Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

HTT031-05 Room: 202 Time: May 24 10:00-10:15

Land use/cover and surface water quality at multiple spatial scales in the Kanto Region, Japan

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Previous research has shown that water quality in a river basin is affected by its land use/cover. However, more research is needed because findings so far vary from one river basin to another. This research assesses relationships between water quality and land use/cover in river basins of the Kanto region, Japan using geospatial data and GIS.

First, land use/cover changes during 1983-1986, 1989-1992, and 1995-1999 were analyzed. It was found that the changes were decreased in number with time, but increased in average size. Their spatial distribution also extended from the urban and agricultural areas to forest in the upper reaches. A larger percentage of forest was converted into residential and industrial areas and cultivated meadows. Agricultural areas including paddy fields were also converted, especially into weed communities.

Then, temporal trends of water quality were analyzed. The results show overall improvement of water quality in most river basins since the 1970s, which can be attributed to the enforcement of the Environmental Pollution Prevention Law. However, degradation of water quality due to nutrient concentration was observed in some river basins. Spatially, lower water quality occurs in areas dominated by urban and agricultural land use/covers. Therefore, pollution controls applied to these areas will improve water quality.

Correlation and multiple regression analyses indicate that, for the spatial scale of the whole Kanto region, water quality is mainly related to percentages of factory/industrial areas, those of urban districts with a few trees, and those of urban/residential districts with many trees. This indicates that despite the presences of sewage systems and wastewater treatment plants, anthropogenic activities associated with land use/cover remain affecting water quality. Weed communities including those on the roadside and in both cultivated and uncultivated paddy fields play a significant role in determining water quality in the spatial scale of river basins. This suggests that resuming agriculture in areas with unmanaged weed communities will improve water quality.

Altering spatial scales used in the correlation analysis of land use/cover and water quality including multiple regression led to different results. This indicates the importance of spatial scales in analyzing relationships between land use/cover and water quality. Therefore, planning of sustainable development should consider the use of multiple spatial scale approaches to protect water quality in an appropriate manner.

Keywords: land use/cover, water quality, river basin, Kanto region