Estimation of Sediment discharge with distributed USLE and L-Q Equation in Water-Conservation Forest

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The purpose of this study is to estimate and validate sediment discharge from forest area for providing water resources in order to discuss policy measures for controlling sediment discharge. The study area is Doshi village in Yamanashi Pref. Its population is 1,884, forest area is 7,468ha, 4,594ha of whole region is designated as forest area preserved for provision of water resource for Yokohama City. Rest 2,824ha is private forest area for forestry. The forest area preserved for provision of water resource has been done thining by Yokohama Water Bureau, nowadays the private forests are seldom do because of a decline of forestry. Therefore, it is concerned that the degradation of provision of water resources, the increase of sediment discharges volume.

To estimate the sediment discharge, we adopted USLE (Universal Soil Loss Equation) model. It considers 5 factors, R (the rainfall erosivity index), K (the soil erodibility factor), LS (the slope length-gradient factor), C (the cover-management factor) and P (The support practice factor).

We converted and integrated sets of data such as forest management plan in Doshi village, soil texture map, precipitation data analyzed by radar-AMeDAS and others to the proper dataset for utilizing GIS. The output data shows sediment discharge in 60 sub-watershed (Max:1,000ha) and in distributed $25m^2$ grid. In addition, we tried to estimate more detailed information which is related to the land information, such as slope degree, land use and land cover.

Next, to validate the estimated result, we calculated the annual SS flux derived from L-Q equation, which makes correlation between the water discharge and SS density data. They were observed from 1955 to 2012 at the Doshi reservoir located downstream of Doshi River. Based on the LQ equation, we estimated the annual sediment discharge.

As a result of evaluation with USLE, sediment discharge per year is valued 97,820 (t/yr). On the other hand, SS flux estimated 400(t/yr) [SS=1.732Q0.0238(R2=0.3223)] and sediment deposition in the reservoir is 62,500(t/yr) with LQ equation. It is known that SS load from households are valued 1.8(t /yr). Therefore the anthropogenic loads is not dominant factor in this area.

The result of USLE does not mean exported sedimentation to observation station. This indicates potential of sediment loss in each grid and their summation in total grid. The reason why sediment loss value decay in runoff process is considered to be the function of sediment retention of each grid. On the other hand, there are three dominant factors of sediment runoff from forest area.

First, more sediment runoff come from natural forest area than coniferous area. Second, more sediment runoff come from abandoned coniferous plantation area. Third, Slope factor is main reason of sediment export.

The results suggests that 1st sediment retention of in this area is able to retain 27% of total sediment discharge in this region, 2nd dominant sediment supply come from natural forest and abandoned coniferous plantation area, preservation measures to control sediment discharge are prioritize forest management in steep area.

Keywords: Water Conservation Forest, Sediment Discharge, Universal Soil Loss Equation, LQ equation