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Farm gate level nitrogen balance and use efficiency in dairy farms in Hokkaido

（北海道酪農場における窒素バランスと窒素効率 - 農場ゲート方式）

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1. Introduction

Dairy farming has imposed significant nutrients surpluses (e.g. nitrogen) to the environment (Stott and Gourley 2016, Powell et al. 2017). Nitrogen surpluses often cause environmental problems such as nitrate leaching from farms to water ecosystems. Nitrogen balance approach is widely applied to evaluate and mitigate environmental impacts in dairy farming (Gourley et al. 2012, Burchill et al. 2016).

The objectives of the current study were to calculate farm–gate level N balance and nitrogen use efficiency (NUE) for dairy farms in Hokkaido, Japan. This research will contribute to making a benchmark for N balance approach in Japanese dairy farming.

2. Material and methods

Fourteen dairy farms in Hokkaido were investigated with their N import/export from autumn (Oct or Nov) 2014 to September or October 2015 except for two farms which manage their enterprises calendar basis (Jan – Dec 2014 and Jan – Dec 2015). Their farm sizes varied from 22–330 ha and the number of milking cows per farm varied from 33–827.

3. Results and discussion

Whole farm N balance ranged −162–700 kg N ha^{-1} yr^{-1} with a median value of 40 kg N ha^{-1} yr^{-1}. Productivity balance ranged −17–29 g N kg^{-1} yr^{-1} with a median value of 6 g N kg^{-1} yr^{-1}. The NUE ranged 20–170% with a median value of 67%.

Hokkaido dairy farms had a smaller amount of N imports and larger amount of N exports per hectare than other countries (de Klein et al. 2016). This is suggested by relatively smaller N balance and higher NUE, when compared to the reports from other countries (Buckley et al. 2016, Stott and Gourley 2016). It is partly because Hokkaido dairy farm has excess low quality hay which farmers prefer to sell rather than to feed their cows. One of the possible reasons for high NUE is smaller milking cow number per land in Hokkaido farms. Only two farms in the current study exceeded 2.5 milking cows ha^{-1}. High NUE does not necessarily mean that N is used efficiently but it can also mean that extra N supporting outputs. Also, high turnover rate of milking cow in Hokkaido might contribute to better N performance indicating young and productive milking cow herds in Hokkaido.

4. Conclusion

This study presented N balance from 14 farms in Hokkaido and compared the values from previous reports. Hokkaido dairy farms presented lower N balance and higher NUE than other countries. However, the N performance can change along with the intensification in the near future. Thus, under further improvements, N balance approach can be a beneficial tool for farmers to manage their farming with their environmental and financial goals.