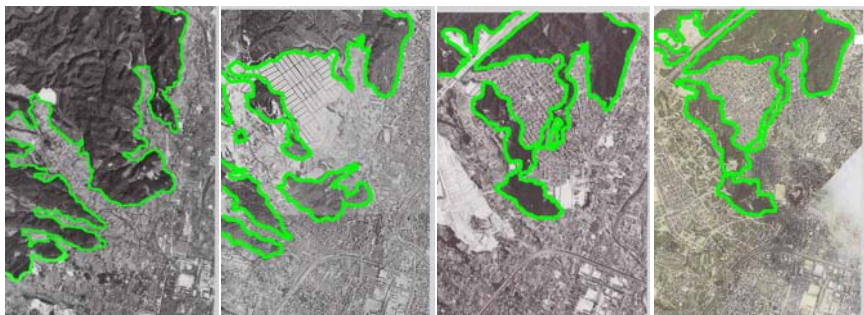


# Hazard map for sediment-related disasters in Japan

Takao Yamakoshi  
Public Works Research Institute

## What is really a problem in Japan?

- Sediment-related disasters keep occurring in Japan.
- One of the principal reasons is that the high development needs cause the extreme urbanization and the increase in the exposure against hazardous phenomena, such as development of residential areas on hillsides as well as on foothills.



1966 1974 1986 1999 (Presented by MLIT)

Example of Hiroshima City: **disaster-prone sites within these photos increased from 4 to 24** between 1966 and 1999.

## In 1999, a severe sediment-related disaster occurred in Hiroshima

- 325 debris flows and slope failures occurred almost simultaneously in Hiroshima in June, 1999.
- 24 people were killed and more than 150 houses were destroyed or damaged in newly developed residential areas beside hillsides and foothills.

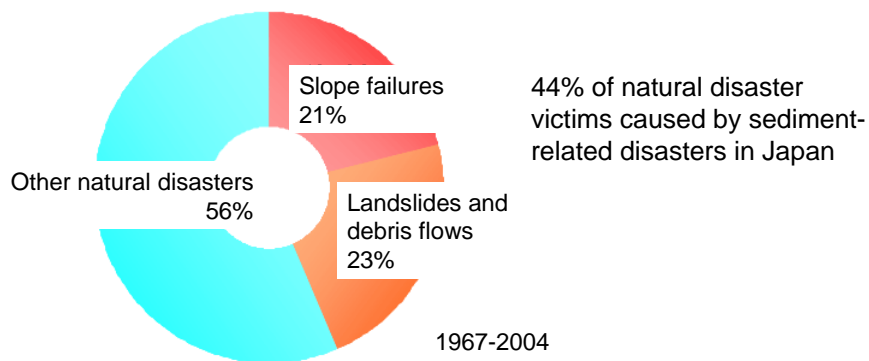


A debris flow struck a residential area

(The sediment-related disaster on Jun 29, 1999: Hiroshima prefecture)

## Sediment-related disasters

- are likely to kill more people than other natural disasters



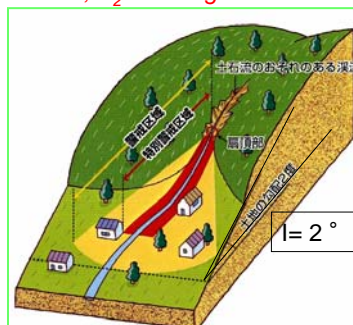
Except for the death toll by the Hanshin-Awaji Earthquake disaster

## What should be done to manage the sediment-related disaster?

- The Japanese government was prompted by this disaster to establish a new law for designating hazard areas in order to:
  - Restrict new development for housing and other purposes,
  - Promote relocation of existing houses, and
  - Develop an early warning system.

## In case of debris flow

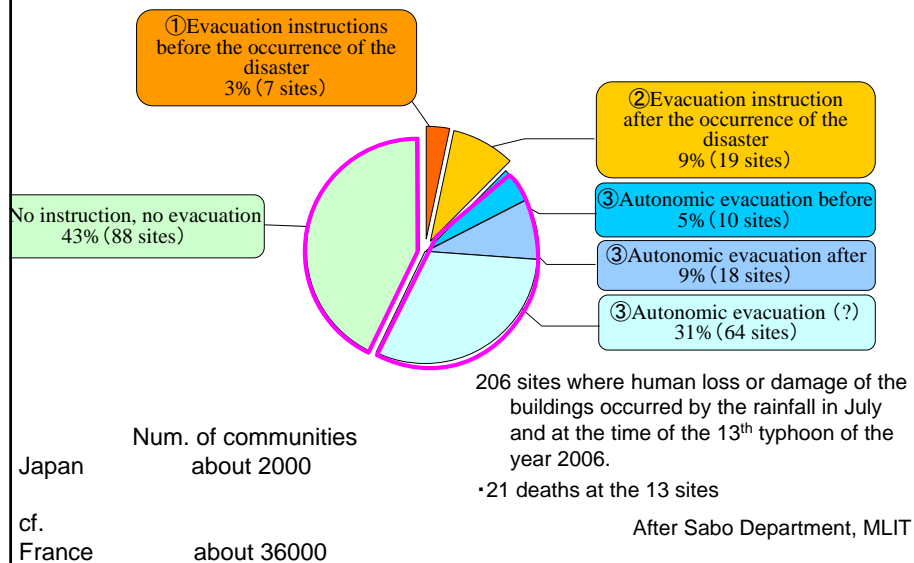
- How to determine a “Yellow Zone”
  - An area located under a stream prone to debris flow and on a slope of 2 degrees or steeper on an alluvial cone is determined as a Yellow Zone.
- How to determine a “Red Zone”
  - An area which satisfies the following equation is determined as a Red Zone.
    - $F_d > P_2$  ( $F_d$ : Fluid dynamic force,  $P_2$ : Bearing force of a house)



## What is a “Sediment-related Disaster Hazard Area”?

- An area prone to sediment-related disaster shall be designated as a **Sediment-related Disaster Hazard Area (Yellow Zone)**.
- If an area is designated as a Yellow Zone:
  - **Early warning systems** must be established,
  - **Steps to raise the awareness of local people about sediment-related disasters** should be taken.
  - **But NO RESTRICTION ON LAND-USE**

## Difficulty in evacuation instruction



## Low public awareness

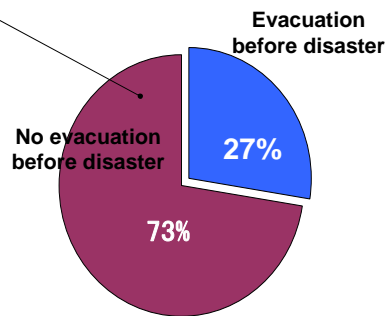
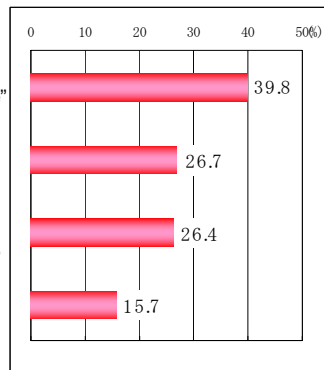
The reasons of no evacuation ←

"I thought that it would be better to stay in my house"

"Neither official evacuation instruction nor order"

"It seemed to be safe because I have never experienced it so far."

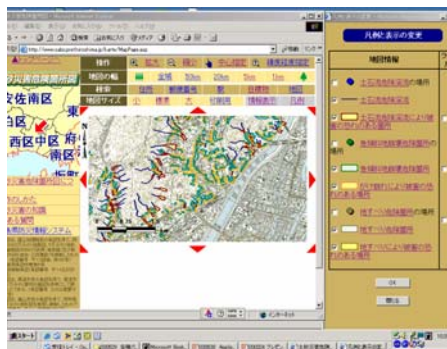
"The rain didn't seem to be very serious. "



※After the result of questionnaires at the 10 sites devastated by the sediment-related disaster in 2006 (After Sabo department, MLIT)

## How to raise public awareness?

- People should be **kept informed** about **hazard maps** by every possible means, such as **the internet, mail** etc., because, **most people don't pay attention to hazard maps during non-disaster time**, and sometimes **lose their copy**.
- Some prefectural governments put **hazard maps on websites**, and some municipalities send **a direct mail** to each family living within hazard areas in order to inform them that they are living in a hazard area.



An example of a hazard map for SDR on a website.  
(<http://www.sabo.pref.hiroshima.jp/karte/MapPage.asp>)



An example of a direct mail  
(Presented by Miyagi prefecture)

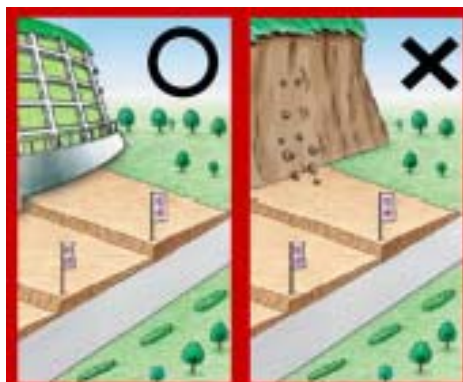
## What is a “Special Sediment-related Hazard Area”?

- An area where damage to buildings and serious hazards may be posed to residents shall be designated as a **Special Sediment-related Disaster Hazard Area (Red Zone)**.
- If an area is designated as a Red Zone:
  - Permission is required for land development for housing etc.,
  - Building certification is required for buildings,
  - Relocation of buildings that are vulnerable to serious damage in case of a sediment-related disaster is recommended,
  - Those who move their residence to a safe area under recommendation can be financed and funded.

## Level of restriction

Switzerland/European countries

Japan



RED	Construction is allowed with permission
YELLOW	Early warning

Mass land development and construction of facilities for people who need assistance are never allowed only if the hazard is properly mitigated by structural measures.

## What is the most dangerous land-use?

### - Mass residential land development

Response against sediment-related disasters should be community based and needs high public awareness on them.

This mass development creates a community with no awareness.

### - Construction of facilities for person who needs assistance at the time of response against disasters

## Summary

- **At first, hazard maps should be created as early as possible for all the sediment-related disaster-prone sites to reduce loss of human lives.**
- **Hazard maps are expected to promote appropriate early warning and evacuation and raising public awareness.**
- **The most vulnerable land-uses, the mass residential land development and construction of facilities for person who needs assistance, are not allowed only if the hazard is properly mitigated by structural measures.**
- **Hazard maps should be revised when the situation of disaster-prone sites have changed, such as completion of structural measures or climatic change**