

Mitigation of the natural disaster by the personal disaster prevention map

Takahiko KONNO⁽¹⁾, Shirou MORIYA⁽²⁾, Hideyuki KUROZUMI⁽³⁾,
Toshiyuki NAKASATO⁽⁴⁾, Ryoki TAKITA⁽⁵⁾, Tadaaki HONDA⁽³⁾, Kazuo SATO⁽³⁾

(1) Geo Planning Inc., Japan

E-mail: k9744@geo-pln.com

(2) Advanced Total Solutions Co., Ltd., (3) NPO Disaster Prevention and Mitigation Support Center,

(4)Geo-Techno Nakasato Industry Co., Ltd., (5) Sankyo technical engineer Co., Ltd.

Abstract

Sediment disasters and floods increase due to the frequent occurrence of the heavy rainfall recently. The measures with the structure such as the barrier preventing landslide were predominant over natural disaster once. However, the measures for evacuation are playing an important role for occurrence of the damage more than the assumption. The disaster prevention map is necessary for such a soft countermeasure. Particularly local detailed information is important to an evacuation plan.

The engineering geology can provide useful information for natural disasters. In other words, we are able to inform people about the factors of natural disaster such as topography and geology. We have technical knowledge of the natural disaster and studied the disaster for a long time. To integrate knowledge with experience is a positive shortcut to disaster prevention and mitigation. We find the essence of the natural hazards and must inform people about the risk. It is the first step to reconfirm an area with one's foot and eyes to convert the knowledge into an action. The disaster prevention map of the wide area has been distributed by the local government, of course. However, the people cannot obtain the local detailed information from this map. In Sendai, we supported making a disaster prevention maps in a neighborhood association, residents' association and an elementary school. Also we provided an evacuation route map to the welfare institution in Ishinomaki. The purpose of a local disaster prevention map is to save life of people and his family. Because many people make a personal map, local information is obtained in a variety point of view. We want to introduce some of case study. We hope that our practices help the action for mitigation of the natural disaster by the engineering geologists.

Keywords: natural disaster, disaster prevention map, neighbor association, elementary school

1. Introduction

Recently, the trend of large rainfall in a short period of time has increased (JMA, 2007). With this, the sediment disasters such as landslides and debris flow tend to increase. (the Ministry of Land, Infrastructure and Transportation, 2014a). Since the Tohoku region Pacific Ocean earthquake of March 11, 2011, aftershock activity has been continued. And earthquake has occurred in various parts of Japan. As is well known, the geological structure of the Japanese islands is complex, and many active faults are distributed (The Research

Group for Active Faults of Japan, 1991). Because less plains are suitable for residential, we forced to select coastal plain and alluvial fan or developed land for residential area. Where such conditions, it is necessary to know the regional characteristics and prepare to the natural disasters. In other words, there will be lurked natural hazards such as a liquefaction of soft sandy ground in the coastal plain, a debris flow in the alluvial fan and a differential settlement in a valley embankment of the developed land. In recent years, many houses have been built ignoring the terrain and ground conditions. Therefore, houses to suffer from an earthquake and a heavy rain increased. We explored how we could explain this information

to people as a specialist of the ground. If people will recognize accurately the information of the ground where they live in, it leads to disaster mitigation, and victim approaches zero. Aiming to this, we launched the NPO Disaster Prevention and Mitigation Support Center, and have been active.

For natural disasters, there are two mitigation methods. One is measures by construction, and the other is evacuation. Here, we think about how to escape by using the disaster prevention map. There is a disaster prevention map for various natural disasters. For example, flood prediction map, landslides hazard map and liquefaction prediction map shows the prone area. Local government creates a disaster prevention map of wide area. And it has been opened to the public (the Ministry of Land, Infrastructure and Transportation, 2014b). This map also provides information about the government agencies, hospitals, police, fire department and shelter, in addition to the hazard. Government agencies manage the administrative area across a wide area. Therefore hazard map for wide area is conveniently to grasp the whole city area. However, in the scene that local people actually use, it is difficult to obtain information on familiar hazards. In other words, the wide area disaster map are not described detailed information such as a flooding of heavy rainfall, a dangerous place on the earthquake and a temporarily evacuation area.

Geological engineers explored in the field and fill in the geological information to topographic map. Its accuracy is affected by a scale of topographic map. We can display clearly to everyone by charting information. This approach can be applied to make personal disaster prevention map (we call it My map), and it helps to grasp the display of familiar hazard. By using this technique, we describe the hazard for the individuals and our families, which can create a map to plan the temporary evacuation place. In the disaster prevention map to open to the public, it is necessary to consider the individual's privacy. The map you want to personally use to make personally these considerations is not required. In addition, hazards are each different due to such as adults and children, men and women, occupation, gender and ages. Disaster prevention map of individuals would be to re-confirm the safe of location you live with yourself and your family.

2. Methodology

We will introduce the order and method of manufacturing concrete map. We help the personal disaster prevention map (My map) making in three stages.

At the beginning of the three stages we aim to share basic knowledge and lecture for the motivation of map making. Because interesting in the region for

mapping is important, we explain geological history, underground structure, change of the land use and origin of the name of land to the participants. Furthermore, the lecture will address the vulnerability of natural disasters in the area, and explain the mechanism and characters of disaster. For this reason, we make a leaflet about the terrain, the ground and land use in the area. Then, we explain about the recent topic of natural disaster occurs in the area. Finally, in actual field work, participants survey the hazards at the natural disaster by using his imagination, and also survey a safe haven, for example, useful vacant land and shops after a disaster occurs. Through such work, the participants will discuss and exchange information each other. In a room, they compile the data of the investigation by a color, encoding and comments in a drawing. The compiling map is more understandable if photos are pasted on this map. Based on this map, they have a discussion of a variety of hazards, an evacuation route and a contact way to family. In addition, local information about the past affected areas and evacuation will be obtained by communicating to the people who have surveyed together. They present it in front of a participant as a result of contents and discussion of the map which they summarized. This is the extraction of a local problem and suggestion of the solutions. From this, it has led to the concrete measures in the neighborhood association.

We enumerate the three stages of the map making mentioned above as follows.

2.1 1st Lecture Contents

- A. Geology and historical natural hazards around the area especially earthquake
- B. Evolution and transition of geohazards in area
- C. The safe evacuation considering from terrain and a foundation
- D. How to make disaster prevention map (My Map)
- E. Question-and-answer session

2.2 2nd Fieldwork

- F. Explanation how to make My map
- G. Map making in the field (Survey)
- H. Organizing My Map
- I. Filling in the disaster record

2.3 3rd Organization and discussion on disaster prevention map

- J. Organization of map
- K. Discussion
- L. Presentation

Furthermore, if editing the My map of people, a hazard map of the area will be obtained. On the map, the hazards and evacuation spot from various viewpoints will be shown. Then, they can prepare to the improvements of a regional disaster by this map.

In this way, they will use a My map information as valuable local information. In addition, they are able to know more such as a disaster supporter required. However, it is necessary to adequate care for the protection of personal information. On obtaining safety information of vulnerable people, his understanding and the consensus of regional identity will be required.

People can understand detailed information of areas by making My Map (a hazard map of individuals). If there is such a foundation, they are able to understand better a warning and alarm, such as heavy rains and earthquakes. Furthermore, they will be able to good use on meteorological data like rainfalls, also they will be possible to evacuate speedy. Various disaster experiences are valuable, but it is forgotten over time. It is important that a person hands down an experience to prevent the weathering of the disaster experience. And it is first step of the prevention of weathering experience that the person who heard it imagines of a disaster. When the mapping, it is important to speak, listen to past experience. Former land use, modification of terrain, and origin of place names are valuable in understanding the features of a hazard on the region.

3. Case studies

In the following, we will introduce two cases of My map making. One is a map making in neighborhood association, the other is in elementary

school.

3.1 Case study 1 : Regional disaster prevention map making of neighborhood association

This case study was carried out over the June-July 2010 before occurrence of the Tohoku region Pacific Ocean earthquake of March 11, 2011. Therefore we aimed to making a map for earthquake into consideration mainly. The area is Sendai Wakabayashi Horyoduka-simo neighborhood association. Number of participants from the first times until the 3rd, was 20 people each time. Finally, by collecting personal map, make a disaster prevention map of the neighborhood association, were provided. Date and contents that people were carried out My map making is shown in Table 1.

Table 1 Date and Contents of Case 1

Stage	Date	Contents
No.1	June 6, 2010	Lecture ; Land and disaster
No.2	June 19, 2010	Field work ; Mapping of the region
No.3	July 3, 2010	Organization and discussion

We performed prior to field work and made a preliminary map, to collect regional information. In

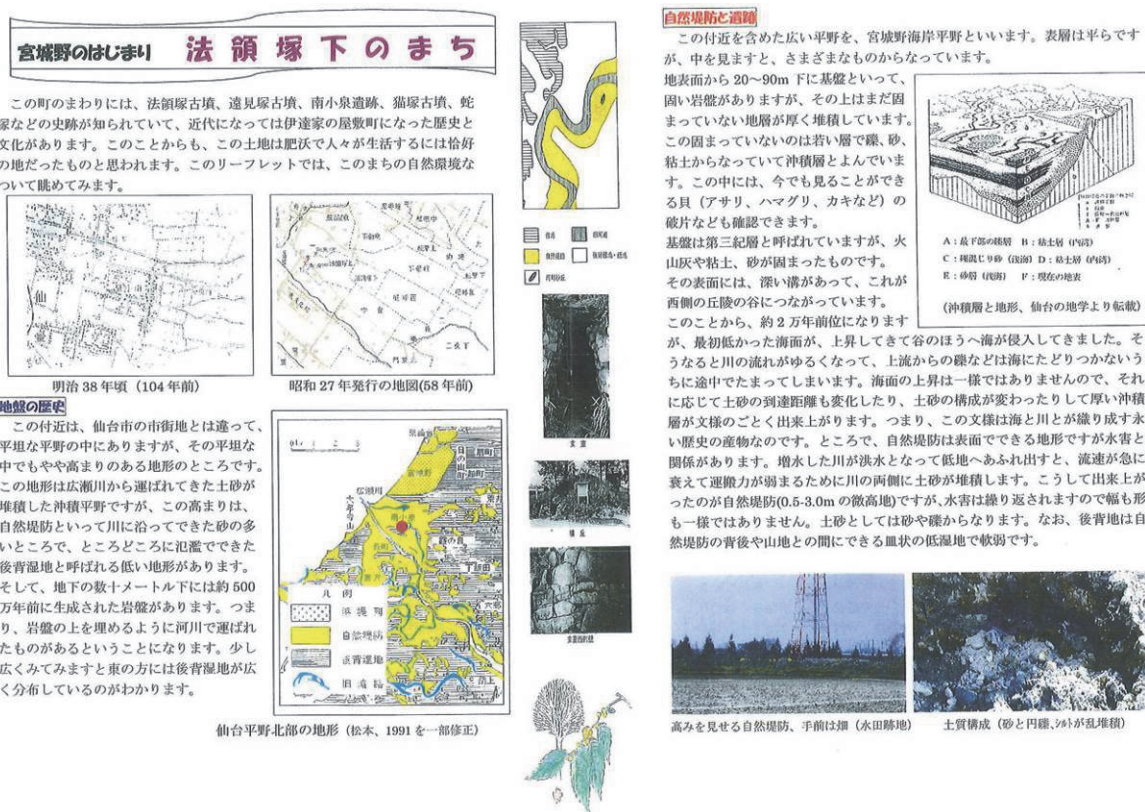


Fig. 1 The leaflet about the terrain and geology in the vicinity of the neighborhood association

addition, we collected the article of the topography and geology in the region to create a regional leaflet. And we made a regional leaflet and explained it in

3.1.1 1st Stage; Lecture in the neighborhood association hall

We had the first lectures in next program.

- 1) Earthquake mechanism; Foundation and earthquake disasters around Wakabayashi Ward Nakakura
- 2) Character of the region; Changes in urbanization and earthquake disaster in the vicinity of Wakabayashi Horyoduka-simo.
- 3) Damage and evacuation; Seismic intensity prediction and Sendai disaster prevention map
- 4) How to make My map (personal disaster prevention map); Map making and its effect



Photo. 1 Attendance scenery of the 1st Stage

3.1.2 2nd Stage; Field work

In the field work, we have configured the team with a combination of participant 4-5 people and NPO member 1-2 people. Since mapping along the road, there is a risk of traffic accidents. In addition, it is difficult enough survey by a large number of people at the same time. Because the group formation acts together until the third stage, it is an art to choose a leader.

Scope of field work is in the neighborhood association. The hazards have a regional characteristic. At the time of mapping, considering a disaster that may occur in the area, participants has to collect the information of the hazard, the safety and the useful for evacuation. Participants fill them on the map, record and further take pictures. Base map will use the urban planning map or residential map. If they do not have this map, it enough a schematic sketch map of roads and terrain. Since understood height of the ground, the base map drawing contour lines is valid in flooded areas. The drawings will be prepared two sheets, the one for fieldwork and the other for the fair copy. Hang

the first lectures. This leaflet was distributed to the participants to print on both sides of the A3 version.

of mapping is to clarity and color-coded observations. For example, the hazard is displayed in red, those that useful after a disaster are displayed in green. It's hard to remember just only color-coded map of the local information. For this reason, it should always be to fill by letters to the map. About result of the fieldwork on one day, we keep fair copy on the same day. Time goes by and we forget the information. Because it is My map for families, they are sufficient to fair copy which a family is able to understand. Ways of fair copy of the participants are the two. In other words, one is the performing by himself the other is combination of the large-format drawings in group work. The latter is one in which it was carried out in the neighborhood association that was introduced in this case. By this method, we perform fieldwork by a group consisting of several people and perform an organization together in a group. In this case, for various information gathering, oversight is reduced. Photo 2 shows the status of the field work of group.



Photo. 2 Fieldwork of 2nd Stage

3.1.3 3rd Stage; Organization of My map

We performed an organization of My map and a discussion of disaster prevention measures on the drawing of the large size in the group. The participation group of the neighborhood association was in charge of the north, center and south on the town each and completed a map. A large format drawing is obtained by expanding the drawings which are used in field work. And stretched the transparent sheet on the surface of the drawing, it was filled with a felt-tip pen and sticky notes. Hazard on earthquake such as utility poles with transformer and tiled roof were displayed by attaching a red color seal. After filing the drawing, based on the map, each team has discussed and presented the disaster prevention measures in the region.



Photo. 3 Presentation of a My map organizing

Finally, we edited these maps and made a disaster prevention map of the whole neighborhood association (see Fig.2). We let this map reflect the discussion result about local earthquake measures. Because of a narrow road in the region, we illustrated the figure which referred to road width and the passage of the vehicle at the time of the Great Hanshin-Awaji Earthquake in 1995. In addition, we provided a blank map to the back side of this disaster prevention map. This will be to make it available as a safe map of the school road in the future.

In this activity, we explained underground information and a change of the topography. On the contrary, participants gave local information to us. They told us a damaged situation of the area at the time of the 1978 Miyagi earthquake. People with the technical knowledge are usually suitable for the explanation of the invisible place. We thought that it might become the first step of mitigation that an expert told information to people directly.

By the questionnaire for the participant, we checked an impression made with a map. The questionnaire that we were able to collect was six of them. In this questionnaire, we obtained an answer in four items of very good, good, normal and poor from them. About a lecture of an earthquake and the ground, all the members answer it, "it is good to very good" to show it in fig.2.



Fig. 2 Impression of the lecture of foundation and earthquake

Impression of the fieldwork obtained 4 very good, and was almost well received illustrated in fig.3.

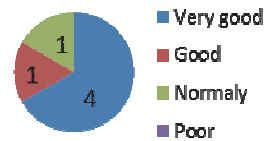


Fig. 3 Impression of the fieldwork

Impression of the finish of My map were variety. This might be an impression caused by a person who succeeded in the finish of my map and a person who cannot. We reflect that this should have had a little more careful explanation.

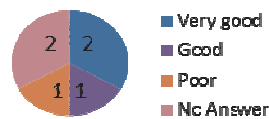


Fig. 4 Impression of the My map making

An impression of the free entry of the participant shows as follow;

- An instructor of professional engineer provided me an advice directly and gave a viewpoint of survey.
- Because a little of people in the neighborhood association participated, I regretted it very much. I thought that it was important that the people of the neighborhood association experienced such a lecture.

3.2 Case study 2: Making the disaster prevention map by the third grader of elementary school

This case study was carried out over the June-July 2013 after occurrence of the Tohoku region Pacific Ocean earthquake of March 11, 2011. Therefore we aimed to making a map not for earthquake but also for other natural hazards. We carried out this case from August 2013 to November. The participants were 87 students of the third grade in Sendai city elementary school. We carried it out at a part of composite learning. By the composite learning, they learned the local history, nature and citizen-based town planning through the year. Furthermore, they aimed at discovery of various problems in the area and at voluntary solution. This course, in the wake of the earthquake of March 11, was realized in the enthusiasm of a teacher who wanted to disaster prevention learning to students. On the theme of "Discovery in the usual place", they surveyed a school road once again at a point of the disaster prevention and thought about measures.

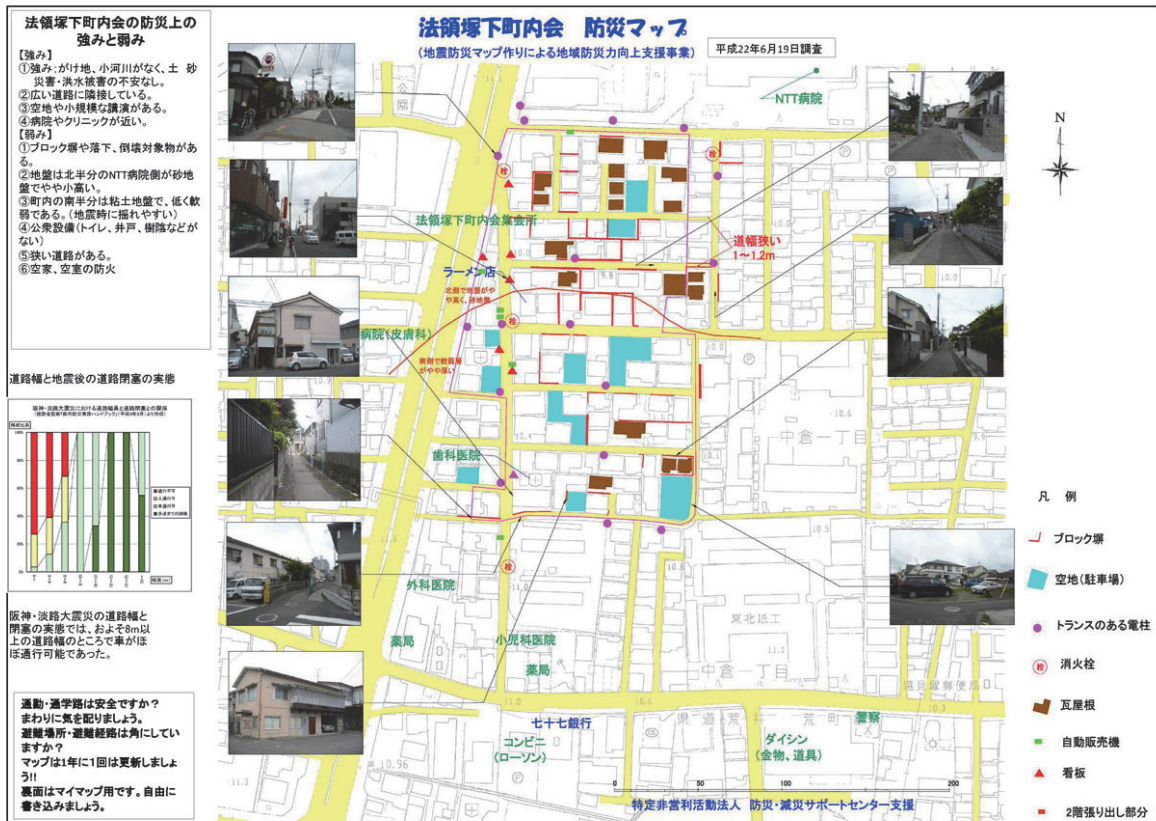


Fig. 5 Hazard map of Horyoduka-simo neighborhood association (compiled from personal map)

Finally, they presented it to a family and local people around the school. A course was 3 times, and the contents were lectures, field work and the organization of disaster prevention map. After this, students made a map under the guidance of teachers. In addition, they presented towards the parents and local residents of the school area about the content of this disaster prevention map. The contents of map making shows in table 2.

Table 2 Date and Contents of Case 2

Stage	Date	Contents
No.1	Nov. 11, 2013	Lecture ; Terrain and foundation around the school
No.2	Nov. 18, 2013	Field work; Discovery and mapping
No.3	Nov. 25, 2013	Organization of map and presentation

3.2.1 1st Stage ; Lesson in the class

In the first lesson, we talked about the topography and the foundation around the school to students. We let them do a drawing for coloring and understand relations of the geology and the topography. The elementary school was located in the alluvial plain near the Nanakita River. It was a flat place and was seemingly unrelated to the disaster. The student of the

third grade of the elementary school just learned a map for the first time, and there is a difference in degree of the understanding. Because we thought that learning by the manual labor was the most effective as for the concentration of the third grader, we offered a drawing for coloring to them and taught it. It was thought that the drawing for coloring becomes the good teaching materials letting the student of the lower grades understand the topographic and geologic relationship.

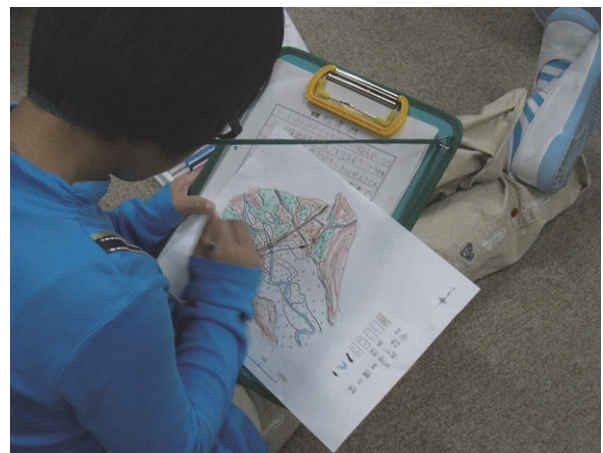


Photo. 4 Student drawing for coloring

In addition, we obtained the ground survey data of a school, to make and show them a simulated core of the foundation. We donated the core sample to school. Since we had explained the formation age of the Tertiary layer, It was thought that interest had been drawn to the age that did not use usually. Many students had an interest in simulated core.

3.2.2 2nd Stage ; Fieldwork

They performed field work of the second stage along school road. We surveyed it preliminarily and gathered this up and made the map for the leader. We decided to divide it into the twice in the afternoon and in the morning, and to perform it because a leader was short to let 87 students in 6 route make a field work at one sweep. We divided the whole into the group of 12-14. The cooperation of teachers and protectors was necessary for this. Students prepared a blank map for sketching and set up writing implements and performed a field work of around one hour. They were especially mapping the hazard of natural disaster. For example, block made of wall in the school route, old houses, utility poles (with a transformer), and large billboards and the like. In addition, those that useful in evacuation, for example a park, vacant lot, a convenience store, a sewage manhole had been mapped. While receiving a variety of questions from students in survey, we instructed them to recognize the familiar hazard. What are the hazards for me and family? Students initially had puzzled, but they had mapped hazards and useful matters from the next to the next. Although they just learned mapping, it seemed to be very well.



Photo. 5 Students in field work

3.2.3 3rd Stage; Map Organization and discussion

In the organization of the map, we had shown to students a hazard and a safety space of the school road. We provided a quiz by which a hazard and a safety space were easy to understand. After this, they organized map by filling data to a drawing in each group. By the rearranging of the map, they discussed

about encoding, the coloration and the comment of the phenomenon that they described in map. In organization of the map, a leader played a key role about the contents of the map. However, it was a little difficult for this drawing to make it plain to other people.



Photo. 6 Organizing of a map in team

After the organization of the map, the presentation by the student was two times. The first was presentation of the learning result for campus, and the second was a presentation of the free participation of a protector and local inhabitants. Of course, as for us, an observer participated in this presentation. In the disaster prevention map making that was carried out a comprehensive learning of third grade elementary, they knew danger and safety on the school route by using their own hands, legs and a head. And found problems in the event of a disaster, it was believed that it was a good training considers them how to solve this.



Photo. 7 Presentation in class room

4. Conclusions

In this paper we introduced two examples of My map making. The NPO activity starts as a social activity of the employment. Furthermore, not only the activities of disaster prevention and mitigation, we have served as a special lecturer of science education in elementary school. As for the making of my map, the visit lecture of the engineering geologists with the technical knowledge was the biggest characteristic. The member of us visited a neighborhood association and the residents' association and opened a course. It could be understood easily for geologist to obtain much information by fieldwork. If people really perform a town walk using this technique, much information will be provided. Furthermore, they will become easy to obtain information markedly if they perform a town walk after having known topography, geology, the history of a land and disasters. It would be certain that much more information is still provided if there are experience person of the disaster. Seeing is believing to say, it is hard to forget the information that we confirmed with our eyes, hands and foot. And the fieldwork is important above all because of the interchange between inhabitants while walking. The momentary judgment when we met with a hazard appears from an experience, and a judgment will be late without real experience.

The making of disaster prevention map is possible in third graders of elementary school. Through this work, consciousness about the disaster prevention is developed, and the student can give more information for a family. Furthermore, it is thought that they help improvement of the consciousness of disaster prevention and mitigation of the whole area by talking about the evacuation site. This process would be useful regardless of age, gender and with or without obstacle (more than it in third grade at an elementary school).

Because the person with the technical knowledge of the topography geology is limited, we expect the participation of the engineering geologist supporting activity of natural disaster prevention and mitigation.

Acknowledgements

The authors thank for neighborhood association of Sendai Wakabayashi Horyoduka-simo and teachers and protectors of Ichinazaka elementary school in Sendai who had cooperated in disaster prevention map making.

References

JMA (2007): CLIMATE CHANGE MONITORING REPORT2007 (on line) (cited 21 April 2015)

Available from

<URL:http://www.data.jma.go.jp/cpdinfo/monitor/2007/pdf/CCMR2007_chap1.pdf#page=24>

The Ministry of Land, Infrastructure and Transportation (2014a): Occurrence of sediment-related disasters in 2013 (on line) (cited 21 April 2015)

Available

from<http://www.mlit.go.jp/river/sabo/jirei/h25dosha/H25dosyasaigai_matome3.31.pdf>

The Research Group for Active Faults of Japan (1991): Active Faults in Japan, University of Tokyo Press

The Ministry of Land, Infrastructure and Transportation (2014b): Hazard map portal site (on line) (cited 21 April 2015)

<<http://disaportal.gsi.go.jp/>>