Analysis of sediment transport in a thinned headwater, Yayama experimental catchment in Fukuoka

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1. Introduction

Headwater is a primary source of sediments to the channel network. Sediment transport in forms of both suspended sediment and bedload affects channel morphology downstream (Lisle, 1987). Sediment transport also affects to aquatic and riparian habitat quality and structure.

Many factors impact to sediment transport such as topography, vegetation, soil texture on the hillslope, and riparian environment. Logging in headwater alters sediment regime in headwater catchments (Benda and Dunne1997, Gomi *et al.*, 2001). This study aims to analyze the sediment transport in a thinned small steep headwater catchment.

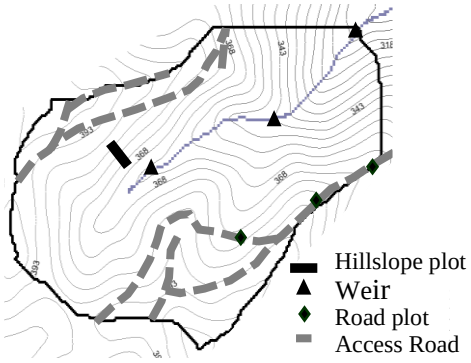

Fig. 1 Map of Yayama experimental catchment

2. Methods

The study watershed of about 2.98 ha is located in southeast of Iizuka city, Fukuoka prefecture. Sediment movements from the hillslope and in the stream channel were studied from May to September, 2013. Four sediment collection plots were installed on the hillslope (Fig 1), where sediments moving out from the plot at the downslope end were collected. Overland flow from each of the plot was also monitored. One of the plots was on the vegetated area (OLF) and other three were on the logging roads. Sediment movement in the stream channel was monitored by measuring sediments trapped in the three V-notch weirs (Fig 1). Sediment sampling was carried out after every rainfall events. Stream sediments were also collected during base flow period.

Precipitation was monitored at meteorology station located about 200m west of the catchment around 200 meters by using a 0.5 mm tipping bucket gauge.

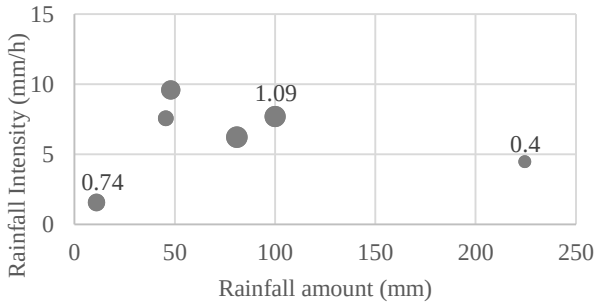

Fig 2 Sediment amount in OLF with Rainfall intensity and Rainfall amount. Points size indicates sediment amount

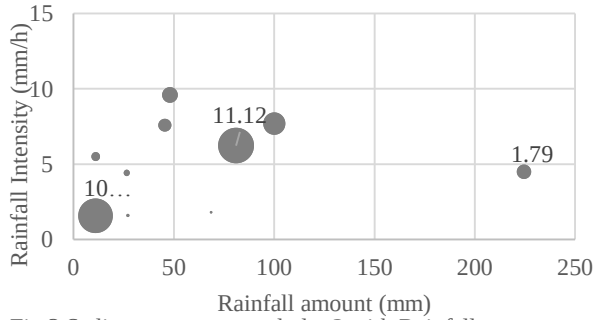

Fig 3 Sediment amount road plot 2 with Rainfall intensity and Rainfall amount. Points size indicates sediment amount

3. Results and Discussion

On the hillslope, sediment movements were observed (Fig 2), but the amount and frequency of sediment runoff from the logging roads was much greater than those from the OLF plot (Fig 3). The sediments on the hillslope was silty, and having vegetation as obstacle for transport, sediments runoff was not observed for many rainfall events. In contrast, road plots have sandy substrate with little vegetation, and sediment runoff was observed for most rain events.

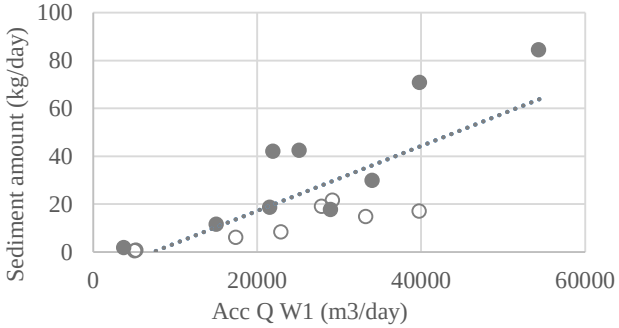

Fig 4 Acc Q W1 and Sediment amount

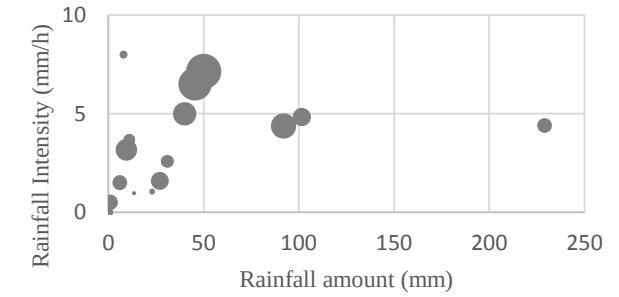

Fig 5 Sediment amount in W3 with Rainfall amount and intensity. Points size indicates sediment amount

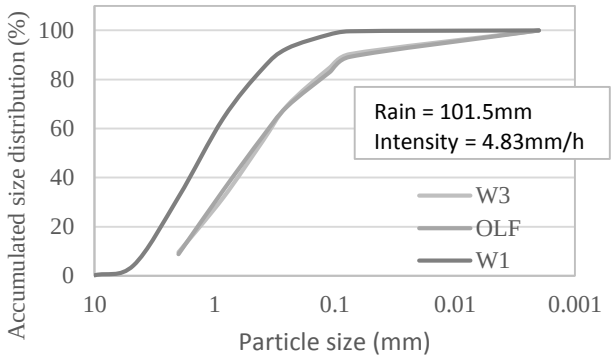

Fig 6 Particle size distribution of W1, W3 and OLF

Rainfall was the driving force of sediment transport on the hillslope, and we examined the influence of rainfall amount and intensity on the transport (Fig 2). In the OLF plot, rainfall intensity played more important role in sediment transport than rainfall amount. It does not mean that rainfall amount did not have any role. However, one event occurred with high rainfall amount with low intensity produced small sediment runoff.

In the stream channel, downstream W1 collected much greater amount of sediment than upstream W3, and sediment texture also differed between the two. Sediment samples taken from W3 were mainly composed of silt, and ones from W1 were sand and gravel. In W1, sediment amount showed correlation with accumulated flow with R^2=0.58 (Fig 4), suggesting that the stream flow is controlling the sediment movement. However, the sediment amount in upstream W3 did not show correlation with accumulated flow, R^2= 0.21. It rather showed relation with rainfall intensity and rainfall amount (Fig 5). The W3 was located where stream starts and the flow was small, probably accumulating colluvium soils.

Source of the sediment trapped in the W3 were likely from the hillslope as the particle size distribution were similar (Fig 6). However, the sediment trapped in W1 may come from the streambed and road plots where the particle size distribution showed higher content of coarse sediments.

5. References

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Benda, L., and T. Dunne, Stochastic forcing of sediment supply to the channel network from landsliding and debris flows, Water Resour. Res., 33, 2849-2863, 1997.

Gomi, T., R. C. Sidle, M. D. Bryant, and R. D. Woodsmith, Characteristics of woody debris and sediment in headwater streams, southeast Alaska, Can. J. For. Res., 31, 1-15, 2001.