

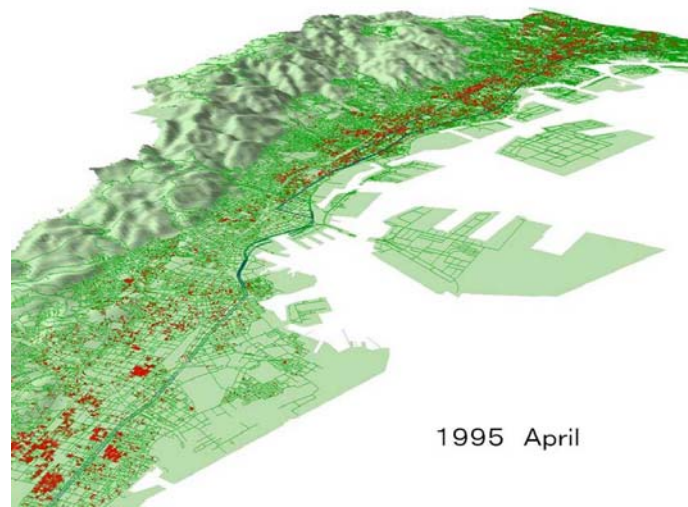
## Glocal Perspective of Urbanization and Disaster in the case of Hanshin Awaji Earthquake

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### 1. Disaster Information Management Activities using GIS

Disaster Prevention Research Institute of Kyoto University (DPRI-KU), and Department of geography, Nara University have created many databases of damages and restorations in the Hanshin Awaji disaster area using GIS. The dead person, building damages and the damages of a lifeline were inputted into the large scaled electronic map, 1:10000 and 1:2500. These restoration and reconstruction databases have a serial information on the debris removal sites of collapsed houses and buildings, on the traffic impossible roads



The first investigation was carried out at the disaster area covered by 17 sheets of the maps 1:10000, on February 9, 1995. It has been continued from just after the earthquake on February, 1995 to on April 2009. This time series investigations have been carried out at 1 month interval from February 1995 to July 1995, at 3 months intervals from July 1995 to April 1999, at 6 month intervals from April 1999 to October 2001 and one year interval from April 2002 to 2009. The distribution of debris removal sites ( fig.1) and the process of debris removal working is made clear by the investigation.

### 2. Air Pollution caused by debris removals works

The air pollution by high asbestos concentrations is caused by collapsed removal works of damaged houses and buildings. According to research by Environmental Agency in Japan the asbestos concentration continued to increase from two months to six months after earthquake as same as the increasing of the number of collapsed house debris removal sites. These phenomena are corresponding to the peak period of collapsed debris working as the result of our investigation. According to the estimation by Hyogo prefecture the total amount of disaster waste is 20,000,000 ton, private houses and buildings waste ,14,500,000 ton, road and railway waste ,4,800,000 ton, public buildings waste,700,000 ton This amount is about five times of the every year wastes. Air pollution caused by incinerating disaster waste and by building demolition. Especially, there were a lot of open air burnings (noyaki) immediately after the earthquake because there were a lot of wooded houses in Japan. This outdoor burning is serious generating dioxin as environmental problems.

### 2. Recycling the Disaster Debris

Debris removal has been the popular management approach in handling the collapsed houses debris after earthquake for restoration, However such approach causes environmental problem

and this approach needs large costs and the labors. In addition to the limited number of suitable incinerators and open spaces, the transportation of dumping debris causes the traffic jam. It is necessary to change the idea of debris removal from the collapsed sites in the environmental problems. The approach of debris management should start with recycling option rather than removal. In Jogja and central Java earthquake 2006 the reuse of debris used for building temporally shelters and to reclaim construction materials from the collapsed debris such as brick and nails unlike the debris removal in Hanshin Awaji earthquake. This practical reuse of debris is beneficial for the solution of environmental problem. The new style of debris management need to be developed using new highest technology.

### 3. Conclusion

Serious damage of the earthquake is related to the vulnerability in urban area with poverty and bad land conditions formed with the process of urbanization. According to Disaster Life Cycle of the Federal Emergency Management Agency (FEMA) , it is classified into the four stage, Preparedness, Mitigation, Recovery ,Response. The shift of the debris removal into the debris recycling, and the reusing of them in the housing construction are important for the solution of environmental problems.

Keywords: urbanization, disaster, GIS, Hanshin Awaji Earthquake Disaster, debris removal, environmental problem