VI Conclusions

The present study proposed a new method for estimating the thresholds for channel initiation by bedload transport from hydro-geomorphic data. The estimation requires the three kinds of data: (1) storm-flow distribution, (2) rainfall-runoff relationship and (3) critical discharge for bedload transport. Threshold for channel initiation by bedload transport can be expressed with source area, A, local channel gradient, S_c, and rainfall intensity, I_R, as follows: $AS_c^m = \gamma / (k_p I_R)$, where γ, m and k_p are the constants calculated from hydro-geomorphic data in channel heads.

Analytical methodology in the present study assumes: (1) peak discharge of a storm event is linearly proportional to drainage areas, (2) peak discharge of a storm event is linearly proportional to maximum T-hour rainfall of the storm, and (3) critical discharge for bedload transport exists. The assumptions (1) and (2) must be satisfied in most humid forested mountains where subsurface storm flow occurs in shallow regolith (e.g. Dunne, 1978). Except for the mountains where groundwater flow predominates (e.g. limestone terrain), methodology of the present study must be applicable to most humid forested mountains. Furthermore, this methodology is applicable to mountains where these assumptions are satisfied even under the different climatic conditions.

Thresholds for channel initiation by bedload transport in a humid forested mountain underlain by Mesozoic chert were analyzed on the basis of hydro-geomorphic observations. Hydrological data in the present study area satisfied the above assumptions (1) and (2). Clear critical discharge is also estimated from bedload data. Thresholds for bedload transport at the channel

heads can be expressed with maximum 4-hour rainfall, R_4, by $AS_c^{2.37} = 52.4 / (R_4 - 0.014)$. The predicted area-slope threshold for channel initiation well fits the observed area-slope relationship in channel heads. Most channel heads are located where bedload transport frequently occurs in response to frequent rainfall.

Two issues remain to be solved in the present study. First, the effect of bedload transport on channel initiation is not verified in a mountain where shallow landslides frequently occur. A future issue is the application of the proposed methodology to mountains with frequent shallow landslides. Second, the present study discussed the erosion rate in channel heads based on short-term observations. Another future issue is quantifying the rate of landform evolution in channel heads on the basis of both long-term observations and the other methodologies for estimating erosion rates.