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Nitrogen and phosphorus export to watershed from Water-Conservation Forest

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The purposes of this study are to estimate and validate water contamination of Total nitrogen(T-N) and Total phosphorus(T-P) from forest as runoff, in order to discuss policy measures for controlling non-point source loads. The study area is Doshi village in Yamanashi Pref . Total population of the are is 1,884, forest area is 7,468ha, 4,594ha of whole region is designated as Water-Conservation Forest for Yokohama City. Rest 2,823ha is private forest area for forestry.

The Water-Conservation Forest has been done thining by Yokohama Waterworks Bureau, but private forest, especially coniferous plantation area has been hardly done thining because of the decline of forestry. Therefore it is great concern that decreasing of water supply, declining quality of drinking water by increasing of sediment discharge and non-point source loads from the forest. A mean inflow at Doshi reservoir is 6.7(?/sec), Water transfer to other reservoirs from Doshi reservoir reached 3.0(?/sec), as a result of them water discharge to downstream is 3.7(?/sec). Consequently, increase of non-point source loads of nitrogen and phosphorus influence on water quality of reservoir such as Sagami reservoir and Miyagase reservoir.

Non-point source load of forest depends on surface run-off volume. To take account of this difference InVEST model (P.Kareiva et,al., 2011) is adopted for estimation of non-point source loads. Equations are shown (1)-(3):

$EXPx= EAFx*polx\prod(1-Ey)$ (1)
$EAFx= \log\Sigma Yu/\log\sum Yw$ (2)
$Yx = \sum(1-AETx/Px)Ax$ (3)

Where EXPx is non-point source loading value at pixelx, polx is the export coefficient at pixel x, y is a pixel of the upper reaches of pixel x. u means all grids located upstream of x, w means a basin including x and y. We used the export coefficients at the Fuji river basin(S.Shrestha et. al.,2007) as polx value. E_y is nutrient retention coefficient. Because of calculating E_y by comparing with result of L-Q equation, E_y is set to be equal zero. EAFx is the hydrologic sensitivity score at the pixel x which is calculated as (2). Y_x is the water yield at pixel x. P_x is the annual precipitation. AETx is the annual actual evapotranspiration on pixel x. A_x is the area on pixel x.

In addition, we made two L-Q equations to explain relation of Total Nitrogen and water discharge., Total phosphorus and water discharge based on the observed water discharge from 1956 to 2012, and water quality from 1991 to 2012.

As a result, when nutrient retention coefficient is zero, non-point source loads of nitrogen is 251.5(t/yr) and that of phosphorus is 5.9(t/yr). In these result, artificial load s of nitrogen such as household is 1.8(t/yr) and that of phosphorus is 0.1(t/yr). These results show that non-point source loads come from forest area. Results of L-Q equation are $TN=0.791*Q^{0.0616}$,(R2:0.8374), $TP=0.00762*Q^{0.0238}+0.004$. Using these L-Q equations non-point loads are 192.3(t/yr) in T-N, 2.4(t/yr) in T-P.

In conclusion, the difference of nitrogen between result of InVEST model and L-Q equation is 59.0(t/yr) 23.5%, that of phosphorus is 3.5(t/yr) 59.3%. These difference due to amount of nutrient retention functions of forest area. It is also cleared that discharge of run-off are concentrated in valleys. Therefore, we conclude that it is important and necessary that forests in valleys are managed by appropriate thining.

Keywords: Water-Conservation Forest, Non-point sources, Nitrogen, Phophorus, L-Q Equation