Geographical Study of the Disaster in Japan and the activities of "Commission of Disaster Responses" of the Association of Japanese Geographers

Japan is subject to suffer disasters due to its natural condition. Until the 1970s, the relationship between flood and the geomorphological condition was studied and the results were applied to hazard mapping. After the 1980s, landslide and debris flows, earthquake, and volcanic activity became the main problem of the disaster prevention. After the Great Hanshin Awaji Earthquake Disaster of 1995, the geographical studies on earthquake disaster increased. The Association of Japanese Geographers (AIG) established the Commission of Disaster Responses in 2001, and it holds symposium on disasters from the geographical viewpoint every year in the general meeting of the AIG. The mapping of the tsunami stricken area of the Great East Japan Earthquake Disaster of 2011 was carried out by a special team of the Association of Japanese Geographers. The study on disaster is conducted now in the field of physical geography and the human geography. The role of the Japanese geographers becomes very important in a world disaster study.

Geographical Characteristics and Natural Disaster of Japan

Since the Japanese Islands (Fig. 1) are situated along the convergent boundaries of four plates (Pacific, North American, Eurasian, and Philippine Sea plates), they are tectonically very active. Earthquakes occur frequently (Fig. 2), and there are many active volcanoes. Uplift rate of mountain area is very high. Therefore, the mountain slope is steep and is geologically open to collapse, and the river gradient is steep in general. Japan is located in the Asian monsoon zone and has high annual precipitation (1500mm on average, up to over 4000mm). Tropical cyclones (typhoons) and/or (or) baiu (early summer rain) sometimes lead to torrential rainfall. While area of alluvial plains underlain by thick unconsolidated sediment account for only 25% of whole Japan, they contain approximately 80% of population. Owing to such geographical characteristics, various natural disasters have occurred in Japan.

Outline of the History of Disaster Studies by the Japanese Geographers

After World War II, the damage of the typhoon was heavy until the 1950s. The Typhoon Kathleen of 1947 (more than 1,900 dead or missing) brought the flooding of rivers widely and inundated a part of Tokyo. The relationship between the micro-landform distribution of plains and the flooding situation was investigated (Ogasawara 1947). This was the first geomorphological disaster study by using air photos in Japan. In 1958, studies on the floods and debris flow disasters of Kanagawa Typhoon (Typhoon Ido), by which more than 1,200 people were killed or missing, were done from both physical and human geographical viewpoints. The resulting papers were published in a special issue of the Geographical Review of Japan (AIG 1960)(Fig. 3).

Isewan Typhoon (Typhoon Vera) of 1959 brought the biggest damage caused by flood in Japanese modern history (Fig. 4). More than 5,000 people were killed or missing by it. The main damaging phenomenon was the high tide invading into Nagoya city and its surroundings, southern part of Nobi Plain. Three years before the disaster, geographer OYA Masahiko made a 1:50,000 geomorphological map on Nobi Plain (Oya 1956)(Fig. 5). The damage area was in accordance with the map which was based on geomorphic features. After this, it became well-known that the geomorphological mapping is effective for understanding the flood risks, and the Geographical Survey Institute (present name: the Geospatial Information Authority of Japan; GSI) of the government started a project to prepare the "1:25,000 Land Condition Maps," which show geomorphic feature and facilities for disaster measures of the plain area in 1960 (Fig. 6). After the 1960s the occurrence of broad flood decreased as the river improvement facilities of big rivers advanced. In 1982, extraordinary heavy rain hit Nagasaki city. It caused a lot of landslides, debris flows, and flooding of small rivers resulting approximately 300 deaths of residential people. It indicated that small-scale flooding and debris flow in populated area became the big problem (Koike 2001). 1980s is also the period when studies of the debris flow mechanism based on the observation was advanced (Suwa 1988, Fujita et al. 1989, etc.).

It is notable that the National Research Institute for Earth Science and Disaster Prevention (NIED) has been preparing 1:50,000 “Landslide Distribution Maps” using air photos since the beginning of the 1980s. Since the 1980s, the risks of potential earthquake and volcanic activity have been also recognized broadly. Both plate boundary and intraplate active faults are the major origin of great earthquakes in Japan. Typical examples are the 1923 Kanto Earthquake (the Great Kanto Earthquake Disaster; more than 100,000 people were killed) and the 1995 Southern Hyogo Prefecture Earthquake (Hanshin Awaji Great Earthquake Disaster; more than 6,400 people were killed), respectively.

Geographical studies on the damage by ground motion and its secondary phenomena (soil liquefaction, landslide, deformation and flow of fill-ground, etc.) have been performed through the experience of repeated earthquakes. It became clear that the soil liquefaction as well as the strong motion is affected by the geomorphic condition through 1964 Niigata Earthquake and the 1983 Central Part of Japan Sea Earthquake, both of which occurred along the eastern Japan Sea. Oya et al. (1982) made a 1:50,000 geomorphological map indicating the risk of liquefaction, and the real liquefaction distribution of the 1983 Central Part of Japan Sea Earthquake was in accordance with the map. Since then, geomorphological earthquake hazard map came to be made by local governments.

Table 1 Major hazard mapping projects promoted by the government

<table>
<thead>
<tr>
<th>Map name</th>
<th>Scale</th>
<th>Date</th>
<th>Organization</th>
<th>Years of project</th>
</tr>
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<tbody>
<tr>
<td>Yoshikawa Zu (Land Condition)</td>
<td>1:25,000</td>
<td>GSI</td>
<td>1993</td>
<td></td>
</tr>
<tr>
<td>Daisi Chikusu Banru Zu (Geological Map for Prediction of Flooding)</td>
<td>1:25,000</td>
<td>GSI</td>
<td>1978-15, 2007-</td>
<td></td>
</tr>
<tr>
<td>Kousi Hazard Maps (Flood Hazard)</td>
<td>1:10,000-1:15,000</td>
<td>Municipalities</td>
<td>1994-</td>
<td></td>
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<td>Jabin-on Chikusu Banru Zu (Landslide Disaster Map)</td>
<td>1:50,000</td>
<td>NIED</td>
<td>1982-</td>
<td></td>
</tr>
<tr>
<td>Kawaito Hazard Maps (Landslide Hazard Map)</td>
<td>indefinite</td>
<td>Municipalities</td>
<td>1992-</td>
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<tr>
<td>Tsunobiki Tatsukten Zu (Active Fault Map in Urban Area)</td>
<td>1:25,000</td>
<td>GSI</td>
<td>1995-</td>
<td></td>
</tr>
<tr>
<td>Yatsukawazu Master Earthquake Disaster Hazard Map</td>
<td>indefinite</td>
<td>Municipalities</td>
<td>2000-</td>
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</tbody>
</table>

GSI: Geospatial Information Authority of Japan
NIED: National Research Institute for Earth Science and Disaster Prevention

Fig. 1 Satellite image of the Japanese Islands
http://www.sagi.jaxa.jp/gallery/carth/detail/01-0405_at.html

Fig. 2 Main active faults in and around Japan and major earthquakes occurred after 1995 (modified after The Research Group for Active Faults of Japan, 1980). KK: Kashiwazaki-Kariwa nuclear plant. 1F: Fukushima Daiichi nuclear plant. Suzuki (2013).

Fig. 3 Papers in a special issue of the Geographical Review of Japan published in 1960

Fig. 4 Air photo along the coast of Ise Bay after Isewan Typhoon of 1959
The photo was taken by GSI.

Fig. 5 Geomorphologic landform classification map of the Nobi Plain, central Japan (Oya, 1956)
http://doi.bousai.go.jp/disaster/1959isewan/material/images/hisu/fu
zu.013.jpg

Fig. 6 Land condition map of "Kyoto" published by GSI
http://www.gsi.go.jp/bousaihtml/lt_index.html
Disaster Responses of the Association of Japanese Geographers after 2001

The study of the disaster is the field where geography can contribute to the society directly. It has been occupied by the disaster and the important position for Japanese geography of the 21st century. Therefore, “Commission of Disaster Responses” was established in the AIG in 2001. The main purposes of the commission are to coordinate geographers’ survey and study and to share information when disasters occur, and to contribute to society by issuing results of the disaster studies. It was chaired by ENDO Kunihiro (2001-2008) and HIRAI Yukihiro (2008-2012). The present chairperson is KUMAKI Yohsai.

The commission held an open symposium in every spring meeting and some autumns meeting in the AIG since February 2003 (Fig. 11). Through these symposiums, the commission announced present results of the disaster studies and their importance to Japanese geographers, and submitted a point of view about the problems geographers contribute to solve the social problem.

On March 11, 2011, the off Pacific Coast of Tohoku Earthquake occurred (Fig. 12). It caused a huge tsunami and more than 19,000 people were dead or missing. This catastrophic disaster including an accident of the Fukushima Daiichi Nuclear Power Station is called the Great East Japan Earthquake Disaster. The AIG coped with the disaster by the special system. The headquarters for disaster response was set up and YAGASAKI Koike, the chairperson of the executive committee of AIG, took office as the general manager. It performed liaison with other academic societies, information dispatch through website², etc. until April, 2012.

One of the very notable activities of the headquarters was the 1:2,500,000 mapping of a tsunami stricken area (Figs. 13 and 14). It started immediately after taking air photos by the GSI and a result map of the first version was uploaded on March 29. This activity was carried out by a great cooperation of geographers who get used to treating air photos and geographers specializing in GIS. The map was updated several times to improve the accuracy. The latest version³ was uploaded in December, 2011. This activity was highly appreciated because the important data opened to public very quickly when a field survey was not easy. Separately from the activity of the headquarters, some geographers investigate the radiation dose distribution⁴.

The Future Prospects

Geography has contributed to disaster prevention measures mainly in a field of the hazard mapping. Geoscientists have played a large role. However, the disaster study should be based on wide field of geography. As to the Great East Japan Earthquake Disaster of 2011, various studies including social or economic geography have been performed, e.g., radioactive contamination, land use planning for revival of the area, community maintenance of inhabitants, etc., and influence on circulation of supplies. This should not be ended as a temporary phenomenon. The disaster raised the recognition of the people of the rare and extraordinary big disasters. A natural disaster is a phenomenon that nature has an influence on the human society. Geography is scientific understanding area properties by both physical and human sides. The geographical disaster studies, therefore, should be applied to the real society and it is necessary to send its result to the society widely. The development of geographical information science will support it.

Japan has massive data and historical materials of disasters, and disaster studies in various sciences including geography have achieved much result. Probably the most of the result will be applicable to the world, especially Asia and Pacific regions. The Japanese geographers must promote a study for reduction of the disaster under the cooperation with the foreign scientists.