

Evaluation of annual nitrogen and silicon discharge in Japanese forested watersheds

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Forest ecosystem located at headwaters in a drainage basin provides water and dissolved components to downstream areas. The runoff water from the forested ecosystem has a good quality owing to a few dissolved inorganic components and scarce dissolved organic components. Recently, amount of dissolved nutrients in stream water have been discussed from viewpoints of a health of aquatic ecosystems and a production in marine ecosystems. In this paper, amounts of annual nitrogen and silicon discharge are estimated at thirteen forested watersheds in Kanto, Kinki, Chugoku, Shikoku and Kyushu district to evaluate the role of the forest ecosystems in a nutrient flux.

The successive drainage runoff rates and the stream water chemistry at weekly to monthly intervals were measured at the watersheds. Annual nitrogen and silicon discharge were calculated from relationship between a load of component and discharge of each water year at each watershed. Annual precipitations were ranged from 900 to 5700 mm within the study watersheds.

Thirty-four annual nitrogen and silicon discharges are obtained from the measurements at the watersheds. The annual nitrogen discharge is varied from 0.4 to 9.0 kg/ha/yr, agreed well with that at watersheds in Atlantic coast area in U.S.A. and at another Japanese watershed. No relation is found between the annual nitrogen discharge and the precipitation and the drainage runoff rate. The discharges are less than nitrogen influxes by rainfall at some of the watersheds where the nitrogen influxes were measured. This result indicates that nitrogen has been accumulating and 'nitrogen saturation' is not occurring at the watersheds. No obvious relation is also found between the annual nitrogen discharge and vegetation, geology and landform at the watersheds. On the other hand, the annual silicon discharge shows a variation from 10 to 240 kg/ha/yr at the watersheds, which are larger than that at watersheds from all parts of the world. The annual silicon discharge is increased with the increase of a drainage runoff rate. Our correlation between the annual silicon discharge and the drainage runoff rate corresponds well to that of the global observations.

Difference of the correlation of that annual discharge to a drainage runoff rate strongly indicates the difference of dynamics of each element in the forest ecosystems. The discharge of the element exhibiting a biogeochemical behavior such as nitrogen is influenced upon the various environmental and biological factors such as temperature, precipitation, forest growth, tree type and so on. On the other hand, the 'transport-limited' leaching process within the soil and bedrock controls the discharge of the element such as silicon exhibiting a geochemical behavior.