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Correlation of Sedimentation and Landslides in Wu Hsi Catchment after the 1999 Chi-Chi Earthquake in Taiwan

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The hilly Western Foothill of Taiwan Island is highly prone to landslides, especially during typhoon season in the summer. The 1999 Chi-Chi earthquake (MW=7.6) resulted in tremendous amount of landslides along the Wu Hsi catchment of central Taiwan. The impact of this earthquake not only makes the geomaterial more fractured but also changes the river morphology in the Western Foothill area. This study investigated the correlation of catchment sedimentation and landslides before and after the 1999 Chi-Chi earthquake. The Wu Hsi is a major river in central Taiwan, with 119km in length, 2025km2 in drainage area, and elevation from 3144m to 20m. In order to consider the flow discharge and sediment discharge in different sub-watersheds, especially in the upstream, this study divides the Wu Hsi catchment to three sub-catchments, the Peikang sub-catchment (I), Nankang sub-catchment (II), and mid to lower stream of Wu Hsi (III). Analyses were performed for each sub-catchment with discussions. The study comprises two major parts, i.e., catchment sedimentation and correlation with landslides. The former part includes field, satellite image and DTM calculation results, and the later part includes analysis on the correlation between the landslides and catchment sedimentation. Following the 1999 Chi-Chi earthquake, two typhoon events, i.e., Toraji (2001) and Mindulle(2004), were adopted for this study.

Our findings indicate, comparing with typhoon Mindulle, about 5.25, 8.94, and 5.47 times more sediments were generated by typhoon Toraji in sub-catchment I, II, and III. Considering the transportation of sediment, sediments accumulated in sub-catchment I is about 2.78 times more than those in sub-catchment II. And Those sediments were transported down to sub-catchment III by typhoon Mindulle. The results reveal sedimentation trend in sub-catchment I and II during Toraji, and incision trend in sub-catchment II and sediment deposition trend in sub-catchment III during Mindulle. (see Table 1) The impact of Chi-Chi earthquake is significant. It induced 4.28 times more landslides than before, and about 95% of the landslides are newly generated. For the landslides in those three sub-catchments, comparing with typhoon Mindulle, 150% more reactivated landslides and 10% less new landslides in sub-catchment I, 70% more reactivated landslides and 30% more new landslides in sub-catchment II, 150% more reactivated landslides and 10% less new landslides in sub-catchment III were generated by Toraji. (see Table 2) The results show strong correlation between the catch sedimentation and landslides. However, the impacts of Chi-Chi earthquake on different sub-catchments are different. The landslides are more prone to reactivation during Toraji, especially in sub-catchment I; more prone to new generation during Mindulle, especially in the sub-catchment I and III. A conceptual model is also developed to investigate the control factors on the correlation of sedimentation and landslides. This case study could provide experiences of the sustained landslide investigation and sediment estimation to regard as the reference of catchment management.