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Field Survey-Based Systematic Formalization of Lessons and Policy Issues on Disaster Risk Communication -- A preliminary approach

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Synopsis

In this study, based on field surveys conceptual models are proposed to systematically formalize lessons and policy issues on disaster risk communication. For the analysis of information flow, particularly from the viewpoint of organizational patterns, hierarchical model and sharing model are proposed to deal with the command and control situation. For the analysis of time flow pattern, the interplay model can be applied to proactive situations. To examine the relation between information and evacuation behavior, a four-layer conceptual model was proposed. With actual flood disaster cases, the above models have been applied and policy implications are derived.

Keywords: disaster risk communication, information flow, lessons, formalization

1. Introduction

For a person responsible for managing risky situations, the worst thing would be that he or she has not treated this risk yet in the event of the occurrence of an actual disaster. In this research we claim that to treat a real disaster risk well in advance, "risk communication" plays an important role. We focus on the communication of "risk" in the period of disaster early warning and quick response.

From the natural disasters which happened in Japan recent years, many issues related with risk communication in the early warning and quick responses were revealed. It is necessary to evaluate the reasons behind them and consider what we need to realize more effective risk communication. Also it is important to systematically formalize these lessons and issues, so that they can be applied or rechecked by the other contexts. In this paper based on case studies, the conceptual models of disaster risk communication are proposed. These models can be regarded as a framework to formalize the variety of lessons of disaster risk communication in the real world. It is also intended that by adaptively applying this approach in future, the findings of this paper will be further monitored and verified for the same fields and /or other ones.

Case studies have been conducted for two disaster fields. One was the northern region of Kyoto prefecture which suffered heavy rainfall and flood disaster by the typhoon No.23 in Oct. 2004 (Ministry of Land, Infrastructure and Transport Kinki Regional Development Bureau, 2004). Another is the Kyushu region which suffered flood disaster by typhoon No.14 in Sep. 2005 (Cabinet Office Government of Japan, 2005). Case studies have been conducted first by analyzing data and information available on the official websites of the central and local governments, local newspapers, etc. Also field surveys were conducted by the authors. The town offices, local residents and enterprises in the affected areas were interviewed. For typhoon No.23, we visited the town of Oe Cho (now it has been combined with the city of Fukuchiyama) in the northern Kyoto prefecture. For the typhoon No.14, field surveys were conducted in the town of Kitakata Cho and Hinokage

Cho in the northern Miyazaki prefecture.

2. Issues revealed from the case studies

There are several issues about risk communication revealed from the case studies:

[1] Town office inundated. Some town offices which were assumed to serve as the emergency management headquarters were inundated in the flood. The communication facilities failed to receive the related information from other governmental agencies, nor send out the evacuation message to the local residents. e.g. the town office of Oe Cho in the case of Typhoon No.23, 2004, and Kitakata Cho in the case of Typhoon No.14, 2005.

[2] Village isolation. In some village the roads and lifelines were cut off by the flood or landslide. Under these circumstances the local residents must depend on their own knowledge and judgment to survive and evacuate.

[3] Evacuation issue. The actions of local residents following the instruction or advices of evacuation issued were different. In the case of typhoon No.23 2004, for different kinds of evacuation information issued in the towns in danger, many local residents did not response. But in the context of typhoon No.14, for the local residents in Kitakata Cho, from our field survey, most of them conducted the voluntary evacuation. That is to say, they more depend on their own judgments to decide whether or not to conduct the evacuation.

[4] Specified refuge shelters. Among the refuge shelters opened in cities in Kyoto prefecture during Typhoon No.23, nine shelters were inundated; and many others had suffered severe damages, especially the lifeline facilities. The similar circumstances happened for Typhoon No.14 too. In Hinokage Cho, one primary school specified as official refuge shelter had not been inundated by river under its foot, but over its head a severe landslide happened. It nearly destroyed the shelter totally.

[5] Information transferring among agencies. In the context of typhoon No.23, during emergency, too much information, without being considered about their importance, were sent to the receiver via FAX, confused receiver and made them spend lots of time to check them.

[6] The gap of risk perception. By field survey some gaps of risk perception between local residents and the person in the town office were identified. For example, in the town office of Kitakata Cho beside the river of Gokase, the dissemination of early warning and evacuation information from town office is conducted via Bousaimusen, which is a wireless broadcast system. The content of information is like "now the runoff from the Hosiyama dam is xxxx ton/sec, please conduct voluntary evacuation, etc." The Hosiyama dam is located on the upstream of the town. But from the viewpoint of the local residents, this kind of information seems too technical. It is difficult for the local residents to judge how risky is in their home via them. So how extent the information affected the evacuation behavior of local residents will not be expected as the town office. In fact for the local residents in Kitakata Cho, they more depend on themselves when conducting evacuation.

3. Patterns of information flow

3.1 The information process within one agent

Risk communication concerns at least two agents. For the information process within one agent, Yoshida (1990) proposed the C-E-D model to describe it. Okada (2005) applied the C-E-D model to the field of disaster information dissemination. The model is shown in Fig.1. The agent receives information from the information source and through the process of cognition, evaluation and direction, and then sends this direction to following agent. Here the information sink of this agent would be the information source of another agent. In the cognition process the agent needs to recognize the fact; and in the evaluation process the agent need to conduct value judgment; and in the process of direction process, the agent makes decision.

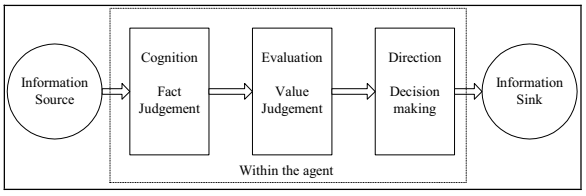

Fig. 1 C-E-D information process model

3.2 Three types of risk communication patterns

In actual risk communication processes we need to consider not only various spatial, temporal factors, but also behaviors of agents. In order to promote the participation in terms of information, knowledge and action sharing, for risk communication two organization

patterns are considered and corresponding prototype models proposed, i.e., .hierarchical model and sharing model. They can be applied to early warning and quick response, and some retroactive situations, especially for the command and control situations. Characteristically, such retroactive situations real-time operations are requested and most of them are irreversible by nature.

If there is a sufficient time for proactive management, the interplay model can be applied to address interactive and reversible actions (such as brainstorming and virtual experience). Therefore we can more explicitly discuss interplay activities along a given timeline.

In order to specify basic components of the above mentioned structures, three symbolic elements are introduced here, as shown in Fig.2. They are "node", "directed arc" and "loop", representing "agent", "information flow" and "information sharing "respectively.

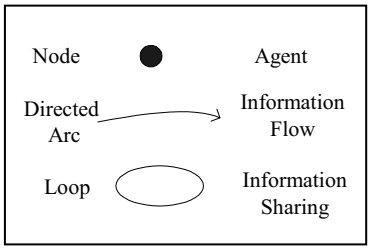

Fig. 2 Three symbolic elements

(1) Hierarchical model

In this case the information flow is commonly one-way. The graph (a) in the Fig.3 gives its basic form, and in actual situations its variations can be observed such as those shown by graphs (b) and (c) in the Fig.3. The information flows among the governmental agencies may commonly take one of these forms.

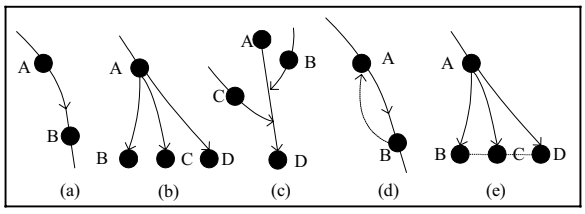

Fig. 3 Hierarchical model

(2) Sharing model

As Fig.4 shows, the related agents share their information. Here the loop serves as an information platform. Based on it the information flows from different sources are integrated and matched properly. In the context of early warning and evacuation, there are two types of sharing models can be applied. One would be the external dependent type. The Bousaimusen system can be regarded as this type. It serves as the common platform to give the external dependent information to the local residents. Another would be the self-reliance type. In the context of community, the evacuation behavior of local residents can be described as this form. The local residents mutually exchange the information they received from other media or related NGOs, and then make their own judgments.

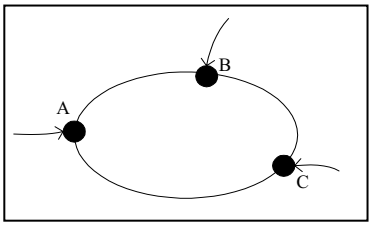

Fig. 4 Sharing model

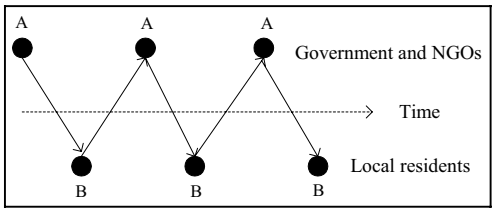

Fig. 5 Interplay model

(3) Interplay Model

The above mentioned patterns are identified mainly when the agents and spatial factors are considered. The flow of information is basically irreversible in time and does not need to be repeated. On the other hand during the period of disaster preparedness, there exist some circumstances under which the risk communication is repeatable. "Be repeatable" here means it can be done again from the beginning. The risk communication conducted in the community based disaster preparedness can be regarded as belonging to this kind of pattern. In this process local residents and experts from NGOs or consulting companies are quite likely involved. The former have more local knowledge, and the latter have more expertise and experience in disaster problems and risk analysis though not so much knowledge of the specifics of the community. Though bi-direction and interactive risk communication, some implicit knowledge hidden within one agent will be developed to become the explicit knowledge used for the community

based disaster preparedness (Okada and Matsuda, 2005). This kind of participatory risk communication can be depicted by the interplay model as shown in Fig.5.

4. Risk perception and evacuation behavior

In this paper we propose that the relations among risk perception, communication and evacuation behavior should be viewed as shown in Fig. 6.

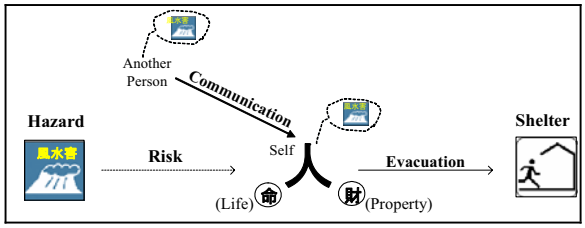

Fig. 6 The risk perception and evacuation behavior

4.1 Risk perception and expression

From the field survey the differences of risk perception and description between the town office and local residents were found existed. The officials in the town office tend to perceive the risk of disaster by depending more on the information system provided by the related governmental agencies, such as meteorological or infrastructural and transportation institutes. Most of these kinds of information are technical, such as the discharge of runoff from a certain dam is this much ton/sec etc. They make their judgment about how risky the situation is according to certain criteria, even though in the real situation the definition of the criteria is difficult sometimes. The local residents tend to perceive the risk of disaster by depending more on their experience and the observation of the situation of the surrounding environment in their living place. In terms of the description of flood risk they tend to refer to one of the buildings people are familiar will be inundated and wish to see if it is the time of a real risky situation for them. Also they are likely to pay attention to the related information from the mass media. When and how extent they will pay attention to is largely determined by their judgment about their changing surrounding situations. Katada et al. (2003) have analyzed the temporal characteristics of relationships between gathering disaster information and updating the overall risk assessment of the current situation in the process as the typhoon is approaching the area.

4.2 Communicating the "risk"

Because the gaps about risk perception and description exist between the local residents and town office, how to fill in them becomes an essential question to improve both the efficiency and quality of sharing messages of both early warning and evacuation (recommendation or command). This can be achieved through series of activity implementation according to the community based disaster management, such as education or disaster prevention trainings. Also the community based tools such as the participatory community based hazards map can be found very useful.

4.3 The behavior of evacuation

The behavior of evacuation for the local residents in the flood disaster is considered more complicated. Even though the local residents understand the early warning or evacuation messages sent from the town office, there are some other factors that may affect their behaviors. Three factors are given for illustration.

[1] Self reliance. Through our field surveys, some local residents were found to take action, relatively based on their own judgment. For them the messages from the town office is only one of references. If this judgment comes from their past disaster experience it might be reasonable to a certain extent, though they also need to imagine that their past experience may not always work properly. But it comes from self-confidence or taking it for granted, it would be very dangerous.

[2] Balance between life and properties. The second point that affects residential behavior is their properties. For residents, it is not merely from the viewpoint of finding a secured place for life to take refugee, but also for the sake of protecting one's properties. When one decides to adopt a certain action, a balance needs to be made between securing life and properties. This point may apply not only to local residents but also to local companies. We should also note that this is particularly the case for flood disasters. It may not hold for earthquake disasters. In the event of a flood disaster there usually is some time left for people to take action, while it is not so for earthquake.

[3] The elder people. The third point that needs to be considered is the evacuation problem of elder or disable people. Ushiyama (2005) has found that in the disaster of Typhoon No.23, among 96 persons killed, there are 54 persons who were over 65 years old. For them even if they received and understood the warning message, they

could not make a quick evacuation by themselves.

5. Four-layer conceptual model

Through the investigation and analysis of various failures and bottlenecks of risk communication systems identified in the case studies, in order to systematically formalize them, here the four-layer conceptual model is proposed as a framework, as shown in the Fig.7. The top layer is the organizational layer, which represents the information flows among different governmental organizations and the dispatch to the local residents. The physical layer includes the physical structure of the whole disaster prevention communication system. The physical layer together with organizational layer as a whole represents the information accessibility. The contents of cognitive layer concerns with the expression format of the risk perception for different cognitive agents such as local residents or official agencies. It represents the understandability of risk. The contents of action layer correspond to the initiatives or reasons behind diversity of actions. This layer is considered most complicated, and corresponds to the physical, social or psychological factors that determine people's behaviors and actions in the emergency of disaster.

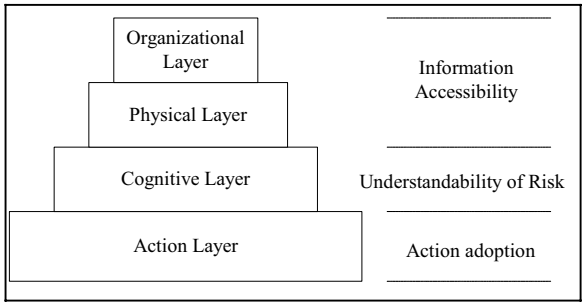

Fig. 7 Four-layer conceptual model

6. Discussions and Conclusions

6.1 Importance of feedback and improvisatory management

For any kind of communication system, the mechanism of feedback is very important. Though it may not always be necessary, but it can guarantee the reliability of the whole system. Here are some examples. During the early warning period, lots of information was sent via fax among the governmental agencies. As Fax to be considered, the information flow is one-direction., so though the agents which sent information knows which is the target, but actually they do not exactly know if the message has arrived at the target agent or if the target agent completely understood the meanings of information. This is exactly what happened in some town offices in the case of typhoon No.23, 2004. For the staff there they received a large number of FAX sheets from the related agents, but did not know which one was more important; and the multiple (and no-classified) contents of the FAX made the recipients confused, particularly about their priority. To solve this kind of problem, some feedback mechanisms are needed, as the graph (d) in Fig.3 shows. Also it is necessary to considering set up some kind of feedback mechanism from the local residents to the town office in the early warning system. For the communication network the multi-routes are needed to be considered. When disasters happened, some communication routes which should work in normal time would be found in failure. So in this case some kinds of improvisatory management should be conducted. Some temporary routes can be considered as a tentative method to transfer information, as shown by the graph (e) in Fig.3. This kind of temporary (and contingent) management should be considered in the disaster training program.

6.2 Problems of "assumption" and importance of participatory risk management

By field survey kinds of bias or assumptions can be found. Town offices are assumed as the headquarters to send information to local residents, but unfortunately sometimes they were found failure and also victims of disaster. The evacuation announcements are assumed to be easily understood by the residents, but it is not always that case. The official specified shelters are assumed to be safe enough to one kind disaster, but sometime they are facing high risk of other kind of disasters. As Fig.8 shows, in order to adjust these biases, the participatory risk communication is needed among government, NGOs and local residents. After all the local residents are the end victims of natural disaster. Their capability of risk perception to natural disaster should be improved under the help of government and NGOs. So in normal time the residents, governmental institutes and NGOs should work together, strengthen the participatory risk communication between them. Otherwise when the disaster comes one day, the early warning would be found no working.

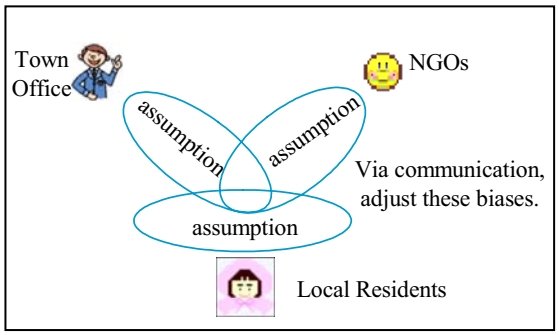

Fig. 8 Participatory risk management

6.3 Further research

For the conceptual models proposed in this study, there remains further research to be conducted in the next step. Provided similar flood disasters take place in other areas, field surveys will be conducted in other areas with already formalized knowledge to be tested. Additionally continued work will be performed in the same field areas and continuous monitoring made to examine the viability of the formalized knowledge and models.

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フィールド調査に基づいた災害リスクコミュニケーションに関する教訓と政策課題の定型化に関する基礎的研究

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要旨

本研究は災害現場での調査に基づいて，災害リスクコミュニケーションに関わる教訓と問題事項を系統的に定型化するための基礎的研究を行った。その際，「情報の流れ」に着目した概念モデルと，「四段階の階層スキーム」を踏まえた調査論の展開が有用であることを提唱した。具体的な対象事例として，2004 年 10 月の台風 23 号災害(京都府)，2005 年 9 月の台風 14 号災害(九州)を取り上げて，具体的な検討を行った。

キーワード: 災害リスクコミュニケーション，情報の流れ，教訓，定型化