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Spatial distribution of nitrogen load and its impact on coastal environment from bay area in Kyushu

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Human activity has obviously changed the global nitrogen (N) cycle, with an increasing amount of N applying to the environment. Clarify N load and N cycle has become more important and necessary. Kyushu area is one of the main agricultural area in Japan. It is an important region which could comprise over one fifth of total agriculture products of Japan. The production of vegetable and beef has rapidly increased in past 30 years after the negotiation with Pacific Strategic Economic Partnership Agreement (TPP) for agricultural products. On the other hand, the increasing amount of fertilizer into farmland and livestock have increased the regional N load into coastal area, which may increase the costal stress of eutrophication and enhance eutrophication in enclosed bays. In this research, it is aimed to estimate the N load in coastal bay watersheds of Kyushu area for the past 30 years. Especially, it is estimated the spatial variation of the current N load into environment, and the water quality of related enclosed bays for identifying N budget in the areas where severe water pollution might be occurred.

The three coastal watersheds, the Yatsushiro Bay, Kagoshima Bay and Omura Bay, are selected as research area. A GIS based N flow model was developed to estimate the N budget in of 1km x 1km scale in this research. The N cycling model includes simple water budget model with the N pathways of agriculture, livestock and human impacts. The estimation was the agricultural production, food consumption, ammonia volatilization and the accumulation of soil in each region, finally to calculate the N load in the water environment and the total N load in the watershed of

Results shows a sharply increasing in N load from 1975 to 2005 in Yatsushiro bay watershed. The estimated total N load in 1975 and 2005 were 133 kg/ha and 214 kg/ha, respectively. It was indicated that relatively higher N contribution from livestock compared to population and crop based on the analysis in 1995; the total N load of crops, resident and livestock were 18.0 kg/ha, 53.7kg/ha and 62.3 kg/ha, respectively. However, the resident became the dominant source of total N load in 2005. While it increased to 204 kg/ha, the crops and livestock decreased to 6.86 kg/ha and 6.89 kg/ha, respectively. The dominant of N load has changed from livestock to resident in 2005. This may due to the change of N structure; with the improvement of people's living standard, the amount of food untaken by resident has increased. The average protein consumption per capita has increased from 30.0g/day in 1975 to 370g/day in 2005. In addition, the Kyushu area has abundantly precipitation which lead to a significant large surface water discharge. It shows a larger portion of N will finally discharged into the related coastal area through rivers compared to groundwater. For example in 2005, the N pathway ratio of surface water/groundwater is 5.5:1. Approximately 8.26 x 10^3 tons of the N could be discharged from land into the bay. The increasing trend of N discharge in past 30 years may contributes to the increasing eutrophication events in related bays. On spatial variation, there shows a series of high N load area along the coastal area, the historical variation of N load shows these area has shown high and constant in last 30 year, the plankton shows high level near these area compared to the low discharge area.
Keywords: N flow model, nitrogen contamination, fertilizer, agricultural production, water pollution, eutrophication