Design Proposal for Notification of Dangerous Water Levels

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Abstract

To limit the harm and damage caused by river flooding, signs to indicate dangerous water levels are placed along the river, particularly where there is a danger of overflow. However, the general level of awareness of such signs is low. In this study, we examined ways to efficiently convey information that people have little interest in and find difficult to understand.

Dangerous water levels are quantified and communicated using colors to indicate the degree of danger, and this information is conveyed to the public with signs on bridge piers and slopes. Various other measures are also employed, e.g., adding evacuation pictograms to signs, displaying signs separate from graduated water level indicators, and providing detailed information via the river office website. In addition to using Internet channels such as websites and Facebook, it is common to create and distribute pamphlets and other kinds of printed notifications to communicate such important information as widely as possible. Nevertheless, information that is essential in an emergency but unnecessary at ordinary times is difficult to communicate widely and effectively, even if all these measures are taken. This is because even if people accept that such information must be understood, they remain uninterested and find the information difficult to understand. To solve this problem, we created a story featuring mascot characters for each danger level. This story, presented as a picture book, overturns the conventional attitude toward such information. We thereby developed a medium for communicating important information in a way that better captures people's interest.

Keywords: River Sign, flood information, Means of provide information

Research Method

Through an Internet survey, case survey, and by interviewing river managers, we clarified the roles of dangerous-water-level signs on rivers. Then, we studied the general public's knowledge of the information shown on such signs, and analyzed their awareness and understanding of them. Finally, we proposed a method of widely disseminating dangerous-water-level information which, according to the above analysis, is disregarded by many people.

Dangerous-water-level signs on rivers erected by the national government

In response to severe flooding and sediment-related disasters, generally caused by torrential rainfall, which has occurred increasingly often in recent years, in 2006 the Disaster Prevention Terminology Improvement Study Committee proposed the creation of an effective flood-related, etc., disaster-prevention information system. In the past, river managers placed dangerous-water-level signs at rivers in order to visually observe water levels during periods of concentrated rainfall; however, the Study Committee highlighted various issues concerning this system, including the fact that the conventional disaster-prevention terms are not easily understood by the public. To overcome these challenges, the committee advocated improving terminology, setting danger stages based on the degree of danger posed by certain water levels, providing easily comprehensible information for the general public, and summarizing the actions that people should take at each danger stage. The dangerous-water-level signs presented in the proposal show five stages of danger. Danger Stage One is colored white, with the boundary between stages one and two representing the inundation-warning level; Danger Stage Two is yellow, with the boundary between stages two and three representing the evacuation level; Danger Stage Three is red, with the boundary between stages three and four representing the inundation-danger level; Danger Stage Four is also red, with the boundary between stages four and five representing the inundation-occurrence level; and Danger Stage Five is black (Fig. 1).

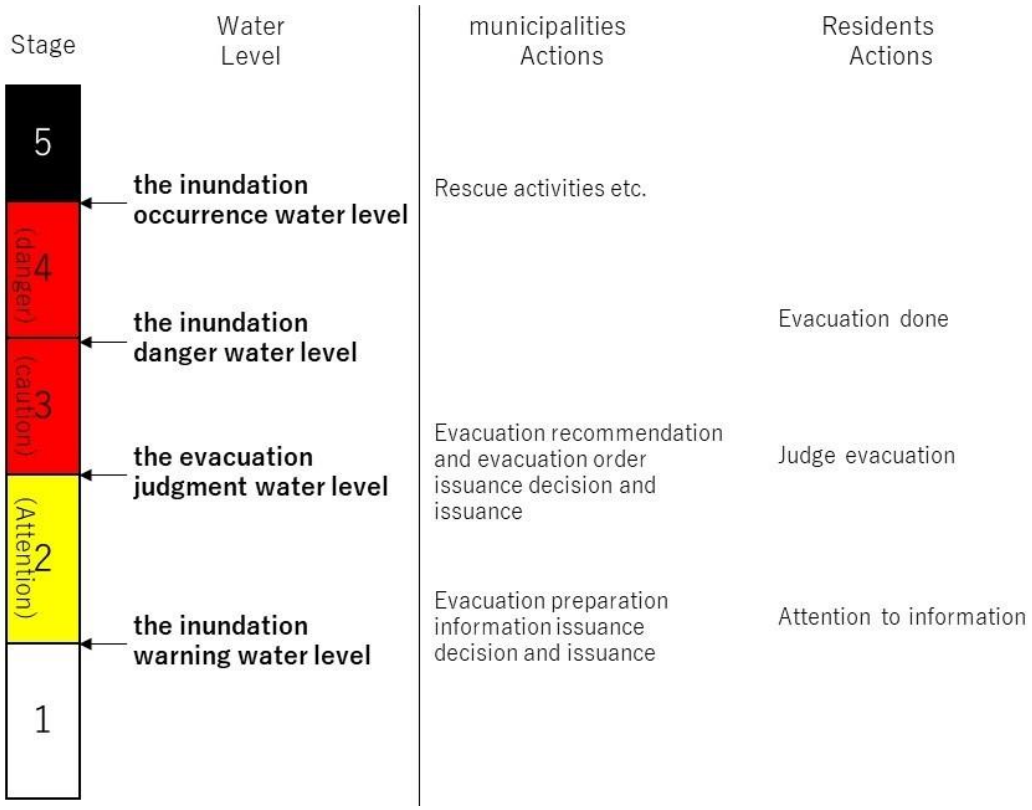

Figure 1 Danger stages for water levels and guidelines for action

Present state of dangerous-water-level signs in rivers

In cooperation with the River Management Section, Kyushu Regional Development Bureau, Ministry of Land, Infrastructure, Transport, and Tourism, we surveyed the placement of dangerous-water-level signs throughout Japan. We also conducted an

interview survey of river managers to determine the present state of these signs. Dangerous-water-level signs are placed at locations where severe flooding has previously occurred, locations at high risk of inundation through concentrated rainfall, etc., and at water-level-observation stations. Further, such signs are rarely placed independently as new structures; generally, nearby bridge piers, where the colors can be seen from river banks, are painted with the danger stages. Meanwhile, other structures used include the top, side, or base of the handrails of riverside steps or slopes and water-level-observation stations. Independent signs are rare because managers prefer as few structures as possible on rivers; this is because driftwood, refuse, and other flotsam can catch on such structures, forming weirs.

Table 1 Examples of typical placings of dangerous-water-level signs

Placed on bridge piers		Placed on steps	
Placed alongside steps		Placed on the bases of handrails	
Placed on water-level-observation stations		Placed independently	

Frequently employed methods of indicating dangerous-water stages are painting the colors over the entire area of the structure in question, such as the whole surface of a bridge pier; painting only lines showing the boundaries between danger stages; and setting a fixed area and painting the colors for each danger stage within this area. Another characteristic method is to show evacuation pictograms at the location of each danger stage; these advise residents of the water levels at which they should begin evacuation activities. Further, the information shown by the dangerous-water-level signs has also been occasionally supplemented by installing notices explaining the signs, or ensuring that people can easily check water levels at night, such as through installing lamps that illuminate when river levels become threatening (Table 2). It must also be considered that, during torrential rainfall, the

surroundings are unavoidably darkened and visibility is reduced, and this is another reason danger stage boundaries must be clearly distinguishable; hence, in many cases either each danger stage is represented by a unique color, or only the boundaries are shown by colored lines, as mentioned above. Generally, it is unnecessary to indicate Danger Stage Five, which signifies that inundation is occurring, so only danger stages one to four are shown. Further, although the proposed color regulations stipulate that both danger stages three and four should be red, in many cases, Danger Stage Three is painted yellow or orange.
When a river's level is raised by torrential rainfall, the river manager visually monitors the dangerous-water-level signs to distinguish the danger stages and issue reports to each city, town, and village concerned.

Table 2 Examples of new coloration techniques, etc.

Coating the entire indication		Painting boundary lines	
Painting fixed ranges		Placing explanatory signs	

Roles of dangerous-water-level signs placed on rivers

As part of efforts to improve the public's understanding of dangerous-water-level warnings, in recent years, dangerous-water-level signs have been placed in locations where they can be seen by residents during their daily lives, such as while strolling by rivers. However, a survey of existing dangerous-water-level signs shows that people still do not understand what these signs signify. For example, as mentioned above, in many cases no additional notification is placed alongside water-level signs explaining the information shown and informing the public of the danger stages of the water levels. This means that if people only see the dangerous-water-level signs, sufficient information is not being communicated to them. Thus, it is clear that, despite the new measures, little has been done to help ordinary people understand the information. We believe that new innovations and techniques to communicate information are required to accurately convey this vital information to ordinary people.

Widely publicizing dangerous-water-level information

The Meteorological Agency website explains the relationship between the colors and danger stages indicated by dangerous-water-level signs, along with the level of danger represented by each danger stage. Further, water-level information for rivers directly managed by the national government can be checked in real time through the "River Disaster Prevention Information" website; the websites of river offices provide information linked to the River Disaster Prevention Information website. Moreover, for water-level

information concerning rivers managed by prefectures, the Foundation of River & Basin

Integrated Communications has prepared a website linked to general disaster-prevention information websites. Many of these websites can be accessed using smartphones or other portable information terminals, so wherever there is an Internet environment, it is possible to obtain water-level information for certain rivers. Furthermore, it is also possible to obtain water-level information through terrestrial digital broadcasts by NHK simply by using the data button, meaning even people who have difficulty using information terminals can obtain such information from their TVs.

As the season of frequent torrential rainfall nears, news reports, etc., often refer to this information to widely publicize that people can easily obtain river-level information. In addition, river managers publish brochures and/or posters stating that river level information is being provided, while social network services, etc., widely report the existence of river-related disaster-prevention websites. It is also now widely known that river level information is provided at a variety of events held at river facilities, etc.
For the above reasons, it can be concluded that means of providing ordinary people with river level information now exists, and that people have been well informed of their existence. However, it is clear that when torrential rainfall occurs, few people obtain river level information from the River Disaster Prevention website and other websites or through their TV sets, and many people are still unaware that they can obtain such information from the Internet or through their TV sets. A possible reason for this is that they do not require such information at the time it is publicized, so they take whatever measures they feel best without actually accessing the websites. Under these circumstances, obtaining such information does not become a firmly established custom, and it is predicted that when there is torrential rainfall, people will not even recall the method of obtaining river level information.

Thus, although it is widely known that water-level information is provided by sources such as the River Disaster Information website, innovative means of inducing users to take an interest in and aggressively access this information have still not been introduced, so it can be concluded that these measures do not function effectively.

Analysis of dangerous-water-level information for rivers

River level information is, from the perspective of ordinary people, unnecessary for their daily lives. While they realize that it is important information when torrential rainfall occurs, and that they must acquire it as advance knowledge, people generally do not remain habitually vigilant. As torrential rainfall and other natural disasters are extraordinary events, it is difficult for people to realize that they could personally be impacted by them, and during normal times they treat it as inapplicable information, which presumably prevents them from storing it.

Considering the fact that basic information such as the danger stages stipulated for existing water-level information are integrated nationwide, and that this information is already provided on websites or through public broadcasting, it is thought that revising this basic information is currently inappropriate.

Thus, according to these findings, instead of merely providing the basic information, it is also necessary to attract the attention of ordinary people to the communication method. By creating interest, it might be possible to teach the information to people as advance knowledge and encourage them to habitually obtain it.

Proposed river level information communication technique

If seeing dangerous-water-level signs while walking along a river arouses people's interest, attracting them to information-providing sites, this information would penetrate more effectively. However, in order to avoid detracting from rivers' scenic qualities, there are restrictions concerning the addition of new information to dangerous-water-level signs. Thus, it is assumed that if people can be taught to recall dangerous-water-level information when they see dangerous-water-level signs in daily life, such signs can function as interfaces.

Although it is necessary to devise a means of publicizing this information to all, it is considered to be effective to first choose a target population and gradually and exponentially publicize the information. Consequently, we decided to target elementary school children, who are a group that regularly visit river facilities as part of school events. It is also thought that with torrential rainfall now becoming more frequent, it would be useful to begin by raising consciousness of river level information among children. We believe that it is likely that children will pass such information on to their parents, and that the adults will possibly spread the information to other people.

Using stories and characters to provide information

We studied the use of stories and characters as a means of conveying river level information, which is generally difficult to present in an interesting way, and as easily understood and entertaining information. The most important aspect to convey is guidelines concerning the recommended actions that should be taken in response to each danger stage. Consequently, to make the categorizations and colors memorable and interesting, mascot characters were created representing the colors of each danger stage. Then, a story was written in which the characters act in ways appropriate for each danger stage when river levels rise, encouraging understanding of the actions recommended for each danger stage.

Developing an interest in and becoming familiar with characters or a story presumably motivates those receiving information to do so positively, so animal characters that are attractive to children were drawn. Figure 2 shows a sample picture book, the characters are shown in Figure 3, and Table 3 presents the story.

Figure 2 Sample Picture Book

Figure 2 Characters that appear in the book

Table 3 Story

Story: “Dangerous water levels and the animals living on the river”
Hey, do you all know about the river, and the animals that live on the river?
A white polar bear, a yellow giraffe, an orange lion, and a monkey with a bright red face
These four animals love all of you and want to keep you safe, so they escaped from the zoo to live on the river.
What? I didn’t know that. I hadn’t noticed it. Where on the river do they live? What do you mean by keeping us safe?
They often live around bridge piers or on the river dykes. Look carefully along the river and you will see white, yellow, orange, and red painted on bridge piers or on the dykes. Look! I see many, many painted bridge piers.

Right!! White places mean a polar bear. Yellow places mean a giraffe. Orange shows where the lion lives, and red places mean a red-faced monkey!! What are they doing there?
The white place is Danger Level One. The white polar bear lives here. “I am very good at swimming. When there is heavy rainfall, there is more water in the river, so the water rises up to Danger Level One, where I live. When this happens, I swim skillfully in the river, where I watch to make sure that there are no large logs flowing downstream and nobody is still playing along the river. I also notify the local flood brigades, who are on standby.”
The yellow places show Danger Level Two. The yellow giraffe lives here. “My neck is really long, and it helps me see for a long way. When there is very heavy rainfall, I can see that the water is rising beyond Danger Level One, where the polar bear lives, to Danger Level Two, where I live. When this happens, this long neck that lets me see far away is very useful. That is because I can see all of my surroundings and I can give appropriate warnings. Also, when even more rain falls, raising the water almost to Danger Level Three, where the lion lives, I can immediately warn him.”
The orange place is Danger Level Three. A lion with an orange mane lives here. “I am proud of my orange mane and my loud roar. When there is really heavy rainfall, the giraffe, who is on the lookout over a wider area, warns me that the water is going to reach Danger Level Three, where I live. After the water rises to my place, I desperately warn everybody with my loud voice. Roaaaar! Roaaaar! (meaning “everybody get ready to escape!!”) Roooaaar! Roooaaar! (“once you are ready, get away!”) Roaaaar! Roaaar! (“warn your neighbors as you escape!!”). But if nobody pays attention to me despite my desperate attempts to warn you, my voice will become drowned out by the sound of the falling rain, and you will not hear my warnings anymore.”
The red place is Danger Level Four. The red-faced monkey lives here. “I’m an old boss monkey. I live with polar bear, giraffe, and lion on the indications that inform you of dangerous water levels on the river. When there is really, really heavy rainfall, the water rises to Danger Level Four, where I live. I suppose that lion has told you that before the water reaches my place, he uses his loud voice to tell you all to get ready to escape, hasn’t he? After lion has finished warning all of you, he calls on me. You wonder why he does that, don’t you?”
“When the water level has reached me, the water will probably overflow at places where the dyke is low. It takes me a long time to escape because I am old; so, lion always calls out to me, telling me to escape with him just before the water reaches me. I am saved because he always calls me early. He teaches me that it is important to escape quickly. “
Is that so? I didn’t know any of that. I didn’t know that those indications along the river show the degree of danger when heavy rain falls, similar to a yardstick for escaping. Or that when there is heavy rainfall, they warn us to escape in order to save our lives. I didn’t know anything about that. I am sorry I did not notice it before.
Thank you all for caring about us.
From now, on, whenever it seems to be raining endlessly, I will remember you all. I will be very careful to listen for lion’s warning! I will prepare to escape once the water reaches the lion. I absolutely promise.

Evaluation of the sample picture book and future study

We performed an interview survey concerning the picture book with leaders of a residents’ group that conducts various activities along the Onga River, which flows through Nogata City, Fukuoka Prefecture.

Their evaluation concluded that transmitting information through a story stimulates feelings of familiarity and interest far more effectively than conventional methods of providing information; however, in regard to the content of the story, they highlighted that children in the lower grades might confuse the characters of the animals designated for each danger level with the level of danger represented by the animals in real life. This information was obtained from a group leader who was a former principal of an elementary school, so his opinion is valuable, and consequently we believe it is necessary to reconstruct the content of the story to address this issue.

Nevertheless, the group did generously praise the method of using stories to communicate water-level information. We believe that devising innovative communication methods can support the wide dissemination of such information. We will consult with river offices and residents' groups and examine the content of the story in order to prepare a new sample picture book; then, we will test it with elementary school children to verify whether this innovative communication method can effectively publicize information that generally does not interest people.

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