Report of the National Research Institute for Earth Science and Disaster Prevention, No. 46 ; December 1990

551 515.9:551.577.6:614.8

Instructive Knowledge about Non-structural Countermeasures for Meteorological and Hydrological Disasters (Part 1)

by

Takeo Kinosita*

National Research Institute for Earth Science and Disaster Prevention

Abstract

The National Research Center for Disaster Prevention, presently re-named "National Research Institute for Earth Science and Disaster Prevention", has conducted intensive studies on big disasters immediately after they have occurred. These case studies fall under the heading "Principal Disaster Survey". The author extracts from these surveys meaningful instructive knowledge about non-structural countermeasures for meteorological and hydrological disasters. This report, Part 1 of the study, examines first the recent general trend of the meteorological and hydrological disasters based on statistics. It is also noted that fatality was observed to be more serious in the sparsely settled areas than that expected from the mean. Personal property damage is reported from the viewpoint of the individuals concerned. Repaying loans was a serious problem faced by all victims after the disasters. Distribution systems helped to reduce price fluctuations. Transfer information was found to be essential. However, serious problems are observed at the time of electrical outage and loss of telephone service. Local information transfer is important.

A summary of other countermeasures, such as evacuation and flood fighting will follow in Part 2 of this report.

Key words : non-structural countermeasure. meteorological and hydrological disaster, Principal Disaster Survey.

1. Introduction

The National Research Center for Disaster Prevention (hereinafter called NRCDP) has conducted case studies on big disasters immediately after their occurrences. These case studies are conducted in hopes of learning from past disasters by recording and analyzing the situations of the disasters. These case studies consist of two components : one is collection of information such as aerophotographs, maps and documents. The other is observation by means of a reconnaissance survey. Each disaster is analyzed by using the information and oral evidence obtained and the impression at the observation site.

*Director for Earth Science Research

A group is organized by the NRCDP staff to conduct a case study when a big disaster occurs. The group makes a written report in Japanese entitled " Syuyo-saigai-tyosa" or "Principal Disaster Survey" in English, published by NRCDP. Thirty volumes have already been published in the past twenty years. Table 1 shows all the volumes listed by the key words regarding disasters, places and years.

Meteorological and hydrological disasters are mainly discussed in this report, with the exception of snow disasters. Most of these have occurred in the past fifteen years. The statistics for the meteorological and hydrological disasters can be seen in Table 2, which is from "Kisyo-yoran", the Geophysical Review of the Japan Meteorological Agency. The numbers in the table are the annual values of damage caused by typhoons, heavy rainfall, floods, high wind and storm surges. Although these data are not directly related to the Principal Disaster Survey of the NRCDP, they are helpful in comprehensively understanding the trends for meteorological and hydrological disasters in Japan in recent decades.

In this report instructive knowledge is presented about non-structural countermeasures, such as fatality, personal property damage, transfer of information and flood fighting, which were obtained at the time of the case studies. The discussions are based on the analysis of the case studies, making them different from other official reports presented thus far.

The detailed informations about the disasters which are described in Principal Disaster Survey are deleted in the report. Please refer to the original volumes for that information. "Vol. 21" in the following parts, for instance, means Volume 21 of Principal Disaster Survey as shown in Table 1.

2. Disaster Situation

2.1 Fatality

Fatality is the most serious outcome of any given disaster. It is the first priority of our research to reduce fatality.

Fatality due to meteorological and hydrological disasters occur every year, as seen in Table 2. This characteristic is similar to fatality caused by traffic accidents or fires yet different from those due to earthquakes or volcanic eruptions which occur only occasionally. The average of the number of fatality (hereafter including the missing) as well as those injured in every decade is really decreasing as shown below :

	Dead/year	Injured/year
1961～1967	489.7	1893.1
1968～1977	233.1	625.8
1978～1987	134.1	466.5

In the past decade approximately 130 lives were lost and 470 people were injured per year in meteorological and hydrological disasters. These figures have decreased 50 % every decade, although there has been no remarkable change in the meteorological patterns in the past 30 years.

According to the case studies, fatality by inundation has been dramatically reduced in recent years, to almost zero or only a few deaths per year at present. At the time of heavy rainfall in Nagasaki in 1982, it was reported (Vol. 21) that the total fatality was

Table 1 List of All Volumes of Principal Disaster Survey.

Volume	Disaster	Place	Year
1	Earthquake	Hatizyo-sima	1972
2	Landslide	Nagano	1973
3	Earthquake	Nemuro	1973
4	Landslides	Niigata & Yamagata	1974
5	Earthquake	Izu	1974
6	Earthquake	Oita	1975
7	Debris Flows	Kumamoto	1975
8	Debris Flows	Aomori & Yamagata	1975
9	Typhoon	Koti	1975
10	Typhoon	Isikari	1975
11	Snow	Northwest Sides	1976
12	Flood	Nagara	1976
13	Landslides	Hyogo & Kagawa	1976
14	Volcanic Eruption	Usu	1977
15	Earthquake	Miyagi	1978
16	Volcanic Eruption	Ontake	1979
17	Snow	Hokuriku	1981
18	Flood	Isikari	1981
19	Debris Flow	Nagano	1981
20	Flood	Kokai	1981
21	Heavy Rainfall	Nagasaki	1982
22	Typhoon	Mie & Nara	1982
23	Earthquake & Tsunami	Japan Sea	1983
24	Heavy Rainfall	Simane	1983
25	Earthquake	Nagano	1984
26	Landslide	Nagano	1985
27	Typhoon	Kanto & Tohoku	1986
28	Volcanic Eruption	Izu oosima	1986
29	Earthquake	Tiba	1987
30	Heavy Rainfall	Simane & Hirosima	1988

299, 262 of which were attributed to debris flow and 37 by flash floods. In the case of Typhoon No. 10 in 1986 (Vol. 27), half the fatality, 21 people, were caused by debris flow and other local disasters, in spite of the widespread floodings in the Kanto and Tohoku regions.

The shifting of the population is a big problem in Japan. In the forest areas, sparsely settled areas, the population distribution is strongly affected by the movement out of the area by the young. The number of fatalities of the aged in relation to the total population was much larger than those among younger people (Vol. 9). This fact indicates that a community becomes fragile due to the movement out of the area by the young.

2.2 Personal Property Damage

Statistics of public property damage and agricultural damage are well recorded by responsible organizations. Personal property damage is also reported in statistical data. The number of houses fully destroyed, houses submerged above floor level and affected families are shown in Table 2. The average of these losses in the past three decades is only one third the losses of the previous decade as follows :

	Houses fully destroyed/year	Houses submerged above floor level/year	Affected families/year
1961～1967	4,577.4	83,728.4	132,446.7
1968～1977	1,145.2	48,686.7	57,328.3
1978～1987	337.1	22,557.8	25,453.0

The houses fully destroyed, the houses submerged above floor level and the affected families in a year were roughly 300, 20,000 and 25,000 respectively in the past decade.

In spite of the decreasing number of damaged houses, the impact of a flood disaster on personal property has become more serious in recent years. This study found the trend to be as summarized below.

(1) Due to the recent rise of living standards, most families become owners of expensive furniture, cars, other durable consumer goods, and in rural areas, costly agricultural machines. Most families suffer both mental and monetary shocks after a disaster. Most families have acquired these items through loans, so for a long period after a disaster, a family has to endure hardsihp in repaying their loans, even though the goods may be damaged or totally lost. This fact was reported at the time of the inundation in Nagara-gawa in 1976 (Vol. 12).

A farmer today has on the average a loan of 10,000,000 yen for agricultural machines. Although a repair service is usually offered by the manufactures, (as described in 2.4), the loan repayment is a serious hardship (Vol. 27).

(2) Disposal of damaged housewares is usually carried out by the autonomous governing body (city, town or village) concerned. It is very troublesome to burn damaged housewares at a safe place after flooding. It is especially difficult to burn tatami (straw mats) that have been submerged and soaked with water.

(3) In the case of a natural disaster, damage of personal effects is not compensated for by any public authority. Only a small amount of money is given to victims as a condolence. Even in Tokyo, only about 50,000 yen is sent to a family whose house has been submerged by water above floor level. Flood insurance is not widely available.

Table 2 Annual Statistics of Meteorological and Hydrological Disasters.

Year	Dead Persons	Injured Persons	Houses fully Destroyed	Houses submerged above floor level	Affected families
1961	904	6,696	16,506	224,661	384,932
1962	284	454	691	43,782	63,563
1963	340	672	701	44,398	77,377
1964	373	947	4,133	31,241	53,029
1965	366	2,105	5,357	69,969	103,792
1966	558	1,441	3,118	89,508	134,843
1967	603	937	1,536	82,540	109,591
1968	212	398	354	12,384	17,775
1969	182	613	576	34,339	10,247
1970	175	1,262	2,302	45,239	62,943
1971	348	724	859	44,547	58,633
1972	636	1,135	2,446	82,200	110,603
1973	72	94	268	23,799	29,914
1974	208	485	493	83,653	97,723
1975	202	607	1,163	40,172	47,975
1976	242	660	1,621	110,317	121,007
1977	54	280	1,370	10,217	16,463
1978	43	297	93	9,209	9,946
1979	199	877	279	25,847	29,329
1980	112	324	163	10,524	12,118
1981	93	386	169	33,551	36,027
1982	508	1,287	853	77,116	90,508
1983	179	429	1,154	21,533	25,573
1984	25	65	19	2,410	2,567
1985	105	468	200	4,153	5,305
1986	48	174	240	34,437	35,165
1987	29	358	201	6,798	7,992
1988	59	174	159	8,083	8,916

After the flood of August, 1986 in Ibaraki Prefecture, flood insurance reparation of 2,880,000,000 yen were paid to 2,600 cases (Vol. 27), about 1,000,000 yen was paid per case. Rather than insurance the low-interest official loan for disaster victims is common for the support of personal effects.

2.3 Voluntary Relief Goods.

The press readily reports disasters and resulting situations. Because of these reports many relief goods are sent from volunteers to those areas affected. Unfortunately the reports are sometimes only focused on a famous area or a big city. Then the voluntary relief goods are apt to be sent mostly to the area reported. Victims whose stories had not been reported have shown a desire for better complete reporting so that a more even distribution of relief goods could result (Vol. 20).

2.4 Service of Distribution Systems.

During mid-disaster and post-disaster periods, the prices of goods usually rise. A way to stabilize prices is an important factor to consider in minimizing the impact of the disaster.

(1) The price of tatami (straw mats) is apt to fluctuate the most immediately after flooding because it is one of the most basic materials found in a Japanese house. At the time of the flooding of Nagara-gawa in 1976 (Vol. 12), 24,209 houses were submerged above floor level. Of course tatami was expected to be in high demand. A few distributors tried to raise the price of tatami, but the majority cooperated and fixed the price for the comsumers who were victims. This decision to fix the price was publicized resulting in a stabilization of the price.

(2) The information and communication systems of distributors are found to operate well at the time of a flood. The managers of wholesale markets know the trends of the consumer (they do not buy raw fish and meat) during a period of a flood, so they control the transport vehicles of raw fish and meat, changing the destinations of products from areas likely to be heavily inundated to areas not inundated. This is accomplished through telephone communication. Such a type of control of the distribution has been effective in reducing price fluctuations during a time of flooding (Vol. 12).

(3) When packed instant foods have been spoiled by flooding at retail shops, the manufactures have taken them back free of charge. The manufactures wanted to avoid the spread of disease from spoiled food. This activity is greatly appreciated for helps to reduce post-flooding damage (Vol. 12).

(4) Manufactures have also sent service staff to communities affected by floods to repair the submerged home equipment, such as bathrooms and boilers as well as agricultural machines in rural areas. It is reported in Vol. 27 that this repair service was free of charge, but new parts were sold at cost in the case of the flooding at Kashimadai in Miyagi Prefecture.

3. Transfer of Information

Transfer of information is of vital importance in order to reduce total damages by taking proper action when receiving information regarding a given disaster. There are

two kinds of information transfer, that from a center to regions and that from regions to a center. Examples of the former are weather forecasting, issuance of warnings and evacuation orders. Examples of the latter are a call for rescue from victims and a dike breach report. If the transfer of information is insufficient, activities for disaster prevention may be delayed and damages will increase remarkably becanse of inadequate action.

In the past in rural areas in Japan, communication was easily cut after a hazardous event, so a family or a community had to survive in isolated conditions. Therefore, a self-defending capability was strong at a family or community level. Communication systems are now well developed. Consequently this self-defending capability has become weak in recent years (Vol. 9).

(1) Information Transfer from a Center to Regions.

For meteorological and hydrological disasters a precursory phenomenon can be easily detected by ground observation networks and satellite monitoring systems. A tropical cyclone can be found by meteorological statellites when it develops in an ocean, and it can also be tracked before it hits land. Forecasts and warnings can be issued from a central organization, such as a weather forecasting station, to the regions concerned in due course and through the mass media. These efforts are usually successful. However, some problems have arisen during past disasters.

(a) In the case of wide flooding, electricity supply and telephone lines have been sometimes cut. It was difficult to inform the isolated victims about the disaster situations. A light airplane was used to inform isolated victims in a wide inundated area in Kashimadai (Vol. 27). All forecasts and warnings should be transferred to all people in the affected areas. Otherwise, forecasts and warnings are useless, even if they are accurate and timely.

(b) Immediately after the big earthquake on May 26, 1983, the tsunami (tidal waves caused by an earthquake) hit the coast of northern Japan. The arrival time was 10～15 minutes after the earthquake at the coast near the epicenter. The formal tsunami warning arrived at the coastal regions after the tsunami had already hit (Vol. 23). In the case of a disaster which suddenly occurs, local people should make an effort to watch the event beyond mistake. In the case of a tsunami, man shonld search immediately for a high wave coming from the horizon after experiencing an earthquake at the seashore.

(2) Information Transfer from Regions to a Center.

The information acquired at the regional and local levels is very important as shown in the discussion above. Several examples are taken from the Principal Disaster Survey.

(a) Telephone lines due to calls for rescue and help were congested at the time of the heavy rainfall in Nagasaki, July, 1982. Regional information was not properly sent to the firestation which was operating as the rescue center. The information arrived after 5 o'clock, that is to say after the office was closed. Moreover, heavy rainfall suddenly occurred in a limited area that was a densely populated hilly region. 299 people died within a few hours due to flash flooding and debris flows (Vol. 21).

(b) Public telephone lines are sometimes out of order due to the congestion of calls or

the submergence of an exchange station (Vol. 12). Communication systems for disaster prevention have been improved as inadequacies have been detected.

In the past the wireless telephone for the prevention against isolation has been set up in every municipality. But it was noticed that there were too many terminal stations, therefore the center station was always too busy when many terminal stations wanted to report to the center station at the same time (Vol. 9).

The wireless telephone for disaster prevention administration has been improved. This improved system has more channels than the wireless telephone for prevention against isolation did. It was thus useful for sending information from regions to the center at the time of the Nagara-gawa flooding (Vol. 12).

It is noted that the operating manual should be completed (Vol. 20). A common staff member of a local office (not the telephone operator) could not operate the wireless when a serious inundation was observed, and he was upset by his inadequate training.

Amateur wireless radios have been always appreciated because of their helpful activities during periods of disasters in spite of strict frequency alocations (Vol. 9 and Vol. 12). Calls for rescue or sending information to disaster control stations sometimes are completed only because of the amateur wireless radios.

4. Concluding Remarks

Knowledge about non-structural countermeasures for meteorological and hydrological disasters were discussed in this report based on the Principal Disaster Survey. First, recent statistics of the meteorological and hydrological disasters were listed. The trend which shows a decrease in fatality and personal property damage is noted. In spite of this trend, some serious facts have become apparent and this is due to uneven distribution of the population and the increase of expensive housewares. Distribution systems, including wholesale markets, help to reduce price changes caused by disasters. Transfer and assimilation of information are very important. Some improvements for the transfer of information are commented on this report.

Part 2 will be concerned with elucidating other important knowledge such as evacuation, flood fighting, etc. The author would like to express his hearty thanks to all NRCDP staff concerned and those people involved in disaster prevention activities during periods of principal disasters.

(Manuscript Received July 21, 1990)

気象・水文災害における非構造的対策について
主要災害調査によりえられた教訓(第1部)

木下武雄*

防災科学技術研究所

要　旨

国立防災科学技術センターはこれまで大災害があった折に,その直後に職員を派遣して現場調査等を含む幅広い調査を行い,主要災害調査報告としてまとめ,すでに30号を数えている。この報告は,その中から気象・水文に係わる災害について,非構造的な対策における有益な調査結果をまとめたものである。第1に統計によって,最近の気象・水文災害の動向をみる.次に,人的被害が過疎地において著しいということを示す.個人資産の被害はあまり明確な統計はないが,ローンで耐久消費財を購入する例が多いことから災害後のローンの返済には困難するようである.救援物資の分配については,末端で問題がありと聞いた.流通機構は物価の安定に努力をしているようで,効果あったという.情報伝達については色々の指摘がなされている.例えば電力・電話線が切れた時の情報不通の問題,無線電話の有効性と限界,地域情報の有用性が論じられている.避難・水防等の重要な問題については第2部で報告する予定である.

統括地球科学技術研究官