linity up to 30 mmol $L^{-1}$ NaCl is more favorable for $CH_4$ emission. The application of gypsum can suppress $CH_4$ emission either in saline or non-saline condition.

# Mitigation of impact of nitrogen cycling associated with agriculture and food consumption on regional environments

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Concerns about environmental problems such as water pollution, eutrophication, acidification, air pollution, global warming, ozone layer depletion associated with nitrogen load is increasing. Global nitrogen load associated with agriculture and food consumption is supposed to account for 90% of the total, and there is a large nitrogen load in Asian countries with the remarkable growth of the population.

Using the inventory data concerning the flows and stocks of nitrogen in the systems of agriculture and food consumption, and the census data in each province of Japan, the export (E), cycling (C), loss (L) and purification in sewage plants (P) were estimated, and their total is obtained as a total system throughput (TST). The L increased with the increase of TST and accounted for 50% of the TST. The L increased with the increase of proportions of urban area and upland crop field significantly. And the L also increased with the increase of population, animal excreta, and chemical fertilizer application, and decreased with the increase of nitrogen fixation significantly.

Stream nitrogen concentration in each province in Japan was estimated by assuming the ratio of stream runoff to net nitrogen input (NNI) of 0.27 and the ratio of stream water discharge to precipitation of 0.75. The NNI is defined as the difference between the input and the output of nitrogen in the region, and equals to L+P. The area with the estimated nitrogen concentration higher than 1 mg N $L^{-1}$, which is the Japanese environmental standard for stream nitrogen concentration, was 66% of the total area of Japan. In that case, 55% of NNI was derived from agriculture, and disposed animal excreta accounted for 14% of L. If all the disposed animal excreta were used to alter chemical fertilizer application, NNI derived from agriculture decreased to 50%, and the area with the nitrogen concentration higher than 1 mg N $L^{-1}$ reduced to 31%.

$N_2O$ emission in each province in Japan was estimated by assuming that NNI not discharged to river is denitrified as $N_2O+N_2$ (based on the significant increase of stream bicarbonate runoff with the increase of NNI not discharged to river), and the ratio of $N_2O/(N_2O+N_2)$ of 0.71±0.26 (which was measured for the 84 soil samples with pH of 4.3 to 6.6). The result showed 41% of NNI was estimated to be emitted as $N_2O$. The estimated $N_2O$ emissions derived from agricultural fields and sewage plants in each province ranged from 2.3 to 32.7 and from 3.0 to 107.1 kgN $ha^{-1}$ $yr^{-1}$, respectively. By alteration of chemical fertilizer to disposed animal excreta, the $N_2O$ emission was reduced by 19%.

These findings suggest that reduction of nitrogen input into agriculture is effectively influencing the mitigation of environmental loss from agriculture, and further improvement of self-sufficiency of food to reduce the loss from sewage plants is required.