



## **Recent Land Failures during Earthquakes and Heavy Rains**

Kazuoh SEO (1)

(1) Tokyo Institute of Technology, 4259 Nagatsuta, Midori-ku, Yokohama 226-8502, Japan,  
seo@enveng.titech.ac.jp

### **Abstract**

Land failure might be triggered sometime by an earthquake, but also triggered some other time by a heavy rain. Such disaster often brings isolation to a local community. Every transportation system might be closed from other districts. Therefore the local community must survive by themselves for a long time. In this paper, recent land failures could be reviewed through the experiences during earthquakes and heavy rains. What would be the difference among land failures triggered by earthquakes and heavy rains? Can we compare the examples of land failures between different districts with similar condition? How about the comparison between different districts with different condition? We want to discuss about such cases by introducing recent experiences.

**Key-words:** land failure, earthquake, heavy rain, local community

### **Introduction**

In this paper, land failures induced not only by earthquakes but heavy rains will be focused. Actually we may have already improved buildings and houses not to collapse during strong ground motions. But when it comes to land failures, we are not sure how to keep the safety from natural disasters. Most of all in rural earthquakes, under populated regions will suddenly meet with very serious social problems. We would like to introduce some of such typical cases those have recently happened in Japan. After that, we would like to introduce also some of very vulnerable cases in the future disaster. We are very sorry but we have no idea how to solve these problems at this moment. But they look very important to be solved with the cooperation among different research fields.

### **Land Failures Brought by Recent Rural Earthquakes in Japan**

The 2004 Niigata Chuetsu earthquake with M6.8 attacked very unstable mountain area in the central Niigata prefecture. Maybe this area has often suffered similar land failures (slope slip) many times one and after, as the topography of the area looks very complicated. The local society consists of many small agricultural villages connected with narrow roads each other. In winter seasons, there is heavy snow with about three of four meters sedimentation in maximum. The process after the earthquake could be described as follows.

1) Just after the earthquake, rural communities were completely isolated from neighbouring cities and towns, because transportation systems were completely shut down. They wanted to communicate with outer societies writing messages on asphalt roads, such as "Help", "We are here", and "No water".

- 2) The Self-Defence Force rescued all the residences with helicopters within two or three days from the earthquake. Rescued people stayed in public facilities (public halls and school buildings) for two months.
- 3) Before snowing, they moved to temporal houses those were quickly prepared for the evacuated people. The circumstances would be much better because each house was given for one family and the original community in their village was kept even in the temporal houses. They spent about three years in this condition. In the same period, they were permitted to visit their own houses to do minimum job. Reconstruction works were made mainly for the protection of collapsed slopes and for keeping the roads available.
- 4) Most of the residences returned back to their own houses after three years.



Photo.1 Land failures could be seen everywhere in Chuetsu district in the central Niigata prefecture during the 2004 Niigata Chuetsu earthquake. The most severe damage appeared in Yamakoshi village in the hilly mountain area. It took about three years until the recovery, that means rural residential people came back to their original houses and restarted their daily lives.



Photo.2 Slope failures those could be seen in a small island near the source region of the 2005 Fukuoka-Oki earthquake. Most of people were fishermen and they preferred daily convenience living near the harbour, then they build their own houses climbing up the slope one and after.