Applying Risk Management Approach to Disaster Reduction
Practical Applications

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Introduction

Although risk is defined in several ways, the most general definition is the expected value of loss, that is;

Risk = Probability of Hazard ✕ Loss Caused by a Hazard (1)

Risk management can be classified into two types, risk control and risk sharing (risk finance) (**Figure 1**). Risk control includes methodologies reducing risk (expected value of loss) directly. In case of disaster risk management, physical infrastructure (reservoirs, levees, etc.) , subsidizing policies (subsidy for improving strength of houses, etc.), evacuation planning are classified into risk control. In other words, most of the conventional measures for reducing possible loss of a disaster are included in risk control.

Risk sharing does not reduce the expected value of loss. Using financial schemes, the agreement for transferring losses is formed. If someone is damaged by a disaster, his/her loss is spread into other people. Typical example of risk sharing is earthquake and flood insurance.

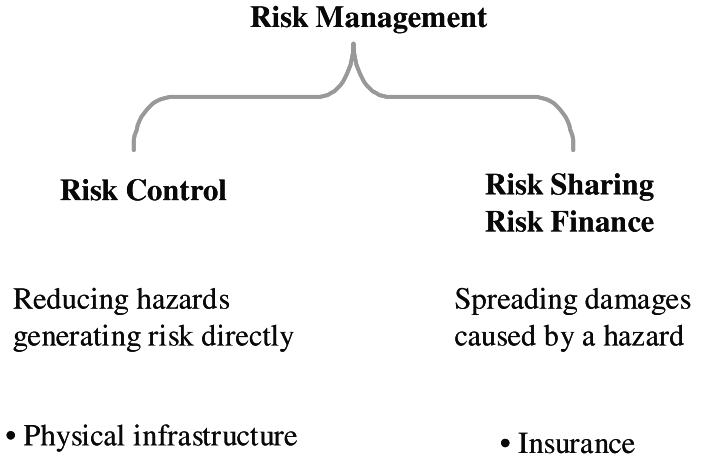

Figure 1 Risk Control and Risk Sharing.

Disaster risk management

(1) Risk management flow

Figure 2 shows the flow of risk management. First, risk management policy is determined. Risk management policy means criteria and purposes of risk management. In the case of disaster risk, the following properties can be included in risk management policy.

- The type of disasters (flood, earthquake, slope failure etc.)
- The scale of the objective disasters
- The area to be protected

The next phase of risk management is risk identification, which specifies the events (hazards) that could occur. Risk identification is partially similar with risk management policy. While risk management policy reflects the value of a society or an organization, risk identification is carried

out in relatively objective ways.
The third phase is risk assessment. Probability of occurrence of an event (hazard) is estimated, and possible loss caused by the event is calculated. Multiplying them, risk is quantified. During that process, model under some assumptions is sometimes constructed. In case of flood risk, frequency of heavy rainfall is calculated using past rainfall data and the loss can be estimated by inundation model. In some cases, vulnerable spots are also specified.
In risk assessment phase, alternatives are evaluated. Decision maker has to choose an appropriate action from alternatives. Alternatives for risk management are often classified into four types, "reserve," "avoid," "reduce" and "transfer."
"reduce" is similar with risk control in 1, and "transfer" is similar with risk sharing.

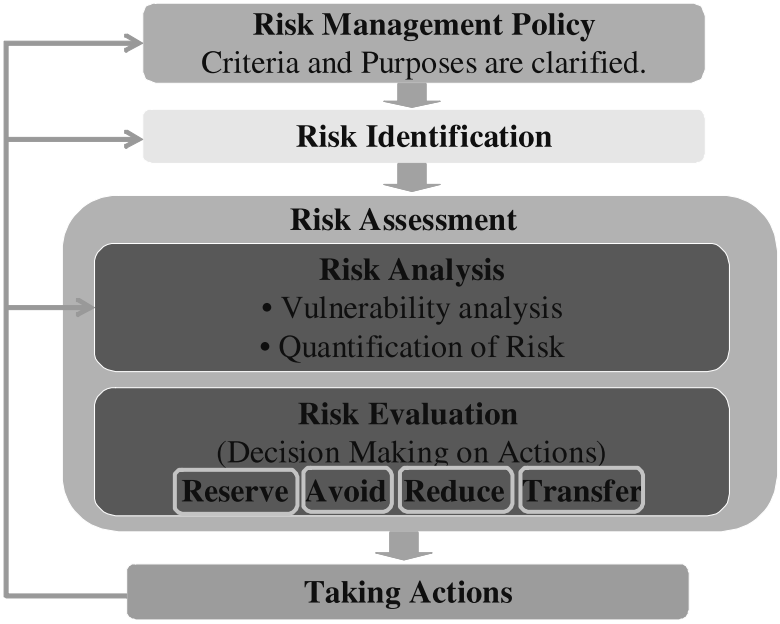

Figure 2 Risk Management Flow

(2) Disaster risk management at household (Individual) level
In order to reduce casualties and economic loss in a disaster, both government and individual residents take actions considering disaster risk. In risk management at household (individual) level, risk identification in **Figure 2** is a critical phase. It is difficult for people to imagine how a disaster occurs. Researchers mention that even the people who have experienced a disaster may not recognize future disaster risk in case they have not been damaged in the former disaster (Katada and Oikawa, 1998).
In order to have individuals recognize risk correctly, the information promoting imagination on a disaster needs to be provided. A series of such methodologies are called risk communication. Hazard map is a typical tool for risk communication.

Hazard map: Application in Yamaguchi Prefecture

Yamaguchi prefecture is located on the western edge of Japan's main island (Honshu). The scale of rivers in Yamaguchi is relatively small, comparing with other regions in Japan.
In the scheme of flood disaster risk management, central or prefectural government responsible for management of a corresponding river provide municipalities with necessary information, and municipalities prepare hazard maps. In Yamaguchi, three municipalities have prepared maps at three rivers, and other three municipalities are preparing (See **Table 1** and **Figure 3**).

Figure 4 shows a hazard map at Nishiki-River prepared by Iwakuni City. Population of Iwakuni city is about 110,000. A hazard map illustrates possible inundation areas, depth at each point and evacuation sites. Iwakuni city provided all households with the hazard map to promote residents' awareness against risk. Differently from Nishiki-river, Awano-river (**Figure 5**) flows through agricultural area in Northwestern Yamaguchi. The river basin experienced flood disaster in 1999, and 41 houses were damaged.
A hazard map is also used for evacuation planning. Residents are recommended to choose routes to an evacuation site to avoid inundation areas. **Figure 6** shows instruction about evacuation to the other district. In this case, capacity of evacuation site at the left district is not enough, and the map recommends that some residents evacuate to the right district.

Table 1 Hazard Map in Yamaguchi

Name of River	
Saba (2001)	Prepared
Awano (2002)	Prepared
Nishiki (2002)	Prepared
Fushino	Preparing
Koya	Preparing
Shimada	Preparing

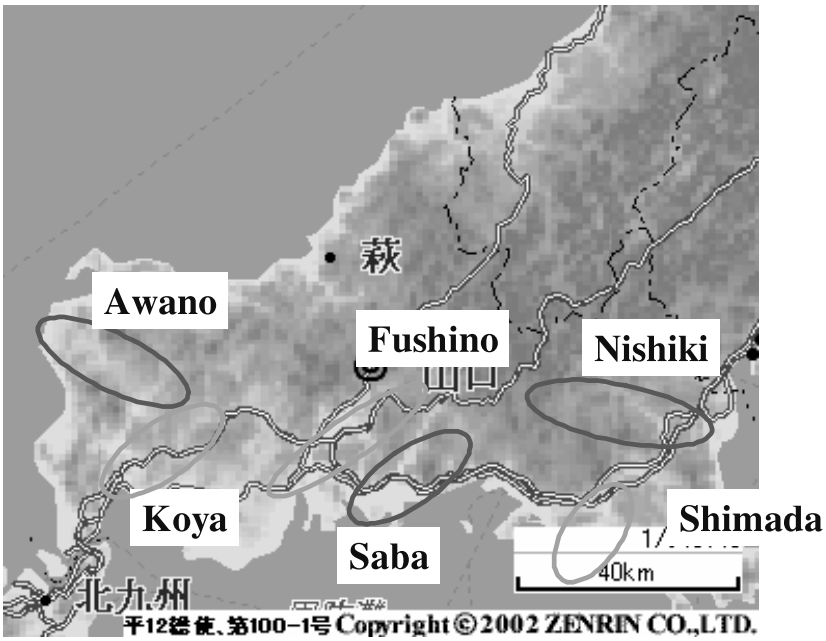

Figure 3 Hazard Map Prepared Rivers

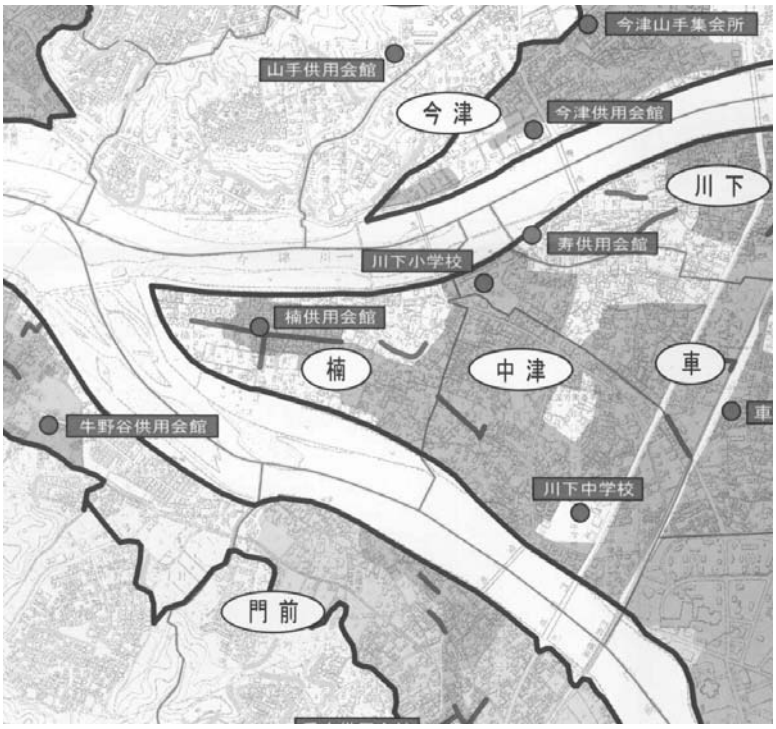

Figure 4 Hazard Map in Nishiki River

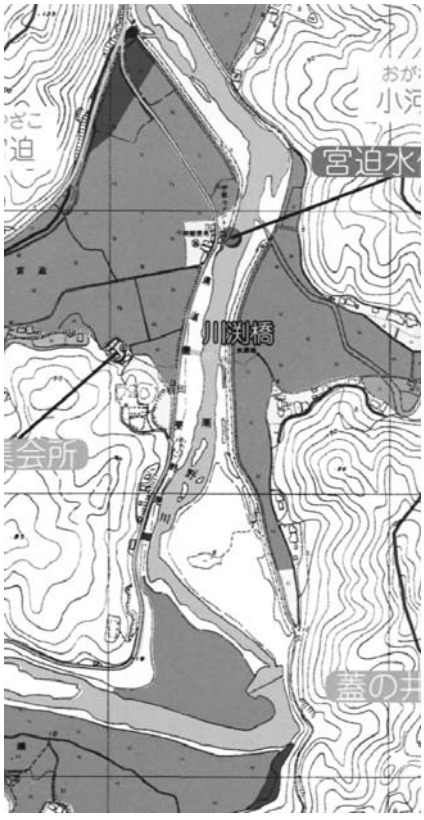

Figure 5 Hazard Map in Awano River

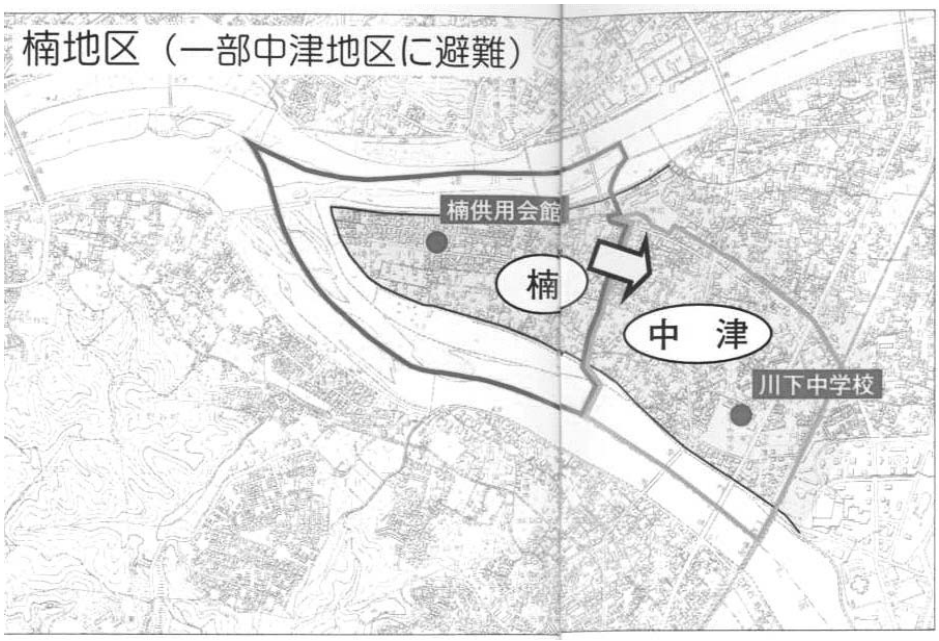

Figure 6 Instruction about Evacuation to the Other District

Role of a hazard map in risk management

In this section, the role of a hazard map in risk management is discussed again. As mentioned before, a hazard map is expected to improve residents' risk perception. If residents are aware of possibility of flood, they may try to collect information in a time of heavy rainfall and can evacuate earlier. In a case of earthquake, ex ante evacuation is difficult, but residents may choose renewal of their houses to improve strength. Such effects can be regarded as short term effect of a hazard map.

For the longer term, land use pattern within a region needs to be changed depending on vulnerability of each district. If the risk information provided by a hazard map is appropriate, people can use the information for choosing their residential place. In other words, residential area should be located in low-risk districts. However, in order to satisfy these purposes, many disaster scenarios need to be generated. In reality, disasters can occur in many ways. Therefore, it is necessary to accumulate possible disaster scenarios.

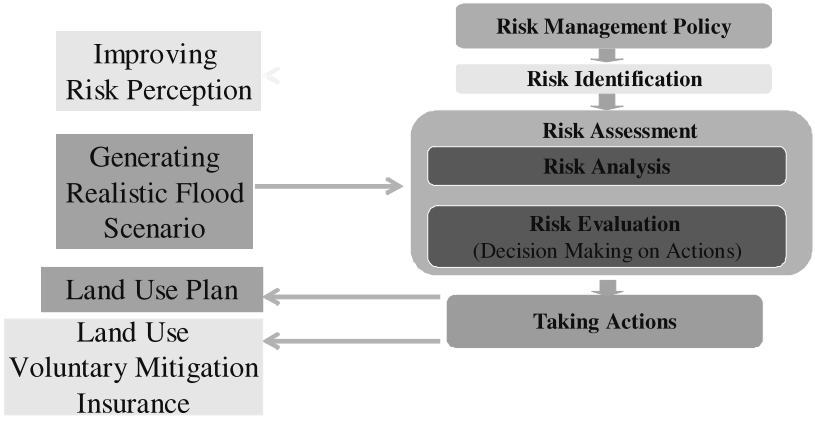

Figure 7 Role of a Hazard Map in Risk Management

Conclusion

Each action in risk management is similar with traditional measures for reducing disaster damages. However, the approach includes ex ante agreements or rules on "what to do," "when to do" and "how to do" in a time of disaster. To construct such agreements, communication with society is necessary. In that sense, concept of disaster risk management has a close relationship with accountability of a government.

References

Katada T. and Y. Oikawa: A Study on Proclamation Effect of the Flood Hazard Map in Consideration of Flood Experience and Disaster Consciousness, Proceedings of Infrastructure Planning, No.21(1), pp.331-334, 1998.