CHAPTER 8

CONCLUSION

The evaluation of potential for the 2001 debris flow and debris flood in Nam Ko Yai sub-catchment and its alluvial fan are summarized and concluded with further recommendation below.

8.1. Evaluation of potential for the 2001 debris flow and debris flood

In this research, three data input, which are thematic (GIS and remote sensing) data preparation, field investigation, and laboratory analysis were used to investigate the parameters influencing the debris flow and associated debris flood occurrence on 11th August 2001 in Nam Ko area, Changwat Phetchabun, Central Thailand. Furthermore, the purpose is to analyze the potential source area, run-out zone, and depositional area; and to determine the evidences of the potential for hazards in Nam Ko Yai sub-catchment and its active alluvial fan. Finally, the relationship between the sedimentary sequences and the debris flow and debris flood occurrence in the active alluvial fan is also defined.

The input data used for flow-flood hazard assessment consists of several data categories of spatial data from the available resources, digitizing from available maps, and prepared from image interpretation and field investigation data. Thematic maps of the input data produced in this thesis consist of elevation (digital elevation data, Digital Elevation Model-DEM, aspect, slope, landform topography), hydrology (drainage pattern, sub-catchments characteristics), meteorology of rainfall intensity, geology (rock unit), soil properties (soil group unit, soil thickness), flow-flood inventory of scar-scouring and depositional locations, land cover, and infrastructure and human settlement. These input data were further used to analyze the debris flow-flood hazard by the statistic analysis.

To investigate the parameters influencing the debris flow and associated debris flood occurrence, the relationship of debris flow-flood scar-scouring and each relevant parameter was analyzed for debris flow-flood susceptibility assessment using the univariant probability method and landslide susceptibility map. A key assumption using this approach is that the potential (occurrence possibility) of flow-flood processes would be comparable to the actual frequency of flow-flood processes and relationships between each parameter are independent. In Nam Ko Yai sub-catchment, scar-scouring locations detected from orthophotograph interpretation and field surveys were formed into a GIS database. Various maps were constructed from the flow-flood relevant parameters derived from the database. The parameters involved in the debris flow-flood susceptibility analysis are flow-flood inventory of scar-scouring locations, slope, landform topography, geology, soil group unit, soil thickness, land cover, and stream proximity. Using these parameters, probability method was applied to analyze the debris flow-flood hazard. It is concluded that debris flow and debris flood occurrence probability value is generally much higher dependent on the significant influencing parameters, namely, slope, landform topography, geology, and land cover. The analyzed result was used to reconstruct the GIS database, and mapped. Furthermore, calculation of debris flow-flood susceptibility was applied to analyze the debris flow-flood hazard in the sub-catchment. It was concluded from the susceptibility map that the middle part of Nam Ko Yai stream channel and its adjacent banks had a very high to high flow-flood susceptibility whereas the lower downstream part of the stream had a high flow-flood susceptibility. It was also remarked that the western and northern steep-cliff areas had a low to moderate flow-flood susceptibility whereas the main other parts else of the sub-catchment have in general very low flow-flood susceptibility.

For the flow-flood event reconstruction and its potential in Nam Ko Yai sub-catchment, the evidences of geotechnical properties of rocks and soils, as well as evidence of the channel configuration and suspected natural dam location were studied. It was concluded that the disastrous debris flow-flood event was not the work of the unusual high amount of rainfalls alone, as previously theorized. Instead it was the work of combined parameters from the terrain characteristics with specific land cover to the

time-delay for accumulation of debris and sediments. This combination of parameters also cause debris flow-flood accompanied with a high amount of precipitation. The damage could be made greater by a natural temporary landslide dam forming at locations within the stream course, followed by destruction of the dam under the weight of impounded water. After such a disastrous event, it could take time for more plant debris and sediments in the sub-catchment area to accumulate before the next debris flow-flood.

After realizing the parameters and processes that governed flow-flood initiation, transport, and sediment bulking in the area of Nam Ko Yai sub-catchment, the stratigraphic recognition and characteristics of the previous alluvial fan deposits were thus essential to evaluate the past flows-floods here. A geological evaluation was done following a two-step procedure consisting of an initial delineation of the active depositional area, and a subsequent detailed, site-specific analysis of the hazard within the active alluvial fan.

In addition, radiocarbon dating of the preserved wooden debris suggested that the debris flow-flood were recurrent processes at least twice (2,618+/- 35 before present and post-1950, respectively) before this 8/11disastrous event. From the previous stratigraphic sequences of the alluvial fan and these radioactive dating results, it is strongly confirmed that this is an active alluvial fan.

Thus the areas down below, especially where the settlements situate on the distinctive alluvial fan, will always be in danger if no proper caution or preinvestigation is not employed. This kind of tragedy could also happen easily in any other areas if the coincident factors exist.

8.2 Recommendation for more accurate evaluation of potential for debris flow and debris flood

Although the methodology of evaluation is appropriate for this preliminary stage of investigation in the present study area, the derivation using this methodology are based on incomplete or unavailable information in some parameters according to the

limitation of accessibility and rarely records in the past. The evaluation of potential for debris flow and debris flood could be substantially improved if the same methodology is applied systematically and carefully over the entire area. Studies needed for careful evaluation of potential should address the following questions:

1) The flow-flood susceptibility analysis using the bivariant probability method to explain the actual frequency of flow-flood processes and relationships between each parameter that are dependent to each other.
2) Relations between rainfall, groundwater levels, and debris flow movement. Such relations would permit prediction of timing of debris flows. Real-time prediction and warnings could then be made based on telemetered rainfall, water level, or ground-movement information.
3) Detailed site-specific studies including stability analyses of the party-detached shallow landslides.
4) The processes of transformation from shallow landslides to debris flow. Understanding developed through such study could help evaluate the potential for debris flow of the party-detached shallow landslides.
5) Volume analysis of the incorporation of channel sediments or materials scoured from the channels and its banks by debris flow and debris flood.
6) The transition from debris flow to debris flood. Understanding of this transition would permit more accurate prediction of the nature of flow from the canyon mouth to the risk area of the active alluvial fan.
7) Actual and potential flow paths analysis by using the hydrological flow models (such as FLO-2D model, etc.). Understanding flow directions, flow accumulation and sediment volume in the stream lines and stream order would utilize to delineate the areas of potential debris flow and debris flood hazard.
8) Recurrence of debris flow and debris flood at the canyon mouth of alluvial fan area. Systematic field investigation and dating of deposits over the entire alluvial fan would help define the expectable frequency of events from the canyon of Nam Ko Yai sub-catchment.