APPLICATION OF IT TO REDUCE FLOOD DAMAGE DURING HEAVY RAINFALL DISASTER IN JAPAN

Sang Hyeok Kang[1], Motoyuki Ushiyama[2]

[1]Lecturer, Graduate School of Technology for Disaster Prevention, Samcheok National University
[2]Research Associate, Disaster Control Research Center, Tohoku University

Abstract: The rainfall observation systems have largely been improved in Japan. The Japan Meteorological Agency, prefecture governments, and other administrative bodies have also increased the number of rain gauges thru out the country. The density of observatories is now one per several km^2. Heavy rainfall information systems have been improved. Besides it, the Internet was popularized in the late 1990s, and has been used to transmit data of heavy rainfall. Internet accessible cellular phones have been popular in Japan since 1999. Such phones are expected to be useful in the field of disaster warning announcements, because they can automatically notify users by e-mail of pending disasters. The use of the Internet during natural disasters is groundbreaking in Japan today. However, in order to use disaster information effectively on Internet it is necessary to investigate how to use the information during the rainfall disaster. Therefore in our study we suggest methods on the effective construction and their use of information technology on Internet.

Keywords: heavy rainfall disaster information, Internet, disaster warning, cellular phones

1. INTRODUCTION

There have been dramatic changes in heavy rainfall disaster information disseminated in Japan during the last 10 years. There are two major reasons for the changes; the first is the advances of rainfall observation and forecasting technology, and the second is the advances of information and communication technology. Japanese citizens are now able to easily use many kinds of specialized disaster information as a result of these advances. In Japan these information technologies have been expected to support warnings and the evacuation of local residents during heavy rainfall (Oikawa Y. et al., 2001). However, most of the studies have been focused on the necessity of information to improve residents understanding for rainfall disaster in Japan (Asada J. et al., 2001). This paper describes the history of heavy rainfall disaster information dissemination in Japan, especially rainfall observation and early warning system for rainfall information that would reduce flooding damage and bodily injury.

2. HISTORY OF HEAVY RAINFALL DISASTER INFORMATION IN JAPAN

Modern rainfall observation in Japan started in the 1870s. Initially, there were mainly

weather offices; after that, the number of cooperative observatories increased. In 1910, there were about 1,200 observatories in Japan. The data collected by these observatories is administered by the Central Meteorological Observatory (the present JMA). The present observatory network, run by the Japan Meteorological Agency (JMA), has more than 1300 observatories.

Since the 1960s, the JMA started automatic observation and real time data collecting in the JMA cooperative observatories. The AMeDAS (Automated Meteorological Data Acquisition System) was the final product of such efforts by the JMA. It was developed in the 1970s, and completed in 1978. It has about 1,320 observatories all over Japan, with one station per 17 X 17 square km grid. Temperature, precipitation, wind, and the number of hours of sunshine are observed every hour.

The observation data is collected through the telephone line in real time. The AMeDAS is the most popular weather observation network in Japan. About 20 years have passed since the AMeDAS was completed, and, therefore, this network has been used to obtain climatic statistics such as normal values.

In the 1990s, the prefecture precipitation observatories were improved in Japan. In 1995, there were 1,321 observatories run by the JMA, 2,886 observatories run by Ministry of Construction (the present Ministry of Land Infrastructure and Transportation), and 2,199 observatories run by prefectures (Hydrology Study Group, Ministry of Construction, 1996). The number of prefecture observatories has recently been increasing. For example, Nagano Prefecture had 97 observatories in 1991, but had 156 (one observatory per 8.3 X 8.3 square km grid) in 1999. In addition, observation and data collection were automated in the observatories during the last 10 years.

3. PRACTICAL USE OF WWW FOR HEAVY RAINFALL DISASTER INFORMATION

According to Internet association of Japan(2001), the number of Internet users in Japan was estimated to be 32 million in February 2001, and the percentage of households using the Internet was estimated to be 46.5%. However, the history of Internet use in Japan is short. The first use of the Internet for disaster information was around 1995, when the Hanshin-Awaji earthquake occurred. Initially, citizens and private sector groups used various Internet sites for the exchange of relief information. In 1996, private weather companies started to supply weather information, e.g., weather forecast, precipitation observation data, weather radar data, etc., through Internet.

The first full-fledged use of the Internet by the government sector was at the time of the Tochigi and Fukushima heavy rainfall disaster in August 1998 (Ushiyama, 1999). Local governments such as the Tochigi prefecture office, the Fukushima prefecture office, and the Kouriyama city office, the area that was heavily damaged, disseminated information on their homepages shortly after the disaster. By 2000, almost all central government, prefecture, city, town and village offices had their own homepages. Several governmental homepage played an active part in transformation of disaster information at the time of Tokai heavy rainfall disaster in September 2000 (Fig. 1).

On the other hand, it is of note that several public offices did not use their homepages for disaster information dissemination, as pointed

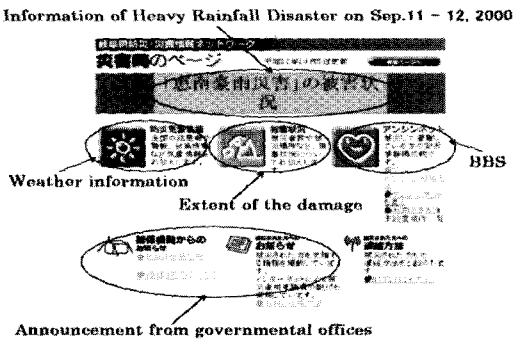

Fig. 1. The Active Web Page about Heavy Rainfall Event in September 2000 by Gifu Prefecture

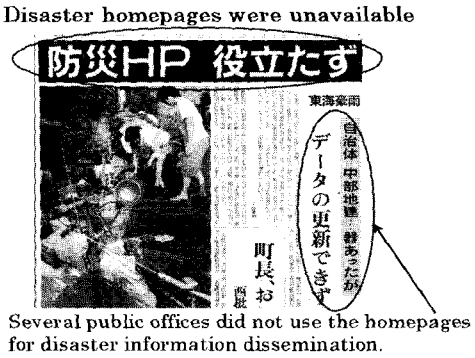

Fig. 2. The Article of Asahi Newspaper in September 14, 2000

out in a newspaper article on the disaster (Fig. 2, Inoue et al., 2001). Namely, we may say that individual homepages are becoming more widely used to provide disaster information.

Until around 1999, most disaster information homepages were opened temporally after the disaster. These homepages mainly contained damage reports and relief information. Since 2000, the number of permanent homepages for disaster information has been increasing (e.g., Fig.1). In 2001, the types of disaster information homepage existing on the Internet consisted of:

1) The Weather forecast
2) Heavy rainfall warnings and advisories
3) Meteorological satellite image data
4) Weather radar rainfall data
5) AMeDAS observatories precipitation data
6) Precipitation and river water level, reported by the Ministry of Land Infrastructure and Transportation or the local prefecture
7) Short range forecasting precipitation
8) Disaster damage statistics and the actions being taken by the government sector
9) Relief information offered by voluntary groups and the like.
10) Hazard maps provided by government sectors (dangerous zones, evacuation zones, hazard simulation data, etc.)
11) Disaster research reports and basic knowledge about the disaster, provided by government sectors or by scientists.

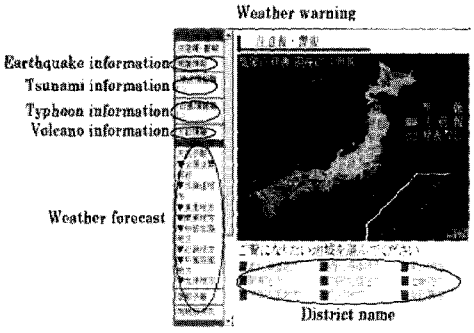

Fig. 3. Weather Warning and Advisory

Figure 3 shows weather warning and advisory (Japan Weather Association, http://tenki.jp/), and Figure 4 shows disaster damage statistics and the action of government sector (Fire and Disaster Management Agency, http://www.fdma.go.jp/html/infor/index.html). Figure 5 also displays real time heavy rainfall display system created by Ushiyama, http://www.disaster-i.

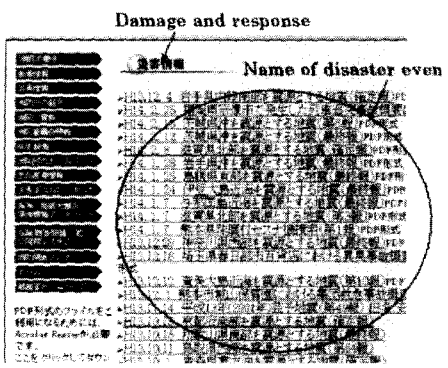

Fig. 4. Disaster Damage Statistics and the Action of Government Sector

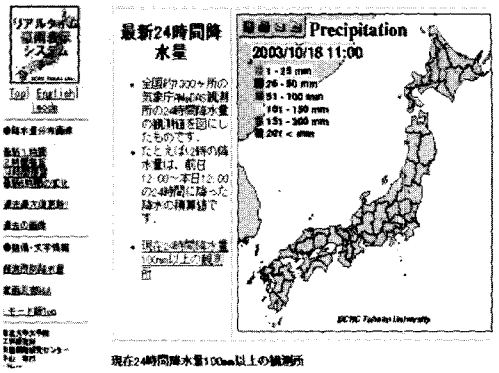

Fig. 5. AMeDAS Observatories Precipitation

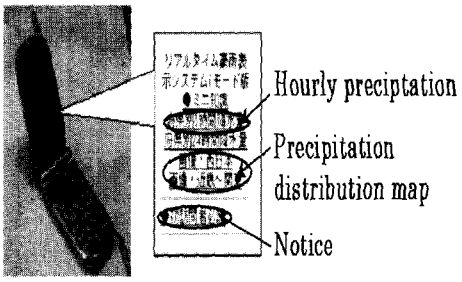

Fig. 6. The Top Page of the Real Time Heavy Rainfall Display System (i-mode Version)

net/rain/)

4. PRACTICAL USE OF INTERNET ACCESSIBLE CELLULAR PHONE

In Japan, the use of cellular phones accessible to the Internet has spread in advance of the rest of the world. The most popular system is the "i-mode" introduced by NTT DoCoMo in February 1999 (Fig. 6). The i-mode can send and receive Internet electronic mail (e-mails); and can also browse HTML files. As of February 2001, the number of Internet users was 32,636,000. The percentage of households using the Internet in Japan 2001 was estimated to be 46.5%, while that of households using cellular phones is estimated to be 28.4% (Internet Association, 2001). The number of users of Internet accessible cellular phones is increasing today.

The systems like the "i-mode" are expected to be useful tools for collecting and exchanging information at the time of a disaster, though they require time to process image data and have limitations on the contents (or characters) they can display on the liquid crystal display of a cellular phone. One reason for the expectation that these types of systems will be used in disasters is that "i-mode" phones can be used to access the Internet without personal computers, PDA, etc. "i-mode" accessible information is increasing. Already, the "i-mode" can browse various kinds of disaster information, as shown in the preceding paragraph.

Another reason is that "i-mode" phones can

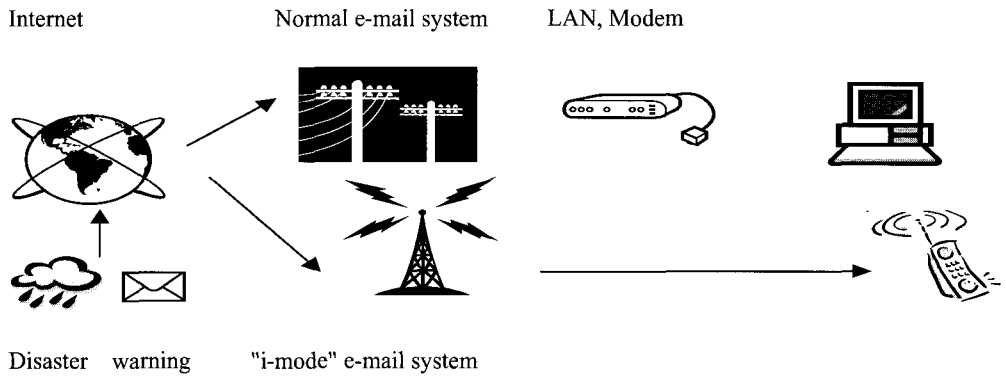

Fig. 7. The "i-mode" and Normal e-mail System

automatically receive e-mail (Fig.7). In normal e-mail systems, a user must access an e-mail server first; but the "i-mode" system can notify the user that e-mails have been received at any time. Therefore, the "i-mode" phones can automatically receive not only precipitation data but also some disaster warning information during times of heavy rainfall. Most pagers, which are called "Pocket Bell" in Japan, can be used similarly, because the pagers are able to receive Internet e-mails.

5. CONCLUSIONS

The recent changes in heavy rainfall disaster information dissemination in Japan are summarized as follows:

1) The high density automated meteorological observatories network of JMA (AMeDAS) was completed in 1979. Recently, the data obtained through this network has been widely used.
2) After the 1990s, local (prefecture) governments improved their rainfall observatories networks. Many rain gauges have been made automatic. As the number of observatories was increased, the rain gauge density in Japan is now one rain gauge per several square km.
3) Since the late 1990s, Internet usage has progressed quickly, and has become widely used in the public and private sector. The first full-fledged Internet usage for rainfall disaster by governmental sectors was at the time of the heavy rainfall disaster in August 1998. Since around 2000, many governmental home pages continuously provide information on disasters for the general public in Japan.
4) Since 1999 in Japan, the use of Internet accessible cellular phones has become widespread, in advance of the rest of the world. Such phones are expected to be useful tools for information collection and exchange at the time of disaster, because they are able to receive warnings at the time of heavy rainfalls, and can notify the user when e-mails have been received.

The quantity and quality of heavy rainfall disaster information in Japan has made remarkable progress during the last 10 years. In the USA, the "Tone Alert Radio" or "Weather Radio" radio type weather or disaster information-warning systems include E.A.S. Emergency

Alert System, E.B.S. Emergency Broadcast System was popularized before the Internet (J. Sorensen, 2000). However, Japan never had such a system, and the Japanese have little know-how about disaster information usage. Ushiyama (1999) indicated that many people did not understand rainfall information well, including the methods used in rainfall observation and the unit of measurement used to measure rainfall (the fact that it is measured in mm). It is important to educate people by not only providing simple data, but also by explaining the information supplied.

It is well known that telephone line congestion often occurs at the time of disasters. In Japan, most Internet users access the Internet through the telephone line. Therefore, it was presumed that many Internet users were not able to access the Internet at the time of a disaster. Nakamura (2001) reported that this occurred during the Geiyo Earthquake in March 2001. These are groundbreaking years in terms of the Internet disaster information age in Japan. It is necessary to investigate how to use the information at the time of disaster, and to suggest methods on the effective use of the information technology available.

REFERENCES

Asada J. et al., (2001). "A study on the providing the information to make inhabitants understand the refuge information at the time of a flood". *Annual Journal of Hydraulic Engineering*, JSCE, Vol. 45, pp. 37-42(in Japanese).

Hydrology Study Group, Ministry of Construction (1996). *Hydrological Observation*, Japan Construction Engineer's Association, pp.12.

Internet Association (Ed.) (2001). Internet White Paper 2001, Impress Inc., pp.32-37 (in Japanese).

Inoue, K., Ushiyama, M., Ishigaki, T., Toda, K. and Kuriyama, K. (2001) ."On Heavy Rainfall Disaster in Tokai District in September 2000", *Annuals of the Disaster Prevention Research Institute Kyoto University*, No.44 B-2, 277-287.

Nakamura, I. (2001) Geayo Earthquake and problems in communication media, *Proceedings of Third Annual Meeting of Japan Society for Disaster Information*, November 2001, p.72-78 (in Japanese).

Oikawa Y. et al., (2001). "The characteristics on inhabitants cognition involving heavy-rainfall hazard in small mountainous river basins", *Annual Journal of Hydraulic Engineering*, JSCE, Vol. 45, pp. 43-48(in Japanese).

Sorensen, J., H. (2000). "Hazard warning system: Review of 20 years of progress", *Natural Hazards Review*, Vol.1, No.2, 119-125.

Ushiyama, M. (1999) A survey of understanding about precipitation information, *Proceedings of First Annual Meeting of Japan Society for Disaster Information*, October 1999, p.143-146 (in Japanese).

Sang Hyeok Kang
(E-mail:kang7231@hanmail.net)