Feeding technologies and their impact on farm sustainability

During the recent 26th UN Climate Change Conference (COP26), 153 countries set new targets towards achieving carbon neutrality by 2030.

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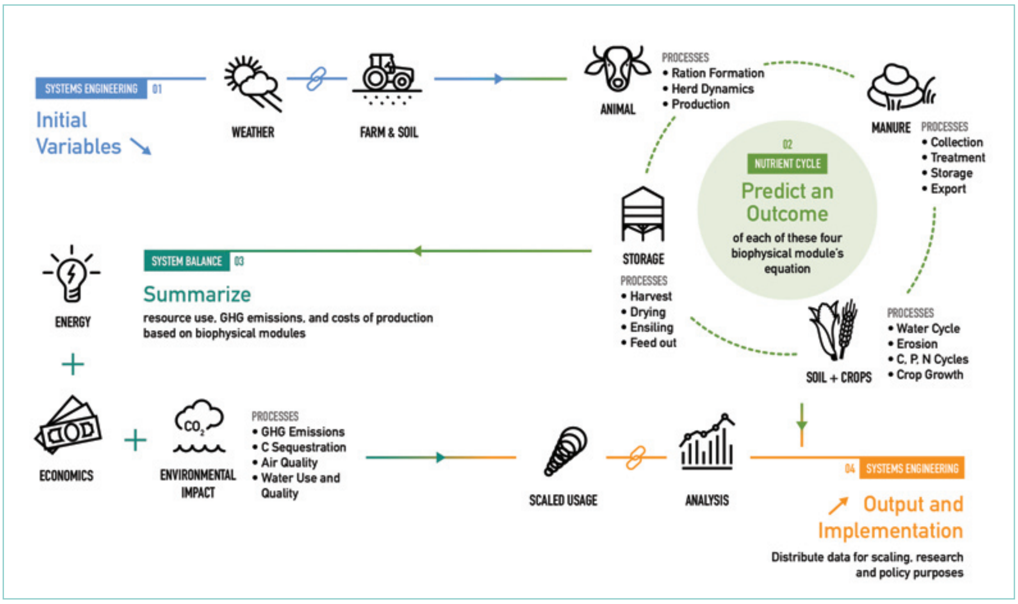
According to the European Commission, in 2017 agricultural activities accounted for 10% of the total greenhouse gas emissions in the EU. This percentage represents a significant improvement as the agricultural sector decreased emissions by 19% between 1990 and 2017.

If we turn our focus to dairy farming, there have been several scientific studies in recent years on how different dairy farming activities impact greenhouse gas emissions; how to predict the outcomes; and detecting areas for improvement.

One of these studies is the Ruminant Farm Systems (RuFaS) model which can predict the environmental impact of dairy production in four main areas; animal, manure, field and feed storage.

These areas can be worked on to reduce greenhouse gas emissions. With the model mentioned above, improvements in feed efficiency, ration formulation, feedstuff selection and energy source used, can have a positive impact on greenhouse gas emissions.

In this sense technologies, such as automated feeding, supports the implementation of different strategies to reduce greenhouse gas emissions in the mentioned areas.



The Ruminant Farm Systems (RuFaS) model.

Automated feeding as a tool to improve sustainability

GEA Farm Technologies has more than 35 years of experience in feeding automation, bringing solutions to farmers around the world depending on their individual situation. This technology is proven to reduce labour time, improve feed efficiency and reduce energy costs. Farms equipped with an automated feeding system would classically have a number of elements, including a kitchen area where bunkers, auger, mineral and other containers are placed. The mixing process would take place in a stationary mixer or inside the

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GEA's MixFeeder system WIC.

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feeding wagon. The feeding wagon has the main task of transporting the mixed feed to the different animal groups.

Depending on the size and logistics of the farm, a feeding system configuration is then selected.

The feeding process is controlled by a central process control where all the necessary information to apply the desired feed strategy is stored. This information, such as feedstuff, rations, feeding groups, locations and feed frequency, is introduced by the user in the feed management software.

This action takes place every day, in the same manner all day long.

What is the impact of automated feeding in terms of sustainability?

- Use of diesel versus electricity:

In GEA's experience a farmer will use 18 litres of diesel per cow per year to use the mixer wagon in a conventional feeding setting.

In terms of sustainability, a litre of diesel represents 2.65kg of CO_2e according to the scientific agency of the German parliament. Automated feeding systems use electricity as a source of energy.

In research conducted in 2015 by the Bavarian State Research Center for Agriculture, a MixFeeder system consumes 21.36kWh/per animal a day. In 2020 a kWh of electrical energy in Germany represents 336g of CO_2e in the form of energy mix.

If we take these values and use them in 200 dairy cow farms, we will see that in a conventional setting we have emissions of 9,540kg of CO_2e per year. Using automated feeding the emissions in terms of energy use can drop to levels of 1,435.4kg of CO_2 per year.

Considering the efforts of different governments to improve the energy mix of electrical energy to more sustainable sources, it is foreseeable that the CO_2 values per kWh will be lower in the upcoming years.

- Feed savings and less refusals:

One of the economic advantages to using automated feeding is the precision of the system that results in less feed refusals.

In a 200 cow farm that consumes 50kg of mix ration per cow per day we will have feed dispensing of 10,000kg a day. In a conventional setting we have, on average, 5% refusal since the animals are fed once or twice a day.

With automated feeding this refusal can go as low as 1%. In GEA's experience refusals of 2% are typically seen. Comparing the numbers in a conventional setting, the sample farm will have 500kg a day of refusals, while an automated feeding farm would have 200kg.

	Scenario 1[a]			Scenario 2[b]	
	DU-6	0.75 DU-8	0.6 DU-10	0.75 DU-8 +0.27 SU	0.6 DU-10 +0.59 SU
Beef output (kg/year)	322	236	131	322	322
Costs (h/year)					
Forage	1076	776	551	982	1007
Concentrates	339	382	419	420	504
Working hours (ha/year)					
Feed	9	8	6	10	11
Animal husbandry	50	37	30	45	47
Land use (ha/year)					
Grassland	0.58	0.43	0.34	0.67	0.85
Arable land	0.66	0.66	0.58	0.74	0.75
Greenhouse gas emissions (kg CO_2eq/year)					
Primary source emissions					
Enteric fermentation	5055	3933	2977	4963	5263
Manure	1321	1050	831	1190	1141
Soil N_2O	1364	1114	915	1580	1948
CO_2 from liming/diesel consumption	479	410	339	497	531
Secondary source emissions					
Mineral fertiliser	722	582	472	720	778
Diesel/electricity	270	263	262	274	285
Bought in feedstuff production	317	289	303	318	368
Others	50	48	42	52	51
Total	9578	7689	6141	9594	10,365

DU = dairy cow production unit; SU = suckler cow production unit; CO_{2eq} = kg CO_2 equivalents.
[a]Scenario 1: constant milk production; variable beef production; model outputs refer to a constant level of 5770kg milk.
[b]Scenario 2: constant milk and constant beef; model outputs refer to a constant level of 5770kg milk and 322kg beef.

Table 1. Model output for Scenarios 1 and 2.

The CO_2 emissions would be difficult to calculate due to the multiple variants. As a general statement, reduction of refusal will have a positive impact on the nutrient cycle that is described in the RuFaS model.

Efficiency improvement, more milk with less feed

Increases in the milk year per cow have been seen in different countries in recent years.

An increase in milk production per cow is considered a powerful strategy to reduce greenhouse gas emissions per kg of milk produced. In 2011 a model calculation by M. Zehetmeier et al. was presented.

This calculation shows that using increased milk production can have a positive impact on greenhouse gas emissions when the handling of the complete farm product (both milk and beef) are taken into consideration.

In this model (see Table 1) we can see a drop from 9,578 to 7,689kg CO_2 per cow per year when production increases from 6,000 to 8,000kg milk a year.

This decrease in CO_2 emissions is basically driven by the reduction of enteric fermentation, manure and soil N_2O.

In GEA's own experience they see that with automated feeding systems there is an increase in milk production of 4kg per cow per day or 1,220kg a year. The results depend on the farm's initial status of feed management.

This effect is possibly due to the animals being fed more frequently (6-8 times a day), fresh mixes and the precision of the system.

Use of additives, reduction of methane and better utilisation of nitrogen

During recent years different companies have introduced additives to the market in the form of methane inhibitors to improve the efficiency of the rumen.

These additives are included in the ration and since we are talking about small quantities, proper mixing and distribution is key for the expected results.

With an automated feeding system you will have a controlled environment where the right amount of additives can be weighed with high precision scales, the mix quality can be constantly monitored and the amount of additives can be adjusted to suit the different groups.

Conclusion

Taking steps towards carbon neutrality to mitigate global warming is on the agenda of most countries around the globe. In some cases, governments have implemented regulations and created subsidies to support greener technologies.

In this context, technologies such as feeding automation need to be considered in future farm investments, as a chance to improve profitability, while also reducing CO_2 emissions. ■

References are available from the author on request