

Study on the prediction of acidification and nitrogen leaching in East Asia  
ecosystems with a catchments scale model

Principal Investigator: Junko SHINDO

Institution: National Institute for Agro-Environmental Sciences  
(NIAES)

Kannondai 3-1-3, Tsukuba, Ibaraki, 305-8604 Japan

Tel:+81-29-838-8322 Fax:+81-29-838-8322

E-mail:shindo@niaes.affrc.go.jp

Cooperated by: NIAES, The University of Tokyo, Asia Center for Air Pollution  
Research

[Abstract]

Key Words Acidic deposition, Catchment analysis, Soil processes and material  
balance model, Nitrogen budget, Southeast Asia

In order to evaluate the effect of atmospheric acidic deposition on the material balance and acidification of forest catchments, the integrated monitoring on the catchment scale and its modeling were conducted. The study areas are tropical rain forest in Danum Valley in Sabah State, Malaysia and tropical dry evergreen forest in Sakaerat in Nakhon Ratchasima Province, Thailand. According to the continuous monitoring, alkalinity and pH of stream water were relatively high because of high mineral weathering rate and large internal cycles in Danum Valley. In Sakaerat, alkalinity and pH were significantly low and showed dynamic changes seasonally. Soil pH of surface layer also showed a seasonal variation.

A model was developed, which took chemical reactions in soil and material flows due to biological processes such as plant uptake, litter decomposition and mineralization, biological nitrogen fixation. The model was validated by the data in Japanese forest and was applied to Sakaerat. It estimated the seasonal changes in soil pH and nutrient leaching from litter mineralization similar to the observed changes. It also showed the internal cycle in Sakaerat was larger than that in Japanese forests and was much larger than the atmospheric deposition.

Measurement of river water chemistry conducted at the region surrounding the objective forests showed that the stream in each objective forest had lowest pH, EC and alkalinity and was considered as the most

sensitive area to acidic deposition in the region. Nitrate concentrations in river water were relatively low even in the area close to the agricultural land probably by the higher denitrification rate in the tropical condition.

Changes in nitrogen load from agriculture, household and atmospheric deposition from 1980 to 2005 were evaluated for the surrounding region: Sabah state, Malaysia and Nakhon Ratchasima Prefecture, Thailand based on the statistical data on population, agricultural production, fertilizer use etc. Ammonia and NO<sub>x</sub> emission rate and water pollution due to nitrogen load were then estimated for each 1 km by 1 km grid cell. It also showed the high denitrification rates in these regions. According to the yearly trends of population, food production, NO<sub>x</sub> emission from automobile etc., nitrogen load and its atmospheric emission was considered not to increase largely in Nakhon Ratchasima Prefecture until 2030. In Sava State, on the other hand, due to the increasing demand of palm oil, increasing use of nitrogen fertilizer may cause the larger nitrogen load to the environment and adverse effects on river water.