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Improvement about Nitrogen flow of Upland and Livestock Farming on Tokachi-region in Hokkaido

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Summary

Large-scale upland cropping farms exist side-by-side with dairy farms in the Hokkaido Tokachi-region of Japan. There are problems about livestock waste management, and fertility needs to be raised. Organic combinations of upland field farming and livestock farming shouled be reconstructed, in order to solve these problems.

Otofuke Town, which is the object of this study, is located in the center of the region. We developed nitrogen flow models for the whole town, for specific areas of the town, and for a standard farm. Based on these models, nitrogen flows were estimated in order to point out problems on the substance circulation.

For nitrogen flow of the whole town, accumulation and leaching in farmland (A&L) was 64 kg N $ha^{-1}year^{-1}$, and waste to the hydrosphere and to the ground outside of farmland (W-h&g) was 18 kg N $ha^{-1}year^{-1}$. A&L was not a serious quantity for environmental conservation.

In the standard dairy farm model (SDM), nitrogen input to farmland was 203 kg N $ha^{-1}year^{-1}$, A&L was 16 kg N $ha^{-1}year^{-1}$ and W-h&g was 47 kg N $ha^{-1}year^{-1}$. The input of livestock waste to farmland was large, and the accumulation and output of nitrogen from farmland were very large. While, in the combination model of one dairy farm and two upland farms, compared with the SDM, nitrogen input to farmland was reduced to 61%, A&L was reduced to 42% and W-h&g was reduced to 34%.

When the SDM expands self-supplying forage by 1.7 times and alfalfa is introduced as a legume into a quarter of the expanded field, the amount of chemical fertilizer was reduced by 23%, and A&L was reduced to 46%. A&L was reduced by more than the livestock density reduction rate caused by the expansion of forage cropping. The introduction of a legume is an effective way to improve nitrogen circulation.

In the simulation in which the number of heads in the SDM was doubled without increasing the self-supplying forage cropping area, not only did W-h&g become 101 kg N $ha^{-1}year^{-1}$, but A&L became huge: 282 kg N $ha^{-1}year^{-1}$. If livestock waste management is improved and 75% of the compost is shipped out in this simulation, the nitrogen flow will be improved sharply: A&L = 13 kg N $ha^{-1}year^{-1}$ and W-h&g = 117 kg N $ha^{-1}year^{-1}$.

In the S area of Otofuke Town, dairy represents half of the agricultural production of agricultural production. The nitrogen flow of the S area was computed from the survey data of all the farms in the area. W-h&g was 44 kg N $ha^{-1}year^{-1}$, and A&L was 89 kg N $ha^{-1}year^{-1}$. Compared with the whole town, W-h&g of the S area was 2.5 times, although half of the compost was shipped out of the S area.

Then, we simulated the effect of introduction

technologies (livestock waste management system, triticale cropping using a slurry and straw ammonia treatment system) to the S area. In this simulation, W-h&g was reduced sharply to 10 kg $Nha^{-1}year^{-1}$, and A&L became 61 kg $N\ ha^{-1}year^{-1}$ to a quantity that would cause few problems. A large part of these reductions is attributed to the improvement of livestock waste management.

It was reconfirmed that proper management and proper use of livestock waste are important for environmental conservation.