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Effect of tree on side-wall failure in expanding gully during one rainfall event, South Korea

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The information related the processes of sediment generation and transportation in catchment that causes seriously damage to life and property is a significant to manage catchments and to frame a policy. Specially, the changes in artificial land-use accelerate soil erosion and slope failure. Morphometric changes on the mountainous slope associated with construction of some graves developed obviously gully around Godam-dong in Icheon-Shi during about last five years.

Gully expansion with gully-bed erosion, side-wall failure and head-wall retreat induced by surface flow and subsurface flow, generally, occurs. According to previous studies, the factors of gully expansion have been known by heavy rainstorm, freeze-thaw effect during the winter season, piping flow and etc., and the control factor of that has also been known by representatively the effect of plant root. Therefore, we have performed the geodetic survey and soil-profile analysis, and have monitored the pore-water pressure on gully to find out the growing mechanism of the gully from September 2004 to September 2005.

The head wall of gully accompanying with widening and deepening retreated approximately 1.3 m during the monitoring period. This growth occurred mainly by heavy summer rainstorm on 11-12 August 2005, but it merely occurred during the winter season. This growth pattern of gully showed that a few of the freeze-thaw effect exists between December 2004 and February 2005. The rainfall frequency analysis indicated that the frequency of the rainfall made the growth of gully on 11-12 August 2005 has annual recurrence. We suppose that total rainfall is not the main factor of gully expansion so far. According to the place of the piping flow on the head-wall, the soil-profile analysis showed that the permeability at soil layer near the upper boundary of the weathered layer was very high value and soil water mainly flowed through the upper boundary during the rainfall events.

The processes of the gully expansion during 11-12 August 2005 appeared to be head-wall retreat and side-wall failure. Head-wall retreat has been occurred by piping flow. The process of side-wall failure was more complicated than that of head-wall retreat. At first, run-off from piping flow in gully undercut side-wall, and then this undercut resulted in the exposure of the tree root. Therefore, the weight of the tree increased the shear stress and caused the side-wall failure. Soil shear strength has been increasing, because the matric suction in soil has been increasing at failure time.

Consequently, we suggest that the gully expansion of this study area has been occurred by heavy rainfall during the monitoring period, and the area in which gully expansion proceed actively, side-wall failure was much more affected by the increasing stress of the added weight of tree than the increased strength of the root mat effect.

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