

**FHM Impact on Land Price (Experience of Japan)**

**I. Development and Popularization of Flood Hazard Maps in Japan**

**II. Changes in People's Awareness in Japan (Opinion Poll)**

## **I. Development and Popularization of Flood Hazard Maps in Japan**

### **1. Introduction**

Japan's vulnerability to floods comes from severe natural conditions such as topography and weather and the fact that about 50% of its population and about 75% of its assets are concentrated in probable flood areas in alluvial plains which account for only 10% of the national land area. In recent years, the spread of nuclear families and population growth in urban areas has meant an increase in new residents in areas prone to flooding who have never experienced inundation. Even residents who have experienced flood damage tend to forget over time and awareness of potential flood damage weakens.

Therefore, in a worst case, a dike break in the event of severe flooding could bring about the loss of many lives and assets, and heighten the threat of huge socioeconomic disruption beyond all imagination. In recent years, characteristics of urban flood damage were revealed in subsurface inundation in Fukuoka City on the occasion of heavy rain in a Baiu front in 1999 and in subsurface inundation and paralysis of lifeline services on the occasion of the Tokai Heavy Rain in 2000. In 2004, damage occurred in many other areas due to such phenomena as the Niigata-Fukushima Heavy Rain, Fukui Heavy Rain, and Typhoon No. 23.

Structural measures such as developing flood control facilities, including embankments, are needed to mitigate this type of flood damage, and non-structural measures needed to convey disaster information and evacuation guidance should be promoted.

As part of the non-structural measures, the Ministry of Land, Infrastructure, Transport and Tourism has guided and assisted municipalities in developing and promulgating flood hazard maps since 1994. In 2001, the Ministry worked to have the Flood Fighting Act amended, and it published "Flood-Prone Areas," which is based on the amendment, to help develop flood hazard maps distributed by municipalities.

The Flood Fighting Act, as again amended in 2005, set "Special-Warning Water Levels" for major small- and medium-size rivers (rivers with water level information) for river areas other than those with flood forecasts. Special-Warning Water Levels are set for small- and medium-size rivers with small basin areas and limited time for flood forecasts, and they are provided with information on high-water levels reached. The Act also provides that flood-prone areas shall be designated, not only for rivers with flood forecasts, but also for major small- and medium-size rivers (rivers with water level information). Municipalities with flood-prone areas are obligated to develop hazard maps showing shelters, the flood-prone areas and expected flood depths.

## **2. History of Flood Hazard Maps**

### **(1) Publication of Maps Showing Where Inundation Occurred**

Maps showing where actual inundation in past floods has occurred simply indicate the danger of flooding. They are technically easy to create and understand. Despite this, the inundation-record maps were only recently created in conjunction with flood control measures. In a project related to comprehensive flood control measures implemented since 1980, actual inundation data has been released to promote proper land use, as an aid to emergency flood-fighting, and for use when evacuation is needed. Such maps were published for six rivers in 1981, and maps for the country's major rivers have been published since 1985.

### **(2) Announcement of the Results of Flood Simulation**

Inundation-record maps do not reflect the development or improvement of flood control facilities in many rivers since the occurrence of floods. Urbanization of river basins is another problem because it can lead to flooding that is more severe than in other areas with rainfall of the same scale. Therefore, it was desirable to use simulation to show areas that could be flooded under current conditions. Hydraulic accounting was used to simulate possible flood situations under current flood control conditions at particular sites. Flood simulation technology was developed to do this. After technical review, the results of the flood simulation were published for use in maps of areas where inundation could be expected along specific rivers covered by comprehensive flood control measures undertaken since 1987.

Further, in 1991, responding to the question of "desirable river improvements in the future," the River Council recommended non-structural measures such as educational programs to help the public learn about floods, storm surges, tsunamis, debris flows and volcanic eruptions in order to minimize damage in the event of a crisis. As part of this effort, flood-danger area maps created on the basis of flood simulation were published for Japan's major rivers between 1993 and 1994.

### **(3) Development and Announcement of Flood Hazard Maps**

Now that inundation-record maps, expected-inundation area maps and flood-danger area maps are published and specific risks of floods in major rivers in Japan are shown, it is natural for many people to ask how to avoid the dangers indicated in the maps. The River Improvement and Management Division, River Bureau issued pamphlets such as "Promoting the Development of Flood Hazard Maps" and "Manual for Development of Flood Hazard Maps" to stimulate organized development of flood hazard maps. This effort helped bring about standardization of the contents.

### **(4) Partial Amendment of the Flood Fighting Act**

**(i) Amendment in 2001**

In 1998, the effectiveness of the hazard maps was confirmed in the heavy rain that hit the Tohoku Region. In 2000, a heavy rain in Tokai Region brought about urban flood damage, including inundation of underground malls. In its recommendations issued under these circumstances, the Flood Prevention Committee, River Council, pointed out the effectiveness of flood hazard maps.

Reflecting this, the Flood Fighting Act was partially amended in June 2001 to create the flood-prone area map system. Under this system, the national government and prefectures shall designate and announce flood-prone areas for rivers subject to flood forecasts. Also, mayors of municipalities shall be notified, and municipalities that include flood-prone areas shall fully inform residents about shelters, methods of communication established in municipal disaster-prevention plans and provide other information needed to ensure smooth, swift evacuation when floods occur. A notice issued by the Director-General of the River Bureau upon enforcement of the Act to Partially Amend the Flood Fighting Act stated that it was desirable to prepare and distribute flood hazard maps or other visual means when fully informing the residents of the requirements for smooth and swift evacuation in the event of a flood.

**(ii) Amendment in 2005**

The Act to Partially Amend the Flood Fighting Act

1. Expansion of rivers subject to flood forecasts (Article 10-2)

- 1) In addition to the Minister of Land, Infrastructure, Transport and Tourism, Prefectural Governors may designate rivers as rivers subject to flood forecasts, when considerable flood damage is likely.
- 2) When the threat of flood exists, in cooperation with the Director-General of the Meteorological Agency, Prefectural Governors shall, notify the flood-fighting administrators of the water level and flow rate situations and fully inform the general public. Cooperation from the media shall be obtained as necessary.

2. Announcement of flood-prone areas (Article 10-4)

- 1) To secure smooth and swift evacuation in the event of a flood, the Minister of Land, Infrastructure, Transport and Tourism or a Prefectural Governor shall, along rivers subject to flood forecasts, designate as flood-prone areas those areas where inundation is expected (under design rainfall established in river improvement plans).
- 2) The Minister of Land, Infrastructure, Transport and Tourism and others shall notify related municipalities of the designated areas of flood-prone areas and the water depths expected in the event of inundation.

3. Measures to secure smooth and swift evacuation (Article 10-5)

- 1) Municipal disaster-prevention conferences held in accordance with the Disaster Countermeasures Basic Act shall, when flood-prone area maps are designated, prescribe the information to be included in the maps on shelters, on the means of communicating flood forecasts, and on other matters required for smooth and swift evacuation.
- 2) When underground facilities such as underground malls used by significant numbers of people exist in a flood-prone area, the means of communication of flood forecasts shall be prescribed to secure smooth and swift evacuation of such facilities.
- 3) Municipal mayors shall fully inform residents of the means of communication of flood forecasts, shelter information, and so on as prescribed in the municipal disaster-prevention plan.
- 4) If a council is established by the municipal disaster-prevention conferences, the council shall prescribe the means of communication of flood forecasts and shelter information for each flood-prone area covered in the inter-municipal disaster-prevention plans.

#### History Leading to Flood Hazard Maps

Month/year	Events
1977	River Council launches “Intermediate Recommendation on Promotion of Comprehensive Flood Control Measures.” Ministry of Construction establishes council for comprehensive flood control measures.
1979- 1980	Ministry of Construction creates comprehensive flood control system for rapidly urbanizing river basins (Notices from Vice-Minister and Director-General of River Bureau). Publication of inundation-record maps begins.
1979-	River basin comprehensive flood control councils created for following rivers: 1979, 9 rivers: Tsurumi, Shingashi, Ina, Hikiji, Sakai (Kanagawa), Tomoe, Mama, Shin, Fushiko 1980, 1 river: Naka/Ayase 1981, 2 rivers: Zanbori, Mekujiri 1982, 2 rivers: Northern Yamato, Sakai (Aichi) 1988, 1 river: Sakai (Gifu)
Oct 1979	Typhoon No. 20
-1981	Inundation-record maps published for 6 rivers including Tama, Naka/Ayase.
Jul 1982	Heavy rain of July 1982
Aug 1982	Typhoon No. 10
Jul 1983	Heavy rain of July 1983
1985	Publication of inundation-record maps begins for Japan’s major rivers.
1987	Results of flood simulations released in maps of expected inundation areas for specific rivers covered by comprehensive flood control measures.
1988	The Kanda and Neya rivers included among major river basins with urban areas.
1991	The River Council decides to recommend “non-structural measures such as

	educational programs to impart knowledge of flood, storm surge, tsunami, debris flow and volcanic eruption in order to minimize damage during a crisis.”
Sept 1991	Typhoon No. 19
1993-1994	Publication of flood-danger area maps based on results of flood simulation for major rivers across Japan.
Jul-Aug 1993	Heavy rain of August 1993
1994	Notices: “Promotion of Development of Flood Hazard Maps,” River Bureau, Ministry of Land, Infrastructure and Transport “Instructions for Developing Flood Hazard Maps,” River Bureau, Ministry of Land, Infrastructure and Transport These notices spurred organizations to develop flood hazard maps and greatly contributed to standardization of the contents.
1998	Effectiveness of flood hazard maps confirmed when torrential rain hits Tohoku Region
Jun 1999	Fukuoka Flood
Sept 2000	Tokai Heavy Rain
Nov. 2000	Emergency recommendation on urban flood countermeasures Effectiveness of flood hazard maps pointed out for urban floods involving underground spaces.
Dec 2000	Effectiveness of flood hazard maps pointed out in Recommendation of the River Council “Desirable Flood Prevention in the Future”
Mar 2001	Cabinet decision on Bill to Partially Amend the Flood Fighting Act (submitted to the 151 <sup>st</sup> session of the Diet)
Jun 2001	Promulgation of Act to Partially Amend the Flood Fighting Act (Act No. 46, 2001) Promulgation of Ordinance for Enforcement of the Flood Fighting Act (Ministry of Construction Ordinance No. 44, 1990)
Jul 2001	Enforcement of Act to Partially Amend Flood Fighting Act <u>(Provisions for efforts to develop flood hazard maps)</u>
Jul 2004	“Niigata/Fukushima Heavy Rain” “Fukui Heavy Rain”
Oct 2004	Heavy rain from Typhoon No. 23
Dec. 2004	“Heavy Rain Damage Countermeasures General Policy Committee” of the River subcommittee of the Council for Social Infrastructure develops “Emergency Recommendation for Comprehensive Heavy Rain Damage Countermeasures”
Apr. 2005	“Heavy Rain Damage Countermeasures General Policy Committee” of the River subcommittee of the Council for Social Infrastructure finally develops “Promotion of Comprehensive Heavy Rain Damage Countermeasures”
Feb. 2005	Cabinet decision on Bill to Partially Amend Flood Fighting Act and Act on Promotion of Sediment Damage Countermeasures in Sediment Damage Vigilance Areas (submitted to 162 <sup>nd</sup> session of Diet)
May 2005	Promulgation of Act to Partially Amend Flood Fighting Act and Act on Promotion

	of Sediment Damage Countermeasures in Sediment Damage Vigilance Areas (Act No. 37, 2005)
Jun 2005	Promulgation of Ordinance for Enforcement of Flood Fighting Act and Act on Promotion of Sediment Damage Countermeasures in Sediment Damage Vigilance Areas (MLIT Ordinance No. 62, 2005)
Jul 2005	Enforcement of Act to Partially Amend Flood Fighting Act and Act on Promotion of Sediment Damage Countermeasures in Sediment Damage Vigilance Areas (Compulsory development and distribution of flood hazard maps).

## II. Changes in People’s Awareness in Japan (Opinion Poll)

### 1. Introduction

Since 1948, opinion polls on disaster prevention, including flood countermeasures, have been conducted by the Cabinet Public Relations Secretary Office and others. Opinion polls on provision of inundation information as a flood countermeasure were conducted in April 1977, August 1985, September 1996, June 1999, September 2002 and June 2005.

Publication of inundation-record maps as a flood countermeasure began in 1979-80. Thereafter, publication of expected inundation maps and flood hazard maps were progressively conducted. Results of public opinion polls over the past 30 years are presented in the table below.

Results of Opinion Polls (since 1977)

Month/year	Contents
Apr 1977	<p><b>Opinion poll on rivers and flood disasters</b></p> <ul style="list-style-type: none"> <li>(1) Danger of flood disasters</li> <li>(2) Flood disasters and insurance coverage</li> <li>(3) Flood control measures</li> </ul>
Oct 1982	<p><b>Opinion poll on disaster prevention</b></p> <ul style="list-style-type: none"> <li>(1) General awareness of disasters</li> <li>(2) Evaluation of safety of living areas and national land</li> <li>(3) Information and evacuation in the event of disaster, and activities of volunteer fire corps</li> <li>(4) Activities of voluntary disaster-prevention organizations</li> <li>(5) Preparedness and mental attitude regarding large earthquakes</li> <li>(6) Information on large earthquakes and evacuation</li> <li>(7) Degree of knowledge on preparedness against earthquakes</li> <li>(8) Requests in regard to earthquake countermeasures</li> <li>(9) Degree of knowledge on “Fitted” mark and its application</li> </ul>
Sep. 1984	<p><b>Opinion poll on disaster prevention</b></p> <ul style="list-style-type: none"> <li>(1) Experience of damage by disaster</li> <li>(2) Evaluation of safety of residential areas against disaster</li> <li>(3) Recognition of information and evacuation order during a disaster</li> <li>(4) Recognition and concept of volunteer fire corps and voluntary disaster-prevention organization</li> <li>(5) Mental and physical preparedness against earthquake</li> <li>(6) Information needed in the event of occurrence of earthquake</li> </ul>

	(7) Requests on earthquake countermeasures
Aug. 1985	<b>Opinion poll on rivers and sediment disaster</b> (1) Awareness of river environment (2) Recognition of flood disaster (3) Recognition of sediment disaster (4) Disaster-prevention awareness on flood and sediment disasters
Aug.-Sep. 1987	<b>Opinion poll on disaster prevention</b> (1) Preparedness against earthquake (2) Information in the event of occurrence of earthquake (3) Requests in regard to earthquake countermeasures (4) Experience of damage from disasters (5) Evacuation instruction and recommendation (6) Disaster-prevention drills (7) Voluntary disaster-prevention activities
Jul 1989	<b>Opinion poll on disaster prevention</b> (1) Preparedness against earthquake (2) Information needed in the event of earthquake (3) Requests in regard to earthquake countermeasures (4) Awareness of disasters (5) Awareness of fire prevention in households (6) Existence of volunteer fire corps and intention to join (7) International cooperation in disaster prevention
Jul 1991	<b>Opinion poll on disaster prevention</b> (1) Experience of damage from disasters (2) Awareness of disasters (3) Preparedness against earthquake (4) Requests in regard to earthquake countermeasures (5) Disaster-prevention information (6) Disaster-prevention drills
Sep. 1991	<b>Opinion poll on flood control</b> (1) Awareness of rivers and flood disasters (2) Preparedness against flood disasters (3) Awareness of flood control
Sep.-Oct. 1995	<b>Opinion poll on disaster prevention</b> (1) Awareness of disasters felt to be dangerous, and safety of living areas (2) Preparedness against disasters

	<ul style="list-style-type: none"> <li>(3) Knowledge and interest in disaster information</li> <li>(4) Awareness of disaster-prevention activities</li> <li>(5) Knowledge and interest in community disaster-prevention activities</li> <li>(6) Requests to the government</li> </ul>
Sep. 1996	<p><b>Opinion poll on rivers</b></p> <ul style="list-style-type: none"> <li>(1) Awareness of rivers</li> <li>(2) Awareness of relationship between rivers and communities</li> <li>(3) Awareness of river environments</li> <li>(4) Awareness of flood and sediment disasters</li> </ul>
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Jun 1999	<p><b>Opinion poll on disaster-prevention and information</b></p> <ul style="list-style-type: none"> <li>(1) Awareness of natural disasters</li> <li>(2) Awareness of flood and sediment disasters</li> <li>(3) Awareness of disaster-prevention information on flood and sediment disasters at normal times</li> <li>(4) Awareness of disaster-prevention information on imminent flood and sediment disasters</li> <li>(5) Awareness of earthquakes</li> <li>(6) Awareness of disaster-prevention activities</li> </ul>
Sep. 2002	<p><b>Opinion poll on disaster prevention</b></p> <ul style="list-style-type: none"> <li>(1) Awareness of disasters</li> <li>(2) Awareness of earthquake countermeasures</li> <li>(3) Awareness of disaster-prevention information</li> <li>(4) Awareness of disaster-prevention drills</li> <li>(5) Awareness of volunteer activities during a disaster</li> <li>(6) Awareness of voluntary disaster-prevention activities</li> </ul>
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Aug.-Sep. 1987	<p><b>Opinion poll on disaster prevention</b></p> <p>(1) Preparedness against earthquake</p> <p>(2) Information in the event of occurrence of earthquake</p> <p>(3) Requests in regard to earthquake countermeasures</p> <p>(4) Experience of damage from disasters</p> <p>(5) Evacuation instruction and recommendation</p> <p>(6) Disaster-prevention drills</p> <p>(7) Voluntary disaster-prevention activities</p>
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Sep. 1991	<p><b>Opinion poll on flood control</b></p> <p>(1) Awareness of rivers and flood disasters</p> <p>(2) Preparedness against flood disasters</p> <p>(3) Awareness of flood control</p>
Sep.-Oct. 1995	<p><b>Opinion poll on disaster prevention</b></p> <p>(1) Awareness of disasters felt to be dangerous, and safety of living areas</p> <p>(2) Preparedness against disasters</p>

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Jun 2005	<p><b>Opinion polls on flood and sediment disasters</b></p> <ul style="list-style-type: none"> <li>(1) Natural disasters</li> <li>(2) Flood and sediment disasters</li> <li>(3) Disaster-prevention information on flood and sediment disasters at normal times</li> <li>(4) Disaster-prevention information on imminent flood and sediment disasters</li> <li>(5) Disaster-prevention activities</li> </ul>

## 2. Opinion poll on provision of inundation information as part of flood countermeasures

### (1) Survey results in April 1977

Q What do you think about informing how deep the inundation will be by erecting signs where flood is expected? Choose one from below.

- |    |  |       |
|----|--|-------|
| A1 | <u>It is good because residents can learn the danger in the event of flood disaster.</u> | 83.6% |
| A2 | It is bad because it unnecessarily worries the residents.                                | 4.2%  |
| A3 | I don't know.  | 2.2%  |

As of 1977, more than 80% of the respondents affirmed information to residents.

### (2) Survey results in August 1985

Q Have you seen or heard about maps showing the inundation areas during past large floods (inundation-record maps) for flood fighting and evacuation in the event of emergency?

- |    |  |       |
|----|--|-------|
| A1 | I have seen one.                             | 8.7%  |
| A2 | I have not seen one, but I heard about them. | 8.7%  |
| A3 | <u>I don't know.</u>                         | 82.6% |

Q What do you think about publication of such map? Choose one from below.

- |    |   |       |
|----|---|-------|
| A1 | <u>It is good because residents can learn the danger and raise awareness of flood disaster.</u> | 82.3% |
| A2 | It is bad because it unnecessarily worries residents.   | 5.2%  |
| A3 | I don't know.   | 12.5% |

Q What do you think about erecting signs in flood-prone areas and informing residents in general of expected inundation water-levels in maps (flood-prone area maps)? Choose one from below.

- |    |  |       |
|----|--|-------|
| A1 | <u>It is good because residents will be made aware of the danger and need for disaster prevention.</u> | 83.6% |
| A2 | It is bad because it unnecessarily worries residents.  | 5.3%  |
| A3 | I don't know.  | 11.1% |

Q To prevent sediment disaster, dangerous areas where sediment disasters are likely to happen may be announced. What do you think about such announcements?

A1 They should be announced. 84.3%

A2 They need not be announced. 3.0%

A3 I don't know. 12.7%

Q (To people who chose A2) Why do you think so?. Choose one from below as nearest to your idea.

A1 Not a good idea because land prices in the surrounding areas will drop. 8.2%

A2 It is unnecessary because it unnecessarily worries people. 86.3%

A3 Others 5.5%

As of 1985, 80% or more of the residents did not know about inundation-record maps, but more than 80% were in favor of disseminating information to residents. As to announcing risky areas prone to sediment disaster, 3% of the respondents thought it unnecessary, and within this group, 8.2% expressed concern about effects on land prices in surrounding areas. (3% of total  $\times$  8.2 = 0.25% or very small.

### (3) Survey results in September 1996

Q What measures do you choose to minimize inundation damage due to river flooding? Choose any from below. (M.A.)

A1 Develop circle levees and fluvial wood zones in order to resist expansion of river flooding into wide areas of towns. 32.2%

A2 Develop drainage facilities to minimize inundation 58.9%

A3 Provide as much information as possible when rivers swell 40.2%

A4 Develop safe shelters and evacuation routes upon river flooding 37.6%

A5 Develop waterproof facilities at damage-prone facilities like hospitals and subways 22.6%

A6 Raise foundations of structures such as individual housing 11.0%

A7 Develop insurance system to compensate flood damage 22.4%

A8 Provide as much information as possible, including dissemination of maps showing inundation areas and shelters (flood hazard maps) 24.5%

A9 Relocate houses from flood-prone areas. 10.8%

A10 Others. I don't know. 6.1%

As of 1996, about 25% of the public favored dissemination of flood hazard maps.

#### (4) Survey results in June 1999

Q Do you need more information about the danger of flood and sediment disasters in areas where you live? Choose one from below.

- |           |  |              |
|-----------|--|--------------|
| A1        | More information than now.                 | 39.3%        |
| <u>A2</u> | <u>About the same level as now.</u>        | <u>55.8%</u> |
| <u>A3</u> | <u>No need to provide more information</u> | <u>4.9%</u>  |

Q (To the people who chose A2 and A3) Why don't you need more information? Chose one which is closest to your idea.

- |           |  |             |
|-----------|--|-------------|
| A1        | The present information is sufficient.   | 88.4%       |
| A2        | I don't use the information.   | 4.9%        |
| A3        | Dangers in the living area makes me uneasy.                                    | 2.5%        |
| <u>A4</u> | <u>Real estate prices will drop if level of danger in living area is high.</u> | <u>0.3%</u> |
| A5        | I don't know.  | 4.0%        |

As of 1999, people who are satisfied with or do not require more information on danger of flood disaster chose fear of reduction of real estate prices by 0.3% (Total  $60.7 \times 0.3\% = 0.18\%$ ) or very small.

#### (5) Survey results of September 2002

Q Do you have a disaster-prevention map, disaster-danger prediction map (hazard map) or other disaster-prevention material for the area where you live? Or have you seen or heard about them?

- |           |  |              |
|-----------|--|--------------|
| A1        | Yes, I have one.   | 12.9%        |
| A2        | I don't have one, but I've seen one.                           | 15.8%        |
| A3        | I haven't seen one, but I have heard about them.               | 18.1%        |
| <u>A4</u> | <u>I haven't seen anything, or heard anything, about them.</u> | <u>49.9%</u> |

Q Do you feel that it is better to provide residents with more information and more details on the danger to the community by disseminating disaster-prevention materials such as disaster-prevention maps and disaster-danger prediction maps (hazard maps)?

- |           |   |              |
|-----------|---|--------------|
| <u>A1</u> | <u>It is better to provide more and more detailed information.</u>    | <u>68.2%</u> |
| A2        | Feel it better to provide more information and more details.          | 20.6%        |
| A3        | I feel it is better to not provide more information and more details. | 2.9%         |

A4 I don't think it better to provide more information or more details. 1.8%

As of 2002, about 50% of the public still did not know about disaster-prevention maps and hazard maps, but about 70% favored greater distribution of information and more details about the dangers faced by communities.

**(6) Survey results in June 2005**

Q Do you feel it is better to receive more information on the danger of floods and sediment disasters in the area you live in?

A1 More information is better. 44.4%

A2 Present amount of information  
is sufficient. 46.5%

A3 No need for more information. 4.5%

Q (To people who chose A2 and A3) Why?

A1 The current amount of information is enough. 89.5%

A2 Not likely to use the information. 4.6%

A3 High likelihood of danger in living area makes me uneasy. 1.9%

A4 High level of danger in the living area leads  
to lower real estate prices. 0.3%

As of 2005, in response to the question about more information on the danger of flood disaster: Among the group answering that the current amount of information is enough or unnecessary, 0.3% cited lower real estate prices (Total 51.0×0.3% = 0.15%) or very small.

**Appraisal of real estate prices in Japan**

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factors and mutual relations among various factors. Price factors are divided into general factors, regional factors and individual factors.

The general factors include natural factors such as weather conditions. Regional factors include (9) the danger of disasters such as floods and landslides in residential areas.

Therefore, real estate appraisal includes the danger of floods that would affect land prices.

## 2. Opinion poll on provision of inundation information as part of flood countermeasures

### (1) Survey results in April 1977

Q What do you think about informing how deep the inundation will be by erecting signs where flood is expected? Choose one from below.

- |    |  |       |
|----|--|-------|
| A1 | <u>It is good because residents can learn the danger in the event of flood disaster.</u> | 83.6% |
| A2 | It is bad because it unnecessarily worries the residents.                                | 4.2%  |
| A3 | I don't know.  | 2.2%  |

As of 1977, more than 80% of the respondents affirmed information to residents.

### (2) Survey results in August 1985

Q Have you seen or heard about maps showing the inundation areas during past large floods (inundation-record maps) for flood fighting and evacuation in the event of emergency?

- |    |  |       |
|----|--|-------|
| A1 | I have seen one.                             | 8.7%  |
| A2 | I have not seen one, but I heard about them. | 8.7%  |
| A3 | <u>I don't know.</u>                         | 82.6% |

Q What do you think about publication of such map? Choose one from below.

- |    |   |       |
|----|---|-------|
| A1 | <u>It is good because residents can learn the danger and raise awareness of flood disaster.</u> | 82.3% |
| A2 | It is bad because it unnecessarily worries residents.   | 5.2%  |
| A3 | I don't know.   | 12.5% |

Q What do you think about erecting signs in flood-prone areas and informing residents in general of expected inundation water-levels in maps (flood-prone area maps)? Choose one from below.

- |    |  |       |
|----|--|-------|
| A1 | <u>It is good because residents will be made aware of the danger and need for disaster prevention.</u> | 83.6% |
| A2 | It is bad because it unnecessarily worries residents.  | 5.3%  |
| A3 | I don't know.  | 11.1% |

Q To prevent sediment disaster, dangerous areas where sediment disasters are likely to happen may be announced. What do you think about such announcements?

A1 They should be announced. 84.3%

A2 They need not be announced. 3.0%

A3 I don't know. 12.7%

Q (To people who chose A2) Why do you think so?. Choose one from below as nearest to your idea.

A1 Not a good idea because land prices in the surrounding areas will drop. 8.2%

A2 It is unnecessary because it unnecessarily worries people. 86.3%

A3 Others 5.5%

As of 1985, 80% or more of the residents did not know about inundation-record maps, but more than 80% were in favor of disseminating information to residents. As to announcing risky areas prone to sediment disaster, 3% of the respondents thought it unnecessary, and within this group, 8.2% expressed concern about effects on land prices in surrounding areas. (3% of total  $\times$  8.2 = 0.25% or very small.

### (3) Survey results in September 1996

Q What measures do you choose to minimize inundation damage due to river flooding? Choose any from below. (M.A.)

A1 Develop circle levees and fluvial wood zones in order to resist expansion of river flooding into wide areas of towns. 32.2%

A2 Develop drainage facilities to minimize inundation 58.9%

A3 Provide as much information as possible when rivers swell 40.2%

A4 Develop safe shelters and evacuation routes upon river flooding 37.6%

A5 Develop waterproof facilities at damage-prone facilities like hospitals and subways 22.6%

A6 Raise foundations of structures such as individual housing 11.0%

A7 Develop insurance system to compensate flood damage 22.4%

A8 Provide as much information as possible, including dissemination of maps showing inundation areas and shelters (flood hazard maps) 24.5%

A9 Relocate houses from flood-prone areas. 10.8%

A10 Others. I don't know. 6.1%

As of 1996, about 25% of the public favored dissemination of flood hazard maps.

#### (4) Survey results in June 1999

Q Do you need more information about the danger of flood and sediment disasters in areas where you live? Choose one from below.

- |           |  |              |
|-----------|--|--------------|
| A1        | More information than now.                 | 39.3%        |
| <u>A2</u> | <u>About the same level as now.</u>        | <u>55.8%</u> |
| <u>A3</u> | <u>No need to provide more information</u> | <u>4.9%</u>  |

Q (To the people who chose A2 and A3) Why don't you need more information? Chose one which is closest to your idea.

- |           |  |             |
|-----------|--|-------------|
| A1        | The present information is sufficient.   | 88.4%       |
| A2        | I don't use the information.   | 4.9%        |
| A3        | Dangers in the living area makes me uneasy.                                    | 2.5%        |
| <u>A4</u> | <u>Real estate prices will drop if level of danger in living area is high.</u> | <u>0.3%</u> |
| A5        | I don't know.  | 4.0%        |

As of 1999, people who are satisfied with or do not require more information on danger of flood disaster chose fear of reduction of real estate prices by 0.3% (Total  $60.7 \times 0.3\% = 0.18\%$ ) or very small.

#### (5) Survey results of September 2002

Q Do you have a disaster-prevention map, disaster-danger prediction map (hazard map) or other disaster-prevention material for the area where you live? Or have you seen or heard about them?

- |           |  |              |
|-----------|--|--------------|
| A1        | Yes, I have one.   | 12.9%        |
| A2        | I don't have one, but I've seen one.                           | 15.8%        |
| A3        | I haven't seen one, but I have heard about them.               | 18.1%        |
| <u>A4</u> | <u>I haven't seen anything, or heard anything, about them.</u> | <u>49.9%</u> |

Q Do you feel that it is better to provide residents with more information and more details on the danger to the community by disseminating disaster-prevention materials such as disaster-prevention maps and disaster-danger prediction maps (hazard maps)?

- |           |   |              |
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