果樹栽培地域での窒素負荷量と地下水再利用システムの適用によるその低減効果についての定量的評価

Effect of groundwater recycle system on nitrate load distribution in an agricultural area, Japan

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As one of the major elements for crops, nitrogen directly affects the agricultural production. However, the excess application of fertilizers leads to a lot of environmental problems such as groundwater and surface water contamination. Especially, groundwater contamination by nitrate (NO_3^-) has been an important issue in agriculture areas. Ikuchijima island, located on the Seto Inland Sea of western Japan is one of the most famous and important agricultural island in Japan, with citrus groves cover 42% of the island. Groundwater is one of important water resources in the area because of low annual rainfall and relatively high risk of drought in the area. To maintain and improve crop yields, nitrogen fertilizer is applied over the whole year at a rate of ~2,400 kg ha^{-1} yr^{-1}. Consequently, most of the groundwater of the agricultural area are significantly contaminated by NO_3^-, and are considered in “eutrophic” condition. Therefore, the recycle of high NO_3^- groundwater to the irrigation on the catchment scale is effective strategy for saving both fertilizer usage and groundwater resource in the area.
In this study, we estimated nitrogen load from the catchments in Ikuchijima island using the SWAT (Soil and Water Assessment Tool) model. Especially, we tried to simulate the effect of reducing fertilizer application on nitrogen load assumed the recycle of NO_3^- in groundwater. The results showed that NO_3^- loads were highest near the coastal areas, which is related to the distribution of citrus farms. 42% of nitrogen load was from citrus farms in the north region of the island, and it ups to 60 % in the south region. It indicates fertilizer is the major source of nitrogen load in the island. Higher average nitrogen loadings also occurred in high density of residential area. The total nitrogen load from whole island was estimated to be 82507kg/yearwhen the annual nitrogen fertilizer application is 240kg/ha/year. However, it decreased to 42548kg/year when the fertilizer application was reduced to 160kg/ha/year.

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