the country's largest source of biowaste is farm slurry, of which around 100 million tonnes are estimated to be produced on UK farms each year. As a result, methane and carbon dioxide greenhouse gas emissions, unpleasant odours and the potential for run-off into watercourses are all key issues that have to be dealt with.

While this copious amount of slurry may be suitable for anaerobic digestion, the material's low biogas yield levels undermine the economic viability of the process. To date, less than 100 AD plants have been installed on farms in the UK compared to Germany who is reported to have around 8000, Austria who has 450 (excluding sewage sludge), Switzerland who has around 130 and Denmark who boasts 82 AD plants.

Many academic research studies have been undertaken to establish if the addition of other organic waste materials to the slurry might increase the biogas yield, while at the same time identifying whether the quality of the digestate outputs might also be improved.

Indeed, organic wastes such as crops, grass, silage or food typically produce between four and 10 times as much energy as the same quantities of farm slurry.

In contrast to biodegradable municipal waste (BMW), source segregated food waste is rich in lipids and proteins and relatively absent of potentially toxic elements, resulting in the delivery of a higher biogas methane content and a fertiliser that is suitable for use in agriculture.

The perfect combination?

However, research has highlighted a problem of longer term instability of the AD process when using food waste as the sole feedstock, a consequence of a build-up of volatile fatty acids and ammonia; particularly the case with larger merchant plants. This can largely be rectified through the addition of slurry and card, whereby the slurry provides a neutral PH and an essential array of micro-nutrient and trace metals as well as a continuous supply of anaerobic micro-organisms, while the card increases the overall carbon content of the feedstock mixture as well as supporting the functioning of the methane producing bacteria.

The relatively low carbon to nitrogen ratio of between 6:1 and 9:1 in various food wastes does not support the ideal content for anaerobic digestion which should be in the order of between 20:1 and 30:1.

The combination of the slurry with a food processing residue such as potato waste, which has a much higher carbon rating of 28:1, can therefore be used to up-weight the methane production.

Mixed food waste has around three times the methane production potential of biosolids and 15 times that of cattle slurry. Blending energy-dense feedstocks with farm slurry is, therefore, a common practice to maximise biogas production. There is also evidence to support the suggestion that on-farm co-digestion of source segregated domestic food waste is the most effective means of making slurry digestion economically viable, with, of course, the associated benefits in greenhouse gas reduction and nutrient management.

The Danish way

In Denmark, the concept of mixing high energy potential substrates such as food waste with low energy potential animal slurries has been successfully applied to improve nutrient management mainly by using commercial or industrial sources of biodegradable wastes from food processing and even animal slaughter.

The predominant mix of feedstock is typically between 60% and 80% slurry with between 40% and 20% imported material, with a typical three-fold increase in biogas production, compared to processing slurry alone, and corresponding fertiliser value.

All our food emanates from the land and it is vitally important that we return nutrients back into it, ideally in a readily available form; AD, of course, is the ideal technology to do this in the form of digestate.

When blended with slurry, food waste can deliver a highly efficient process which brings substantial benefits to farm land, not least of which are the improvement in soil fertility and productivity and the potential elimination of the farm's demand for chemical fertilisers.

Using the energy contained within organic matter can make a substantial difference to a farm's profitability, particularly relevant in these times of escalating energy prices.

Lodge Farm

One farm that has already recognised the value of co-digestion is Lodge Farm on the outskirts of Wrexham, North Wales, which runs its own AD facility.

Over 1000 acres of land are home to a herd of around 650 dairy cows and young stock and the farm has been supplying organic milk on a large commercial scale since 2000.

An application has been submitted for a permit to allow food waste to be brought to the plant which will be sourced from local food producers, hotels, shops, domestic waste, abattoir, waste grains and flour, milk and food production sludge from settlement tanks and grease traps, and will be mixed with cattle slurry and poultry litter generated on the farm in North Wales.

The AD unit produces around 160KW of electricity and 200KW of heat of which circa 30KW electricity and 60KW heat is used on site while the remainder is exported to the National Grid.

Following storage to suit the farm's nutrient requirement, the liquid digestate is spread onto pasture while the solid digestate is applied to land used for growing winter crops to feed the dairy herd.

The farm does not import any artificial fertiliser to grow grass or crops and is wholly served by the AD output.

While food waste as a collective mix of various food stuffs has been proven to be a valuable addition to the AD processing of animal slurry, individual food waste items have the potential to deliver specific material content to the resultant biogas and digestates.

In the knowledge that fats generate around 50 times more biogas than cattle slurry, and notwithstanding the impact that the content of the feed-stock might have on the biodegradation process, it can be argued that a pre-determined set of ingredients could provide the perfect recipe for optimising the output and consequent benefits of the AD process.

Perhaps the time is approaching when the same care taken by a chef to ensure his or her dishes are enjoyed by customers to the full might also be vested in determining how best to source separate, distribute and process the resultant unavoidable food waste.

Certainly, by encouraging catering establishments to re-use and recycle their unavoidable food waste, WRAP's recently introduced voluntary agreement for the hospitality and food service sector begins to target this issue.

Larger businesses signing up to the agreement are required, and smaller operations encouraged, to measure and record the amount of food waste that they produce and to report on how the resource value of the waste is being recaptured rather than disposed of to landfill or down the drain.

The many thousands of catering establishments that currently use a food waste disposer, the use of which is to be banned in Scotland with effect from the end of this year, could instead recapture the macerated food waste in order to supply it in bulk in a format that is much more readily digestible.

Both the farming community and key sectors within the food industry have an opportunity, at a local level, to partner in a symbiotic relationship whereby the food supply chain, from farm to table, can be run on a closed loop basis. RWW