SEDIMENT DISASTER CAUSED BY THE TYPHOON "RUSA" FOLLOWING FOREST FIRE IN THE EAST COASTAL REGION, THE REPUBLIC OF KOREA

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To clarify the indirect influence of forest fire on sediment disasters, the characteristics of land slides and debris flows under synergetic effect of the repeated forest fires and the rain storm caused by the typhoon "Rusa" in 2002 in Korea were examined comparing with the sediment disasters in healthy forest. Based on the results of field measurement, we proposed the idealized practice of countermeasure for disaster prevention in the east coast of Korea.

The Korean central mountain range extends from north to south along the east coast of Korean peninsula, therefore, river channels located on the east coast are characterized by short length and steep gradient rather than them toward the west coast. The hill-slope area of the east coastal region had been completely devastated by sequential deforestation in the period of both Japanese occupation and Korean War before 1953, and peoples has spent the following half century for restoration and reforestation of the devastated hill-slope area. Furthermore, frequent strong wind in spring exceeded 20m/s in wind speed and foehn climate dominated have often caused forest fire. Indeed, more than 17.000 forest fires were recorded with ranging beyond 15.000km^2 during 1960 and 2000. Especially, the forest fire occurred in April 2000 has burned out the 238km^2 mountain forest of the east coastal region.

At the end of August 2002, that was only two years later since the forest fire damage in 2000, the typhoon "Rusa" moved across the Korean peninsula has brought a heavy rain storm with maximum hourly rainfall at 98mm and daily rainfall at 870mm, and caused lots of landslides and debris flows in the east coastal region (Photo 1). Consequently the total area of landslide occurred during the typhoon "Rusa" has extended to 1.171ha, and the gross volume of sediment yielded from landslides was estimated between 3 and 4 million m^3. The most of landslides occurred near the ridgeline of the damaged area that had been affected by the former forest fire. The landslide area dominated by synergetic effect of forest fire and rain storm has attained to 6.4% of the entire mountain area, which was 12 times bigger than the area without fire damage. The density of landslides was calculated at 83/ km^2 which were 45 times more than the area without fire damage. The depth of landslides varied from 0.2 to 0.8m and was averaged less than 0.5m. Such shallow landslide referred to the disappearance of humus layer by forest fire and underdeveloped surface soil above the weathered granite zone. Each landslide area was ranged between 100 and 200 m^2, the slope was averaged at 39 degrees and the elevation of occurrence points was lower than 200m. Although red pine and broad leaves trees had been planted on the devastated slope after the 2000 forest fire, they are estimated to affect scarcely to the increase in surface resistance. Furthermore the burial mounds built on hill-slope, which is still common in Korea, and the banking material of forest road were destroyed and contributed to additionally sediment production.

The wide range of sediment disaster area is geologically fragile, because granite and granite

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gneiss underlying the whole Korea at 28 % each are considerably dominated. Most of rivers there tend to be shorter than 50km in channel length, and decrease the channel slope abruptly at the transit section between the mountainous valley and the alluvial plain. Debris flow involved lots of drift woods and weathered granite rocks have occurred in most river channels of the east coast during the typhoon “Rusa”. Not only disintegrated granite materials yielded by landslides but also sediment temporally accumulated on stream bed by mass wasting since the forest fire 2000 was expected to be comprised in debris flow (Photo 2). The debris materials deposited at the transit section overflowed from embankment especially along the bending reach of channel course. Most of drift woods originated from the red pine trees, which had been withered by forest fire while still standing, has became to a trigger of debris flow, and jammed at the bridge downstream and led to enlarge the debris flash area. Insufficient cross section area of designed channel available for debris flows and intermissive construction of embankment could be pointed out as major causes of overflowing. However the volumes of sediment delivered from each catchment during the typhoon “Rusa” were unknown, the additional sediment yielded from landslides has increased with the sediment accumulated on river beds before the typhoon. In contrast to these debris flows from the fire damage area, debris flows in the healthy forest without fire damage was resulted to be mostly initiated by bank erosion in a mountain valley with smaller magnitude and lower frequency.

Before the sediment disaster caused by the typhoon “Rusa” in 2002, the mainstream of the watershed conservation project in Korea was to preserve the hill-slope area by revegetation rather than torrent control. Although check dams were scatteringly constructed in major catchments, they didn’t function successfully in debris flow prevention because of destroying their wing. From the point of view for disaster prevention in catchment scale, the priority of countermeasures must be sifted from hill slope preservation to systematical torrent control for sediment transport. In the catchment under synergetic effect of the repeated forest fires and the rain storm, a series of consolidation works with the sediment traps and drift wood barriers is necessary to be installed. Considering the relief feature of catchments in the east coastal region, the sediment transport control at the fan apex or the transit section from mountain valley to plain could be especially prompted. Actually setting up of sediment reservoir system available for large amount of disintegrated materials, which is still stored on the stream bed after the typhoon event, is effective at the outlet of mountain valley. Then, dredging the deposited sediment there is periodically required. It is also important to install channel works downstream completely for reducing the channel bed scour and fixing the stream course safely. Furthermore, the preparation of hazard mapping is to be realized for the integral treatment of disaster mitigation.

Photo 1: Landslides by the typhoon “Rusa” in the fire damage area

Photo 2: Deposition of fine sediment and degradation of stream bed

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