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CAN COW BEHAVIOUR INFLUENCE PERFORMANCE?

This ongoing research is about the validation and application of leading-edge technology to monitor the variations between individual dairy cow's behaviour in a grazing-based system and their contributions to overall herd productivity. So far the research team has compiled two studies (with more to come) and the preliminary results are discussed in this article. Early indications from these results will be of interest to rural professionals as they advise farmers on this topic.

Lifting dairy performance

To ensure the competitiveness of the dairy industry in New Zealand, a consistent focus is required on lifting dairy production by considering it more in terms of quality, not quantity, and value, not volume. An individual animal's performance (productivity) has a key role to play in the overall herd's performance and the profitability of the farm. Having data on an individual's performance can help farmers to adjust feed so their animals produce more or better quality products. It can also highlight the best and worst-performing individuals and aids in decisions about which cows to keep.

Animal performance is influenced by several factors including genetics, feeding regime and type of feed, reproductive status, health and the overall management of the farming system. Animal behaviour is believed to be one of the most important factors contributing to animal performance, and generally includes all the ways they interact with other animals and the physical environment.

Animal behaviour

Knowledge of animals' natural behaviour is essential in creating the right environment for individual animals and herds so they can express themselves naturally. This also helps to manage and care for animals in a better way to keep them healthy with a high quality of life. This is a fundamental aspect of livestock production, which is supported and promoted by farmers and other rural professionals.

Gaining an understanding of animal behaviour allows us to identify and treat sick animals, respond to immediate challenges, select better animals for breeding, design appropriate housing, and handle herds without creating unnecessary stress. Therefore, farmers, stockpeople and animal handlers should have at least a basic understanding of the behaviour of the animals they work with to adopt best farming practices and to achieve the desired farming efficiency.

Grazing and rumination behaviours

In a grazing-based dairy production system practised in New Zealand, grazing and rumination behaviours are of particular importance:

- Grazing behaviour refers to grass intake and reflects the eating patterns and absence of prolonged hunger. It is influenced by grass type, climatic conditions and the social status of the animals in the herd
- Rumination behaviour indicates an animal's digestive efficiency, fibre intake and health status, and varies depending on grass quality, type and size.

A cow with collar grazing on pasture

PLF tools can supplement the eyes and ears of the farmer through real-time monitoring of behaviour, milk production, temperature, oestrus, and in some cases can predict the onset of disease.

Both intake and digestive efficiency (i.e. grazing and rumination behaviours) substantially affect the animal's performance.

Effect of animal behaviour on dairy cow performance

It is therefore useful to explore the contribution of animal behaviour to dairy cow performance. In New Zealand, average dairy herd size is large (~400 animals) and monitoring individual animal's behaviour using visual observations or camera recording is quite laborious. A lack of tools to measure individual animal behaviour in a commercial grazing-based system has been a hurdle in the past. Advancements in Precision Livestock Farming (PLF) technologies have removed this barrier and paved the way for studies focusing on animal behaviour.

Precision Livestock Farming tools

PLF, also referred to as the 'per-animal approach', uses advanced technologies to optimise the management of individual animals, enhancing the contribution of each one in a herd to improve overall herd performance. PLF tools can supplement the eyes and ears of the farmer through real-time monitoring of behaviour, milk production, temperature, oestrus, and in some cases can predict the onset of disease. This information can be used by farmers to improve animal welfare by improving feed intake, physical health, reproduction and the overall management of the farming system.

PLF tools can monitor different behaviours in cattle such as eating, ruminating, calving, lying, walking and urinating. The devices that specifically measure behaviour have been tested and used overseas in indoor confined dairy systems, but there is little evidence of their accuracy in outdoor grazing systems like those in New Zealand. This lack of evidence and the system's cost are barriers to the farming community adopting the technology.

Behaviour monitoring cow collar device-based study

A study carried out by the Animal Science section of the School of Agriculture and Environment at Massey University primarily aimed to validate a behaviour monitoring collar device for dairy cows in a grazing-based system in New Zealand. It involved examining individual animal's variations in grazing and rumination behaviour and evaluating whether behaviour can improve performance prediction in dairy cows.

Data collection and PLF tools

The study used a herd of dairy cows from Massey University's Dairy Farm, comprising three breeds (Holstein-Friesian, Jersey and KiwiCross) in different lactation numbers. The data collected comprised of an individual animal's hourly/daily grazing time, hourly/daily rumination time, daily live weight, daily diet, monthly body condition score, monthly milk production and composition of dairy cows during the whole lactation period for three consecutive lactation seasons.

Behaviour data was collected using an automated device called AfiCollar, which continuously monitored and recorded daily and hourly grazing time and rumination time on a real-time basis. The collar was fitted around the cow's neck, with the sensor positioned on the right side of the neck. The collar had a triaxial accelerometer sensor, which was fitted in a box.

The sensor could identify specific motion patterns in different behaviour categories, such as grazing and rumination, based on head movements. Built-in generic algorithms processed the collected data and expressed it as hourly and/or daily grazing time and rumination time of the individual cows. The collar wirelessly transmitted the collected data to a base station when the cow was in the range of ~500 m and a wireless internet connection in the farm environment was used to download it.

Analysis and preliminary results

To recap, so far the research team has compiled two studies: one focused on the validation of the PLF tool; and the second focused on the effects of breed, lactation number, seasonal patterns and stage of lactation on the grazing time. The preliminary results of both studies have already been mentioned and are further discussed in the 'Implications of the study' section of this article. Data for rest of the studies have not been analysed yet.

Data for behaviour and the other variables mentioned above have already been collected for the 2018-2019, 2019-2020 and 2020-2021 lactation seasons. The preliminary statistical modelling to evaluate the difference in grazing and rumination behaviours in different breeds, ages and lactation stages and how the variations in diet types fed throughout the season affected grazing and rumination behaviours will also be evaluated. Statistical modelling was performed to see how grazing and rumination behaviour patterns fluctuate during different seasons and weather patterns.

The study will also provide information on the association of grazing and rumination behaviours with animal performance (milk production and composition), body weight and body condition score, and the extent to which animal behaviour can predict animal performance. The last part of this study will evaluate the variations in behaviour patterns before and during any health-related incidents such as mastitis, lameness, fever etc. The objective of the last part of the study is to examine if the collar device can help to predict the occurrence of any sub-clinical disease, as a dip in grazing and rumination is expected before and during sickness.

Investigations of intra-and inter-animal variations in dairy cow behaviour throughout the lactation period and their effects on performance are expected to contribute to improving the production efficiency of the dairy farming system.

The behaviour monitoring tool used in the study showed consistent results with the visual observations of behaviour performed by a trained observer, which proved the validity of the collar to measure the behaviour of grazing dairy cows. A preliminary analysis of the data collected has revealed that the cows with different breeds and lactation number did not vary in their daily grazing time and rumination time, but Jerseys generally spent more time grazing and less time ruminating compared to Friesians.

Time spent grazing appeared to decrease with an increase in age (lactation number). Time of the year and stage of lactation seemed to have significant effects on grazing time and rumination time. Grazing time varies significantly for different stages of lactation or month of year across the lactation period. Overall variations in grazing time throughout the lactation period had a curve consistent with the lactation curve. The study's next steps include analysing the remaining data, and the outcomes of that analysis will help determine any further investigation.

Implications of the study

Investigations of intra-and inter-animal variations in dairy cow behaviour throughout the lactation period and their effects on performance are expected to contribute to improving the production efficiency of the dairy farming system. This also might help the upcoming studies aimed at selecting more efficient animals for the future.

Daily grazing time of individual cows indicates eating patterns and time spent on grass intake to fulfil satiety needs and it reflects the absence of hunger. Grazing time is expected to be different for healthy and sick animals, and for pregnant and non-pregnant animals. As behaviour data is provided on an individual animal basis, it is easy to notice any fluctuations in the eating patterns of every single animal. Fluctuations in the grazing time of a cow (e.g. a consistently lower grazing time) reflect that the animal might be unhealthy, lame or unwell, so it might be easier to predict and/or identify any health-related issues happening to the animal.

On the other hand, it could be easier to identify those animals with high grazing time but low productivity, and those with low grazing time and high productivity. This might be helpful in developing a future herd consisting of more efficient animals. In turn, the selection of alternative, high-yielding dairy cows with appropriate indices will help to meet future demands for milk volume and quality.

Grazing time patterns for different seasons can help to manage feed resource and pasture availability by preventing feed shortages during extreme weather conditions. Similarly, rumination time also indicates the health status of the animal, so any consistent fluctuations in rumination time would be helpful for identifying if the animal has any physical or physiological problems. Also, grazing time and rumination time in dairy cows differ during oestrus. Behaviour monitoring might help improve on-time oestrus detection, hence improving the conception rate and preventing economic loss to the farmer.

Key messages

- Monitoring animal behaviour should help to improve the welfare status or quality of life for individual cows in the herd
- Monitoring grazing behaviour during different seasons and stages of the lactation period should help manage feed availability and pasture resources, and help to understand the variations in cow feed requirements
- Grazing and rumination behaviour data should help disease prediction in dairy cows to improve their health status
- Monitoring grazing and rumination behaviour during oestrus should help to improve oestrus detection and rate of conception
- Monitoring cow behaviour should help to improve the overall production efficiency of the farming system.

Conclusion

The collar device tested is valid to record individual dairy cow behaviour in a grazing-based dairy production system. This study addresses two perspectives of the grazing-based dairy farming system practised in New Zealand: monitoring dairy cow behaviour at an individual level, not at the herd level; and research that provides knowledge and leads to a pathway for upcoming studies focused on the application of PLF tools in dairy farming systems practice in New Zealand. The knowledge gained about individual animals provides an opportunity to improve health, welfare and performance.

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