Paving the way for a greener dairy industry

By Glenneis Kriel

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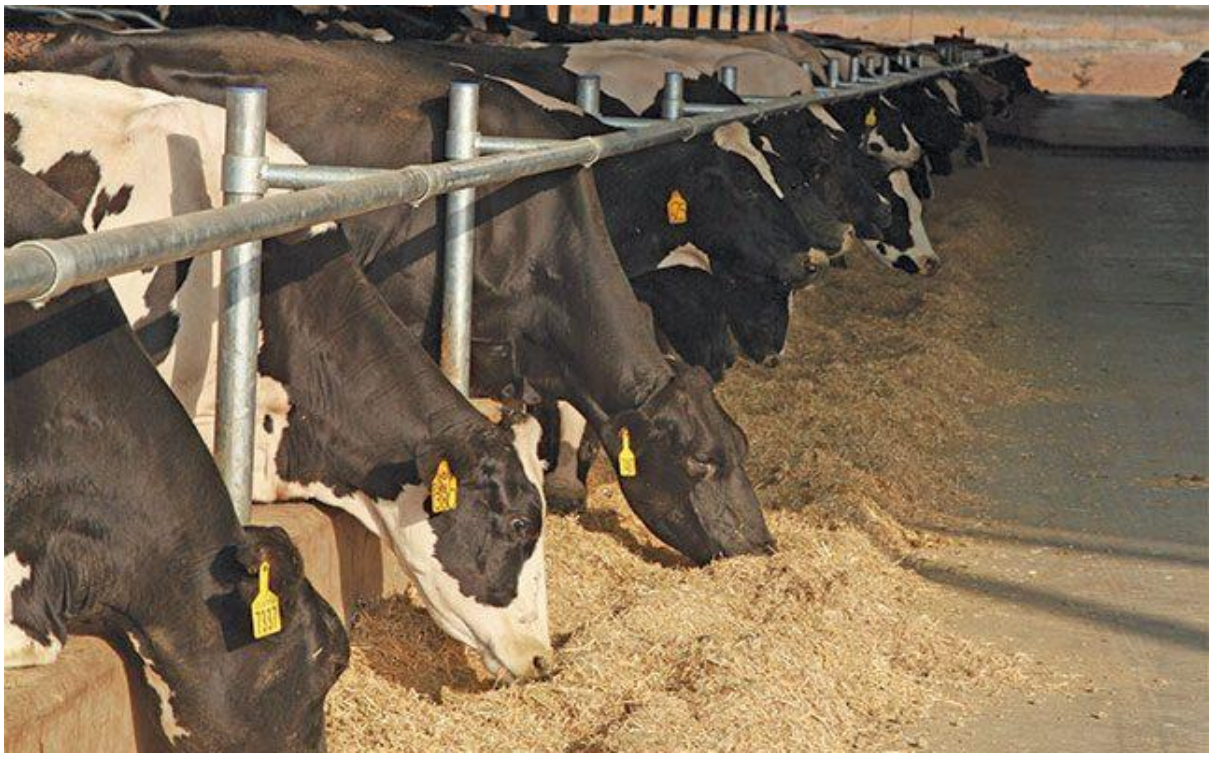
The dairy industry is often criticised for its environmental impact, but a new innovation called DESTiny aims to empower farmers to take control of their carbon footprints. Riana Reinecke, the tool's developer, explained to Glenneis Kriel how it works and how farmers can benefit from it.



The DESTiny model considers the type of feeding regime used on a farm.
Photo: Glenneis Kriel

In January 2022, Milk South Africa (Milk SA), in conjunction with ASSET Research, initiated the development of a web-based tool called Dairy Environment Sustainability, or DESTiny for short, to help dairy producers analyse and calculate their carbon footprints.

Riana Reinecke, who developed DESTiny as part of her doctorate in sustainable dairy production at Stellenbosch University, says the tool is much more than a carbon calculator, as it considers a farm's environmental impact holistically.

Riana Reinecke has developed a web-based platform called DESTiny, which allows dairy producers to calculate their farms‘ emissions holistically.

“Instead of merely focusing on net greenhouse gas [GHG] emissions from cattle, DESTiny considers the biological carbon cycle to give a holistic view of the footprint of cattle within a farming system. To this end, it uses system dynamics modelling to evaluate multiple aspects of sustainability, including energy, water, waste management, and biodiversity,” she explains.

“The model identifies areas on different farms that require focus, and allows users to create a baseline, track progress, and make data-driven decisions.”

The tool’s development was driven by growing international concern over climate change and efforts to limit global warming to below 2°C. In response, various dairy industries in countries like the US, Canada, and Denmark have committed to reach net-zero emissions by 2050.

Strategies to reduce and achieve net-zero emissions include improving feed efficiencies, enhancing manure management, promoting sustainable agriculture practices, and increasing energy efficiencies.

A science-based tool

Reinecke says the objective of DESTiny is to give the industry a science-based tool with which to measure sustainability. As such, it will counter arguments from activists, who might make impossible demands based on unscientific assumptions, and could be used to inform future policy development, for example, those related to carbon taxes.

“People have called for a reduction in cattle numbers to reduce their environmental footprint. Truth is, cattle offer several environmental benefits that

contribute to healthier ecosystems and more resilient agricultural practices. They play a vital role in carbon sequestration, and reducing their numbers to reduce greenhouse gas emissions could therefore actually defeat the purpose," she explains.

For now, however, she says, the web-based platform gives farmers an opportunity to generate a baseline against which to identify room for improvement and measure progress.

Reinecke's notion of the importance of cattle in the ecosystem is supported by the paper 'The broad-based eco-economic impact of beef and dairy production: a global review', published in the South African Journal of Animal Science in 2023.

The paper emphasises the importance of animal-based product consumption to address nutritive imbalance, stunting, and low cognitive development in poor countries in particular.

It found that methane emissions from cattle are much lower than previously assumed because global cattle numbers are lower than estimated, the global warming potential of methane has been overestimated, and methane's relationship with biogenic carbon pathways and how it is affected by the physical function of animals are poorly understood.

The study pointed out that cattle manure and compost could be used as an organic source of fertilisation to counter the negative impact of chemical fertilisers, and that herbivore grazers like cattle were vital to protect grasslands against soil degradation.

The way in which waste is managed in a dairy is included in the tool‘s calculation of carbon emissions.

According to the paper, grasslands constitute 46% of rangeland surfaces and are the largest source of photosynthesis and carbon sinks in the soil – even larger than forests.

The background

For her master’s study in agriculture, which she completed in 2014 and graduated cum laude, Reinecke worked on an integrated model to quantify total GHG emissions from dairy farms.

“Studies up until then did not reflect the diversity of farming systems when calculating greenhouse gas emissions. Information was also fragmented and not based on consistent or comparable methodologies, which is even more problematic for countries such as South Africa where data is scarce, often outdated, and not supported by scientific and technical publications,” she says.

The model was developed by using different accounting methodologies to quantify the GHG emissions of six dairy systems that differed in terms of production, feeding, animal breeding, general management, and material input.

Two of the six farms were pasture based, two were on mixed rations, and two were on partial mixed rations. Each farm in each pair was further categorised based on whether it had a high- or low-stocking density.

The first set of parameters considered included general farm data on farm size, energy consumption, and the use of synthetic fertiliser, purchased feed, dairy chemicals, and bedding material. Climate information under which the dairy production system was managed was considered when calculating emissions.

The second set of parameters focused on the feeding situation, herd composition, annual milk production and milk composition, feed information, and manure management systems.

One of the interesting findings of her study was that dairy systems that had the lowest GHG emissions per animal or unit of area did not necessarily have the lowest GHG emissions for a given product.

Building on previous research

Reinecke is doing her doctorate under the guidance of Prof Pieter Swanepoel, head of the Department of Agronomy at Stellenbosch University; Prof James Blignaut, director at ASSET Research; and Dr Heinz Meissner, research and development programme manager at Milk SA.

Her doctorate is building on research of people like Dr Henk Smit and Dr Josef van Wyngaardt, who showed that carbon emissions of dairy cattle in South Africa was probably lower than what was internationally assumed at the time.

According to research conducted by Van Wyngaardt around 2018, methane emissions of pasture-based Jersey cattle were 7% lower than the values derived from the Intergovernmental Panel on Climate Change's values in 2010. He also found that methane emissions from cows could be reduced by up to 30% by improving feed efficiencies.

Reinecke was also influenced by Blignaut's work and research on regenerative farming, and its potential to improve the resilience of a farming system. She also built on the valuable knowledge she gained from her master's study and turned the model into the user-friendly Internet-based platform that is DESTiny.

DESTiny uses system dynamics modelling to evaluate multiple aspects of sustainability throughout the dairy production cycle.

She is using the model to assess GHG emissions and carbon storage on dairy farms for her doctorate study, but the model is also available to farmers, researchers and technicians free of charge in order for them to analyse their own environmental footprints.

Data inputs required relate to farm inputs, feed and additives, manure management, pasture management, crop and fodder, soil management, and direct emissions. The farm input data, for instance, covers the overall structure and administration of the herd, including the dynamics in the herd regarding animals replaced and/or sold.

It also considers the number of female calves born from productive and newly acquired animals, and looks at animal weight and milk production.

In terms of pasture management, the crops, grazing strategies and their impact on emissions and carbon sequestration, pasture allocation, and fertilisation practices are taken into consideration.

Easy to use

Reinecke says the DESTiny platform is easy to use, as most of the data required should already be available in existing farm records.

The platform generates a report once all the inputs have been entered. This includes overall emissions generated by the farm, as well as the fraction of emissions generated from different sources, such as the soil, manure, or pasture production.

The report also shows the carbon mitigation and carbon sinks in the system, in the form of carbon captured in pasture and sequestrated in plant biomass, captured in the soil, and within the end product, which in this case is milk.

Reinecke says most dairy farmers aim to be as sustainable as possible, since failure to do so would jeopardise their businesses. However, these efforts need to be scientifically evaluated and quantified to address misconceptions about the environmental impact of cattle.

“Endeavours to become more sustainable are laudable in our community, but we need to assess whether our efforts sufficiently champion and safeguard animal agriculture on a broader scale and find ways to improve on these. We also need to move beyond our comfort zones and embrace innovative thinking to become even more efficient,” she concludes.