

Chapter 7

Improvement Practice and Planning Assessment of Tsunami Evacuation Plan at Community Level-Case Studies of Municipalities with Coastline in Chubu Region



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Abstract This study investigated the practice of plan formulation for Tsunami evacuation. This planning assessment is carried out based on questionnaire while collecting necessary planning materials from municipalities with coastline in Chubu region. From the planning materials including planning documents and drawings, we classify methods of plan-making in the municipalities. As a result, there are differences in crisis recognition between the municipalities located in the coastal zone of the Sea of Japan and those in the coastal zone of Pacific Ocean, which have great impacts on plan formulation. According to the questionnaire, there are more public participation activities where crisis recognition is high. From the view of methods of plan-making, the planning can be classified into three types as Planner type, Public Hearing type, and Public Participation type.

Keywords Tsunami evacuation · Community participation planning · Planning contents · Determination awareness

7.1 Introduction

As one of Tsunami disaster countermeasures, a Tsunami evacuation plan was developed in all municipalities in coastal regions of Japan (from now on, municipality evacuation plan). It was based on the Act on the Promotion of Tsunami Mitigations (June 24, 1948, Law no. 77) under Article 9, paragraph 2, for the preparation of the Tsunami that may affect the municipality. It was planned to establish essential

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activities of municipalities such as evacuation recommended area, evacuation instructions, and emergency evacuation place. Also, there are Tsunami Evacuation Plans at the community level (hereafter, community level evacuation plan) that were decided according to actual situations in the community so that residents can evacuate quickly and safely. Neighborhood association units, voluntary disaster prevention organization units, elementary school units, evacuation spot units, and assumed Tsunami-inundation units are separated as the community unit. When Tsunami occurs, residents must seek shelters for evacuation and for this situation the community level evacuation plan is essential and necessary.

The necessity for deciding community evacuation plan is described in the basic plan for disaster prevention (Central Disaster Management Council (2015)). Moreover, to support the making of the community-level evacuation plan, the national government has summarized manual reports on Tsunami Evacuation countermeasure from Examination Committee (hereafter, manual reports) (Fire and Disaster Management Agency (2013)). Furthermore, several prefectures also published guidelines for Tsunami evacuation plan to support developing a community-level evacuation plan and municipality evacuation plan. Also, from the manual report, a method for making community level evacuation plan was recommended by workshops with the participation of organizations, such as municipalities, volunteer disaster prevention organizations, neighborhood associations and so on (hereafter, local residents). Organization of the local residents was described in paragraph 2 of article 5 of The Basic Law for Disaster Mitigation (Act No. 223, November 15, 1967).

Until now, there are several existing types of research on community-level evacuation plan in literature. Abe et al. (2005) proposed a flowchart for describing a community-level evacuation plan based on discussion from the workshop. Ota et al. (2006) suggested a management system for making policy on a community-level evacuation plan based on cooperation between municipalities and residents. Yashiro et al. (2004) conducted a survey on examining whether or not community-level evacuation plan was determined in all municipalities in Japan and proposed a flowchart of a community level evacuation plan for a chosen case study. Moreover, Nomura et al. (2013) determined community-level evacuation plan by workshops, organized survey data on residents' low recognition about their community and proposed a method for disaster prevention planning and disaster prevention education. Terumoto (2012) clarified the problems of Tsunami evacuation at the community-level by conducting a Tsunami evacuation drill. However, the above researchers only considered few municipalities as case studies or examined whether or not community-level evacuation plan was determined in all municipalities. Different from previous studies, this study clarifies what should be stated in the evacuation plan. Moreover, this study also clarifies factors affecting high enrichment of determination methods by evaluating enrichment of community-level evacuation plan's content based on determination methods and items for consideration derived from workshops.

To ask residents to take appropriate evacuation action during Tsunami, the contents which affect evacuation behaviors from start of evacuation to shelters should be described in the community level evacuation plan. Then, establishing a method

for evacuation through evacuation drills is essential. Also, the contents which described in community-level evacuation plan could be confirmed by national guideline and guidelines for Tsunami evacuation plan published by prefectures and local disaster management plan (hereafter, guidelines). However, because now the enrichment of plan contents is delegated by determined objects, it is a matter that various factors affect the enrichment of plan contents. For each factor, there is a determination method and residents' participation situation is also considered influencing the enrichment of planning contents. Determination method is also delegated by determined objects. The determination method which is different according to residents' participation situation could be expected in three ways as follows. A determination method based on meetings held in municipalities (hereafter, Planner type). A determination method for confirming draft of planning contents determined by Planner via field work, public comments, and hearing from residents (hereafter, Public Hearing type). A determination method based on the residents' participation in workshops (hereafter, Public Participation type). Moreover, determination method is characterized by determination unit such as neighborhood association, primary school district and so on.

In the case of determination method based on Public Participation type, consideration items will be related to the conference for confirming evacuation method and so on, and related to the field in case of confirming dangerous spots by field works. These consideration items affect enrichment of the plan contents. Determination method and consideration items in Public Participation type have influences on determination awareness of community-level evacuation plan (hereafter, determination awareness) for residents and Tsunami damage estimation. As a future Tsunami disaster countermeasure, the necessity of community-level evacuation plan's determination is higher. Moreover, there is also a problem in the determination of community-level evacuation plan from previous studies.

This study firstly aims at clarifying the actual situation of the community level evacuation plan. Then, to obtain knowledge for improving enrichment of the plan contents, the study also clarifies the way for developing determination method, evaluates enrichment of the plan contents from determination method, and confirms the contents which should be described in the community level evacuation plan. In this study, we can show one factor which has high enrichment of community level evacuation plan when municipalities determine or revise community-level evacuation plan.

7.2 Method

First, we clarify the actual situation of community-level evacuation plan by knowing determination situation and problems in determination. In this study, we conduct questionnaire to know actual situation and method of determination on municipalities of the prefectures (Fukui, Ishikawa, Toyama, Niigata, Shizuoka, Aichi, Mie) with coastline in Chubu region.

Next, we obtain knowledge improvement of the plan contents' enrichment. Specifically, we confirm contents to be described in community-level evacuation plan from guidelines which have a strong association with community level evacuation plan in the prefectures of Chubu region. We did type classification from determination method in the questionnaire survey. The actual situation of the determination method of community-level evacuation plan is clarified by the types. Later, we evaluated enrichment of plan contents by the types to clarify determination method. Next, to clarify a factor as determination method of high enrichment, we analyze the relationship between assumption damage of Tsunami and determination method or determination awareness. Moreover, to clarify contents items, we focus on Public Participation type. We classify groups as to contents items "field" and "meeting". We evaluate enrichment of community-level evacuation plan by the types. Later, to clarify the factor of high enrichment type, we analyze the relationship between the groups and damage assumption of Tsunami or determination awareness of the local residents.

7.3 Outline of Research Area and Questionnaire Survey

The area of interest in this study is shown in Fig. 7.1. Many municipalities on the Pacific Ocean side are in and around the assumed epicenter of the Nankai Trough huge earthquake. In the Earthquake Research and Promotion Headquarters, it was calculated 60–70% that chance of an earthquake of M8-9 in Nankai Trough would occur within 30 years from 2013. However, as shown in Fig. 7.1, the frequency of the maximum class earthquakes of Nankai Trough is considered to be lower than one digit rate compared to a massive earthquake that occurs over a period of 100–200 years (Earthquake Research and Promotion Headquarters (2013)).

A questionnaire survey was conducted in May 2015 for determination situation and determination method of community-level evacuation, consideration items, and organizations involved in Public Participation type. The outline of questionnaire survey is shown in Table 7.1.

The reason why questionnaire survey was conducted in May 2015 is following. The Great East Japan Earthquake occurred in March 2011. The manual report related to it developed 2 years later in March 2013. It was considered to influence the determination of community-level evacuation plan, enrichment of the plan contents and publication of the guidelines. The questionnaire survey is conducted for official recognition of community-level evacuation plan as a municipality. The survey method was based on a questionnaire to the disaster prevention division of target municipality. For results of the questionnaire survey, 105 copies were mailed and 95 copies were collected by mailed or email (Table 7.2). The questionnaire collection rate was 90.5%. As community level evacuation plan differs in consciousness depending on the community, we consider that the plan contents differ by the



Fig. 7.1 Relationship between the prefectures in Chubu region and epicenter of the Nankai Trough earthquake area

Table 7.1 Outline of questionnaire survey

Method of survey	Mailing answer, E-mail answer
Distribution regions	Fukui, Ishikawa, Toyama, Niigata, Shizuoka, Aichi, Mie
Term of survey	2015.5.11–2015.6.3
Content of survey	<ol style="list-style-type: none"> 1. Determination situation of evacuation plan at community level 2. Reason for not determining evacuation plan at community level (free answer) 3. Determination method and determination subject of evacuation plan at community level 4. Community unit to determine evacuation plan at community level 5. Considerations items and participating subject in Participation type 6. Evacuation drill situation based on evacuation plan at community level 7. Provision request for evacuation plan at community level

Table 7.2 Results of questionnaire survey

Prefecture	Number of responses/distribution number	Collection rate (%)	Uncollected	Rejection
Fukui	9/11	81.8	2	0
Ishikawa	15/16	93.8	1	0
Toyama	9/9	100	0	0
Niigata	13/13	100	0	0
Shizuoka	17/21	81.0	3	1
Aichi	15/17	88.2	0	2
Mie	17/18	94.4	1	0
Total	95/105	90.5	7	3

Table 7.3 Determination situation of community-level evacuation plan

	Number of responses (%)
Determined in all or specific communities	38 (41.8)
Being determined in all or specific communities	10 (11.0)
Planned to be determined in all or specific areas	21 (23.1)
Not determined and no plans	22 (24.2)
Total	91 (100.0)

community. Therefore, in the questionnaire survey, we requested community level evacuation plan for one community with the highest enrichment of plan contents and evaluated it.

7.4 Actual Situation and Problems in Community Level Evacuation Plan

In this chapter, actual situation and problems in community-level evacuation plan are clarified. From the results of a questionnaire survey, the actual situation of determination is summarized in Table 7.3. Four replies do not fall within the scope of a community-level evacuation plan for this study, so they were excluded. The ratio of “determined in all or specific communities” and “being determined in all or specific communities” are 52.8%. More than half of municipalities have determined. However, the ratio of determination is still low. We consider it is necessary to increase the ratio of determination in preparation for future Tsunami.

Next, we clarify problems of determination. Table 7.4 is summarized the reason why community level evacuation plan is not determined. The questionnaire survey was a free response, and similar answers are aggregated into groups. Regarding

Table 7.4 Reason for not determining community level evacuation plan

	Number of responses (%)
Not in a tsunami-inundation area	5 (12.5)
Respond to another plan	6 (15.0)
Earthquake assumptions in countries and prefectures differ	2 (5.0)
Low awareness of local people	3 (7.5)
Unification of municipal evacuation plans due to geographical factors	2 (5.0)
Municipal evacuation plan recently determined	3 (7.5)
Plan to determine it in the future	
Planned to determine it in the future	9 (22.5)
Other	10 (25.0)
Total	40 (100.0)

Tsunami-inundation area, it was described in Act on the Development of Tsunami Disaster Mitigation Area (December 14, 2011, Act no. 123), the provisions of article 8, paragraph 1.

There were answers “planned to be determined in a current fiscal year”, “planned to be determined in municipal evacuation plan recently”, and “budget, due to a shortage of department personnel but planned for the current fiscal year”. These answers were grouped into “plan to determine it in the future”. Examples of “other” were “shortage of employees”, “having priority jobs”, and “do not need to determine Tsunami evacuation plan because it has been discussed at the regular meeting of the neighborhood association”. There were three municipalities on the Sea of Japan side that did not respond. The highest ratio except “other” was “planned to be determined it in the future”. The result shows that municipalities were highly motivated to determine community-level evacuation plan.

7.5 Contents from Guideline to Be Described in Evacuation Plan

7.5.1 Targeted Guidelines

In this section, the guidelines are extracted to confirm the contents that should be described in the community level evacuation plan. The guideline of the prefecture is still not established sufficiently. We consider that some prefectures do not establish the guideline to support the determination of community-level evacuation plan. Therefore, to confirm the guidelines, we extract the guidelines which are closely related as shown in the flowchart of Fig. 7.2. As some prefectures do not publish guidelines of community-level evacuation plan yet, we consider that this method is the most appropriate for extracting the guidelines to confirm the contents to be described in the community level evacuation plan.

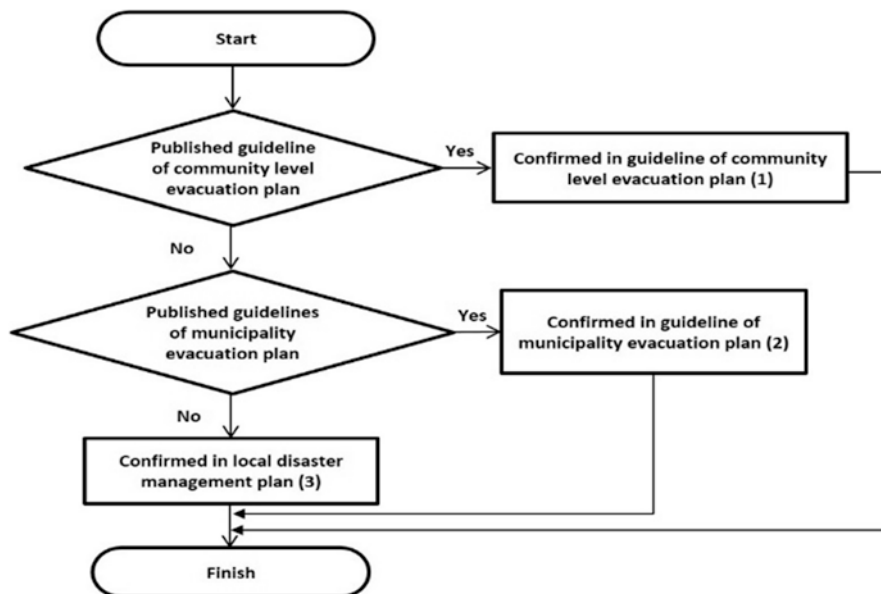


Fig. 7.2 Extraction of targeted guideline

From Table 7.5, the following guidelines are applicable in seven prefectures with coastlines in the Chubu region. The contents to be described in community level evacuation plan are confirmed from the guidelines in Table 7.5. The guidelines are published on the homepage. If it is not published yet, it is obtained by inquiring to prefecture employee.

1. Guidelines for determination of community-level evacuation plan: applicable in Mie prefecture. This guideline is characterized that residents determine an evacuation plan at the community level by themselves. The process is to lead determination of Tsunami evacuation plan at community level based on Participation type. In Mie prefecture, municipalities showed hazard map and evacuation spot to residents and conducted Tsunami evacuation drills. Mie Prefecture considered that this method is insufficient in understanding each person. Based on characteristics of the area where the arrival time of Tsunami varies from place to place, each resident is considered as a method for evacuating Tsunami. It is the guideline that its contents are summarized.
2. Guidelines for determination of municipality evacuation plan: applicable in Niigata prefecture, Shizuoka prefecture, and Aichi prefecture. Aichi prefecture included some guideline for a community level evacuation plan, but the purpose of the guideline is to support the determination of municipality evacuation plan.
3. Disaster management plan: applicable in Fukui prefecture, Ishikawa prefecture, and Toyama prefecture. Ishikawa prefecture has determined the guidelines for damage from the nuclear power plant, and it is not covered in this research.

Table 7.5 Guidelines to be covered, contents to be stated and reasons for selection

Region	Sea of Japan side			Pacific ocean side			
	Fukui	Ishikawa	Toyama	Niigata	Shizuoka	Aichi	Mie
Guidelines for determining CEP	☒	×	×	×	×	×	○
Guidelines for determining MEP	×	×	×	○	○	○	-
Guidelines to be covered	LDMP			Guidelines for determining MEP			Guidelines for determining CEP
Title of guideline	LDMP –Earth-quake disaster countermeasures	LDMP – Tsunami disaster countermeasures	LDMP – earthquake and tsunami disaster counter measures	Guidelines for Determining MEP in Niigata	Large-scale Earthquake Counter-measure (Guidelines of Evacuation plan determination)	Guidelines for determining MEP in Aichi	Guidelines for Tsunami Evacuation Planning at community

(continued)

Table 7.5 (continued)

Determination or revised date (final)	2015.3	2015.5	2015.6	2014.7	2013.9	2015.2	2013.9	Reason of selection
Determination with public participation type	△	△	×	×	×	○	○	
Evacuation route	○	○	○	○	○	○	○	Necessary for knowing the route that can be used to evacuate safely in a short time to the evacuation spot
Dangerous zone	○	○	○	○	○	○	×	Necessary for knowing landslides and soil liquidation area at the time of the earthquake
Dangerous spot	×	×	×	×	×	×	○	Necessary for knowing facilities that may be overturned or collapsed when an earthquake occurs

Evacuation recommended area	△	△	×	○	○	○	×	○	It is one standard for evacuation of residents
Evacuation method	○	○	○	○	○	△	○	○	Evacuation ratio improves by checking evacuation method
Evacuation bag	△	○	△	×	×	×	○	○	It is preparation for evacuees, prepare for disasters
Information acquisition method	○	○	○	○	○	○	×	×	Necessary for obtaining accurate information
Evacuation drill method	○	○	○	○	○	×	○	○	Evacuation behavior is established for residents

(□1) “○” if it is maintained as a guideline; “×” if it is not
 (□2) “○” if there is description of the flow, specific method and so on;
 “△” if there is only the term listed; “×” if there is no description.
 CEP: Community-level Evacuation Plan
 MEP: Municipality Evacuation Plan
 LDMP: Local Disaster Management Plan

Mie is the only prefecture that is published a guideline of the community-level evacuation plan, and its improvement is a future issue.

7.5.2 Contents to Be Described in the Community Level Evacuation Plan and Situation of Each Prefecture

Based on guidelines extracted in the previous section, contents to be described in evacuation plan at the community level are confirmed by a questionnaire survey, manual reports and guidelines. Contents described in the manual report are extracted first as the contents which should be described in the community level evacuation plan. After that, one or more descriptions are extracted from the guidelines of seven prefectures. It is related to the content mentioned above, and those with 10 or more applicable in community-level evacuation plan by questionnaire survey are extracted. As a result, the contents to be described in community-level evacuation plan are evacuation route, evacuation bag, dangerous zone, dangerous spot, evacuation recommended area, evacuation method, and information acquisition method. Table 7.5 shows the situation of each prefecture. Also, as the evacuation plan at the community level is not finalized upon the determination, the evacuation drill method is necessary as well. Confirmation of the contents to be described in community-level evacuation plan is conducted only by the guideline of the target. The Tsunami-inundation area, evacuation shelter, and evacuation spots are not included in this study because it is a clear description in the community level evacuation plan.

From the following, situation of each prefecture from the guideline in Table 7.5 will be described. For evacuation route, explanation of designation evacuation route is seen in all prefectures. In the case of a Tsunami evacuation, designation of evacuation routes is important and become the most essential content on evacuation. Therefore, it is considered that the description of designation route is important as indicated in each prefecture. Dangerous zone is described as evacuation spot and evacuation route which is avoided. It is seen in all prefectures except Mie. It is considered that dangerous zone is described in some prefectures because it has a significant influence on evacuation action of residents at Tsunami disaster. The dangerous spot is explained only in Mie prefecture. It is considered that dangerous spot is described based on Participation type because it may include resident owned facilities and need to obtain the consent of the local resident. Evacuation recommended area is described in Niigata Prefecture, Shizuoka Prefecture, and Aichi Prefecture. Evacuation recommended area is considered to be a standard for the municipality under evacuation advisory and an evacuation order for the evacuation of residents. So, the designation in the prefecture where guideline of municipality evacuation plan published is considered important. Evacuation method is described in all prefectures except Shizuoka. It is considered important for each prefecture because in Great East Japan Earthquake the evacuation of evacuees by automobile was obstructed evacuees on foot. Evacuation bag is described in Mie Prefecture and Ishikawa Prefecture. Since detail of evacuation bag differs from the community, it is considered that a few

prefectures are described from the viewpoint of local residents in Public Participation type. Information acquisition method is described in all prefectures except Shizuoka and Mie. From the viewpoint of the importance of obtaining information in Tsunami evacuation, it is considered that the description is seen in some prefectures. Evacuation drill method is described in all prefectures except Shizuoka.

7.5.3 Detail of Contents to Be Described in the Community-Level Evacuation Plan

In the previous section, contents to be described in evacuation plan at community level from the guidelines is confirmed. This section confirms detail of contents to be described in the community-level evacuation plan. Detail of contents to be described in community level evacuation plan is shown in Figs. 7.3, 7.4, and 7.5. Although Nagaoka city and Joetsu city do not describe all the contents of prefecture guidelines, all the contents except executability in evacuation drills can be confirmed in these two cities and detail of contents are satisfied.

The evacuation route indicates cases of “evacuation route” and “evacuation direction only” considering that residents will evacuate as shown in Fig. 7.3. The

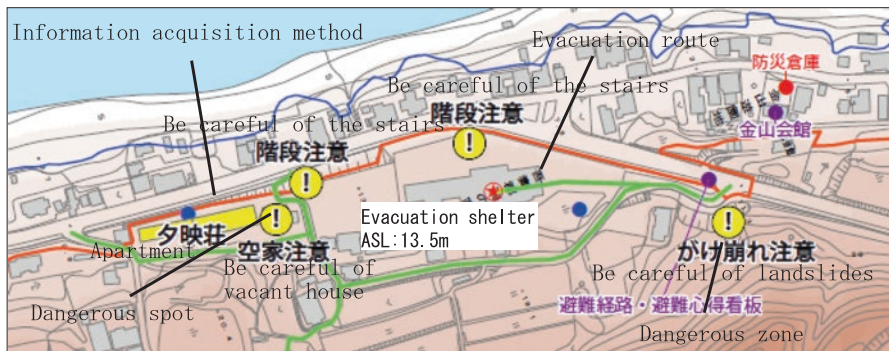


Fig. 7.3 Description of evacuation routes, dangerous zones, dangerous spot, and evacuation recommended areas. (Nagaoka City Tsunami Hazard Map)

(4) 避難の方法・避難先	(4) Evacuation method, contact address
1 原則として徒歩で避難します。	1 In general, evacuate on foot
2 原則として個々で避難しますが、可能な限り近隣に声を掛けて避難します。	2 In general, to evacuate individually, evacuate to inform as possible as the neighborhood
3 原則として、町内または地域ごとにあらかじめ定められた指定緊急避難場所・指定避難所に向かいます。	3 In general, evacuate to emergency evacuation spot, evacuation center in community

Fig. 7.4 Description of evacuation method and contact address. (Community level evacuation plan in Joetsu City)

more detailed evacuation route describes the contents detail. For dangerous zone, an earthquake occurs first in Tsunami disaster. Due to the earthquake, landslide could occur, and the possibility of broken down the evacuation route is considered. Therefore, detail of contents is a description of the area where there is a risk of sudden slope collapse or landslide as shown in Fig. 7.3. The dangerous spot is public facilities such as bridges, tunnels, underpasses, privately-owned facilities such as utility poles and block walls which are the possibility of collapse, vacant houses and so on. When an earthquake occurs, there is the possibility of collapse utility poles and block walls. Therefore, detail of the contents is described including privately-owned facilities as shown in Fig. 7.3.

The contents of evacuation recommended area are those indicated by height above sea level as shown in Fig. 7.3. Evacuation method is considered for healthy individuals and people in need of assistance during Tsunami disaster. Since the evacuation method of person who needs support is thought to be different depending on the type of support, it is necessary to consider in each. The evacuation method of majority healthy individuals is shown in Fig. 7.4. Contents of evacuation bag are a description of specific goods to respond the emergency as shown in Fig. 7.5. As for information acquisition method, detail of contents is considered to differ depending on the community. Specific information such as television, disaster prevention administrative radio, and public relations car are described in the method as shown in Fig. 7.6. As the effectiveness of the plan in evacuation drill needs the participation of many residents,

<p>(3) 避難時に持ち出すものや装備・服装</p> <p>1 動きやすく、安全な装備・服装 軍手、スニーカー、雨具、ヘルメット 上着・セーター 等</p> <p>2 非常用持ち出し袋の中身 非常食、懐中電灯、携帯ラジオ、ライター、持病の薬 等</p> <p>3 貴重品や日用品 財布、携帯電話 等</p>	<p>(3) Items to bring out when disaster occurs, equipment, clothing</p> <p>1 Easy to move, safe equipment, clothes Gloves, sneakers, rain gear, helmet, sweater, etc</p> <p>2 Contents of evacuation bag Emergency food, flashlight, portable radio, lighter, medicine for chronic illness, etc</p> <p>3 Valuables and daily necessities Wallet, mobile phone, etc</p>
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Fig. 7.5 Description of evacuation bag. (Community level evacuation plan in Joetsu City)

<p>(2) 津波に関する情報の入手方法</p> <p>1 防災行政無線 地震・津波の情報のほか、市から避難の情報をお伝えします。</p> <p>2 携帯電話・スマートフォン 市域内にいる方には緊急速報「エリアメール」・緊急速報メールで地震・津波の情報や避難の情報をお伝えします。また、上越市安全メール登録者には、上越市からメールで津波の情報などをお伝えします。</p> <p>3 新井町町内会からお知らせ 町内会で、拡声器を使用して、災害の状況を周知します。</p>	<p>(2) Information acquisition method on Tsunami</p> <p>1 Disaster management radio communication system Earthquake and Tsunami warning are informed, and there is evacuation information from municipality</p> <p>2 Mobile phone, smartphone People in the city is informed about Tsunami and evacuation by earthquake early warning e-mail. Joetsu city also informs about the Tsunami by email for safety mail registrant</p> <p>3 Information from neighborhood association Neighborhood association informs the situation of disaster by loudspeaker</p>
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Fig. 7.6 Description of information acquisition method. (Community level evacuation plan in Joetsu City)

detail of contents for participation in evacuation drill is to drill all residents who participated in evacuation drill based on a community level evacuation plan.

7.6 Actual Situation and Evaluation of the Plan Contents Enrichment

In Sect. 7.5 we confirmed the contents to be described in community-level evacuation plan (hereafter, plan). From the results of a questionnaire survey, it is possible to categorize the determination method presumed in Sect. 7.1 like Planner type, Public Hearing type, and Public Participation type. In this chapter, we evaluate the actual condition of determination method, the enrichment of plan contents by type, and clarify the determination method. Then, to clarify the factors that have high enrichment to the plan contents, we analyzed the relationship between assumption damage of Tsunami, determination method and consciousness of local residents.

7.6.1 Actual Situation of the Plan Determination Method by Types

Based on questionnaire survey's results, Table 7.6 shows a summary of the plan determination method by type. From Table 7.6, Public Participation type is the highest result of 54.2%, and it shows that the consciousness of local residents was high. It is considered that the consciousness of local residents in the Tsunami has been grown due to the Great East Japan Earthquake. The ratio of Planner type is tended to be higher than Public Hearing type. In next section, we evaluate enrichment of plan contents by types and clarify the determination method of the plan.

7.6.2 Contents to Be Described and Evaluation of Plan Contents Enrichment by Types

In this section, we analyze each content to be described in the plan and then evaluate enrichment of the plan contents by types. An evaluation index is the contents to be described in the plan, and the contents detail ratio confirmed in Sect. 7.5.

Table 7.6 How to determine the plan by type

Type	Number of responses (%)
Planner	12 (25.0)
Public hearing	10 (20.8)
Public participation	26 (54.2)
Total	48 (100.0)

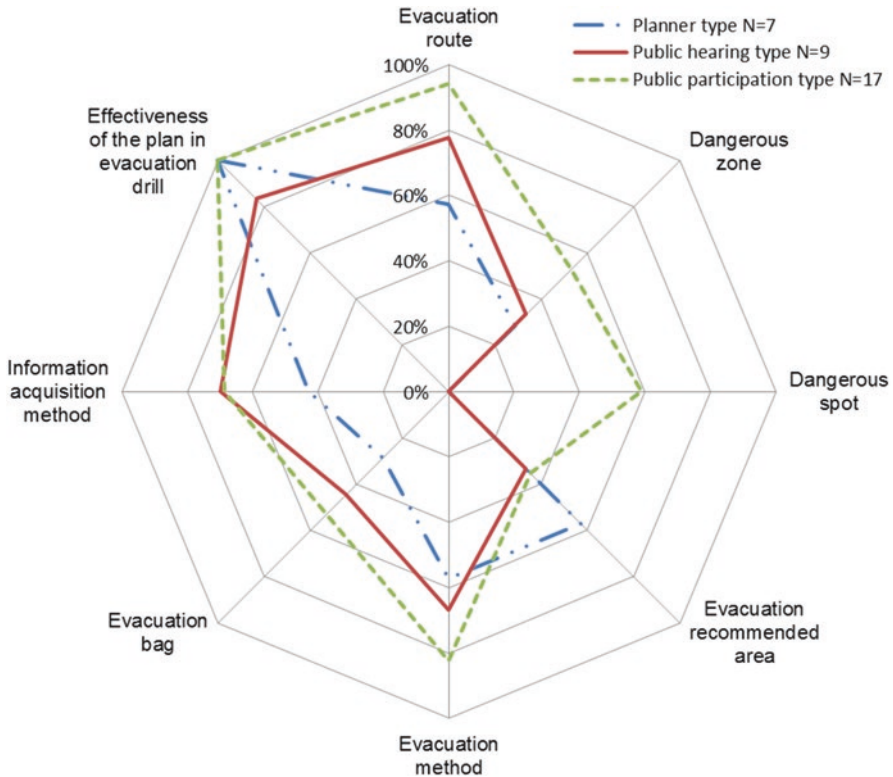


Fig. 7.7 Ratio of planned content by type

The enrichment evaluation was done only on the content described in the plan, which was provided in the questionnaire survey. We received the plan to be determined in the questionnaire survey. As it was being determined, there was no evacuation drill based on the plan yet, and effectiveness of the plan in evacuation drill cannot be evaluated. The description of evacuation bag and evacuation method were not described at the time of receiving the questionnaire. Since there were cases planned in the future, it is necessary to pay attention to the point.

We classified the plan from the questionnaire survey. Planner type has been used in seven municipalities, Public Hearing type in nine municipalities, and Public Participation type in 17 municipalities. Figure 7.7 shows the ratio of each plan content. Enrichment of the plan is the size and overall balance properties of radar chart area. The calculating method of description ratio is the proportion of what was described in the plan for each population type.

1. Analysis of the contents ratio to be described in the plan

- Evacuation routes

The ratio of description was higher in the order of Public Participation type, Public Hearing type, and Planner type. When evacuation routes were designated,

Table 7.7 Group name of participant in public participation type (N = 17)

Group name	Municipality employee	Prefecture employee	Learning experienced person	Disaster prevention expert	Disaster prevention leader	Neighborhood association	Voluntary disaster prevention organization
Ratio	100%	11.8%	11.8%	17.6%	17.6%	94.1%	100%
Group name	Voluntary fire employee	Elementary and high school	Elderly association	Social worker	Social welfare corporation	Other residents	
Ratio	17.6%	5.9%	11.8%	23.5%	11.8%	17.6%	

designation other than the main road such as roads managed by neighborhood association was necessary, especially when considering evacuation from houses. It is considered that evacuation routes are not able to know the road managed by neighborhood association only. Indeed, many of evacuation routes described in Planner were only main roads. Therefore, it is necessary to designate evacuation route based on opinions of local residents who most understand the community.

- Dangerous zones and dangerous spot

Description of the dangerous spot is only in Public Participation type. Contents that needs the most adjustment when determining the plan as the dangerous spot was related to privately owned facilities. As shown in Table 7.7, when the dangerous spot is described in community-level evacuation plan by Public Participation type, it can get the consent of local residents like neighborhood association and voluntary disaster prevention organization. Dangerous zone is the same as a dangerous spot for the participation of local residents. Landslide area related to private land is considered to have the consent of the community.

- Evacuation recommended area

The ratio of Planner type is the highest while Public Participation type and Public Hearing type is almost the same. Evacuation recommended area was determined only by the municipality and considered that it was emphasized in Planner type. Also, Public Hearing type and Public Participation type were not emphasized. As a factor of this, Public Participation type and Public Hearing type have a high proportion of determination by neighborhood association as shown in Table 7.8. Since Planner type was determined in a wide area such as multiple neighborhood associations, Public Participation type, and Public Hearing type were considered for the entire area rather than a specific evacuation by the community.

- Evacuation method

The ratio of description was higher in the order of Public Participation type, Public Hearing type, and Planner type. As a factor, the evacuation method on foot was the main principle. However, the content that needs to be decided on a community basis, such as a method of calling to the neighborhood, was decided by local residents in the discussion of the neighborhood association. Therefore, as shown in Table 7.8, it was considered that proportion of the plan was high in Public

Table 7.8 The plan determination unit

Determination unit	Neighborhood association	Elementary school	Multiple neighborhood association	Evacuation spot	Inundation area	Response number (%)
planner type	0 (0.0)	2 (28.8)	4 (57.1)	1 (14.3)	0 (0.0)	7 (100)
Public hearing type	5 (55.6)	0 (0.0)	3 (33.3)	0 (0.0)	1 (11.1)	9 (100)
Public participation type	15 (88.2)	0 (0.0)	1 (5.9)	0 (0.0)	1 (5.9)	17 (100)
Total	20 (60.6)	2 (6.1)	8 (24.2)	1 (3.0)	2 (6.1)	33 (100)

Participation type and Public Hearing type with a high ratio of determination by neighborhood association unit.

- Evacuation bag

Description ratio was higher in the order of Public Participation type, Public Hearing type, Planner type, and description ratio of the plan content was lower overall. As shown in Table 7.8, Public Participation type and Public Hearing type have high determination ratio of neighborhood association unit. Planner type is considered to describe general contents indicated in hazard map or the like which was not the plan.

- Information acquisition method

Public Hearing type and Public Participation type had a high description ratio. As a factor, in some cases municipality requests the local residents to inform public relations car to communicate with a loudspeaker or the like in the community when a disaster occurs. Therefore as shown in Table 7.8, Public Participation type and Public Hearing type had a high determination ratio in neighborhood association unit. Information acquisition method was considered to be described by obtaining the consent of neighborhood association.

- Effectiveness of the plan in an evacuation drill

Planner type and Public Participation type description ratio were 100%. It was an opinion that Public Hearing type was only conducted in some communities as the test. It was found that the effectiveness of the plan in evacuation drill was high in all types.

2. Evaluation of the enrichment of plan contents by types

- Planner type

Evacuation routes, evacuation recommended areas, evacuation methods, and effectiveness of the plan in evacuation drill tended to a high description ratio. On the other hand, description ratio of dangerous zones, dangerous spot, evacuation bag, and information acquisition methods were low. Enrichment of the plan contents tended to be different depending on the contents. Municipalities determined the Planner type. Therefore, the plan contents only specified by municipalities and

contents related to the establishment of evacuation behavior had high description ratio. However, the plan contents that needs to be confirmed and considered at the meeting were low in the description ratio. Enrichment of the plan contents was low and unbalanced overall.

- Public Hearing type

Description ratio of evacuation route, evacuation method, information acquisition method and effectiveness of the plan in evacuation drill were high. Evacuation route and information acquisition method tended to be high when compared with Planner type. On the other hand, description ratio of evacuation bag was about half and description ratio dangerous zone, dangerous point and evacuation recommended area tended to be low. As for Planner type, the plan contents which need to be confirmed by field work and considered at the meeting tended to be low. Enrichment of the plan content was higher than Planner type, and the overall balance was slightly better.

- Public Participation type

The overall balance was a good trend with high description ratio of all contents except for evacuation recommended area. It is considered in Public Participation type that the high enrichment of the plan contents has been determined because participation of local residents and description ratio of considering many items was confirmed in the field walk and meetings. In the evaluation of plan contents enrichment by type of determination method, the most enrichment and a good overall balance were by Public Participation type. Public Hearing type and Planner type were in the next turn. As the tendency, if participation of local residents increased, the enrichment of the plan contents will be better.

In this study, we received the plan determined by the municipality and the plan determined only by local residents such as voluntary disaster prevention organization. Enrichment of the plan contents determined only by local residents was low. In general, it was considered that municipalities know the contents to be described in the plan. However, since the local residents have the most knowledge in the community and there were many contents that cannot only be understood by municipalities, it is important that municipalities and local resident cooperate in the determination of the plan.

7.6.3 Factors for Public Participation Type

In the previous section, we analyzed the contents to be described in the plan and enrichment of the plan contents. We found that the one with the highest level of enrichment was Public Participation type. In this section, we analyzed the relationship between the Tsunami damage estimation with determination method and the consciousness of local residents with Tsunami damage estimation. It was done to understand one of the factors to be the Public Participation type.

Table 7.9 Relation between determination method and Tsunami height

Number of responses (%)				
Tsunami height (×)	$1 \text{ m} \leq \times < 5 \text{ m}$	$5 \text{ m} \leq \times < 10 \text{ m}$	$\times \geq 10 \text{ m}$	Total
Planner type	3 (42.9%)	2 (28.6%)	2 (28.6%)	7 (100%)
Public hearing type	3 (33.3%)	5 (55.6%)	1 (11.1%)	9 (100%)
Public participation type	2 (11.8%)	10 (58.8%)	5 (29.4%)	17 (100%)
Total	8 (24.2%)	17 (51.5%)	8 (24.2%)	33 (100%)

The damage caused by Tsunami was considered the highest Tsunami height (from now on Tsunami height) reaching the municipalities, the reach time of Tsunami, and Tsunami-inundation area. Tsunami height was most widely known and has the most significant influence on determination consciousness of the plan of municipalities and local residents. So in this study, we focus on the Tsunami height and analyze it. Classification of the Tsunami height was divided into three groups which were described by national guidelines related to disaster prevention. The first group is 1 m or more and less than 5 m, the second group is 5 m or more and less than 10 m, and the third group is 10 m or more. Table 7.9 shows the relationship between the determination method and Tsunami height. For Planner type, each Tsunami height was average, but the ratio tended to be relatively higher at 1 m or more and less than 5 m. The ratio of Public Hearing type and Public Participation type tended to be higher than 5 m or more and less than 10 m.

Regarding the relationship between determination method and Tsunami height, it was tended to be Public Participation type when the Tsunami height estimation was high. However, there was no notable difference from the relationship between determination method and Tsunami height.

Next, the consciousness of local residents was considered to be high in Public Participation type. In the questionnaire survey, we investigated the determination method and found that local residents were the determination subject for Public Participation type by about 70.6% and the consciousness of local residents tended to be high. The Awareness of local residents was considered to be related to damage estimation (Tsunami height) which affected the disaster awareness in Tsunami damage of local residents.

From the following, we analyzed the relationship between determination awareness of the local residents and the damage aspect (Tsunami height). Since determination subject in Planner type and Public Hearing type were municipalities, the analysis was conducted only with Public Participation type involving municipalities and local residents. Definition of determination subject was proposed by local residents to municipalities when the plan was determined. After that when local residents mainly developed the determination of the plan, the determination subject was local residents. In other cases, the determination subject was a municipality. Table 7.10 shows the relationship between determination subject and Tsunami height by Public Participation type. In the case of Tsunami height was more than 10 m, it was found that determination subject was the local residents and determination awareness of the local residents was high. In the

Table 7.10 Relationship between determination subject and Tsunami height by public participation type

Number of responses (%)				
Tsunami height (x)	$1 \text{ m} \leq x < 5 \text{ m}$	$5 \text{ m} \leq x < 10 \text{ m}$	$x \geq 10 \text{ m}$	Total
Municipalities	1 (25.0)	4 (75.0)	0 (0.0)	5 (100.0)
Local residents	1 (8.3)	6 (50.0)	5 (41.7)	12 (100.0)
Total	2 (11.8)	10 (58.8)	5 (29.4)	17 (100.0)

relationship between determination method and Tsunami height, there was no notable difference from the Tsunami height.

Determination subject focused on Public Participation type was found to be a high ratio of the local residents. Also, in the case of Tsunami height was more than 10 m, the local residents were highly aware of Tsunami disaster, and determination subject tended to be a high ratio of the local residents.

In this chapter, we evaluated the enrichment of the plan contents and found that Public Participation type was the highest enrichment. It was found that the determination unit of the plan had a high ratio for the neighborhood association that emphasized the community. To know one of the factors to be Public Participation type, we analyzed the relationship between determination method with Tsunami height, and determination subject and Tsunami height. As a result, it was found that in Public Participation type the determination ratio of the local residents was high and in the case of Tsunami height was more than 10 m, determination subject tended to be the local residents.

Public Participation type was greatly differenced from other types of the enrichment of plan contents where the local residents need to be considered for field survey and meeting. Therefore, in the next chapter, we focus on Public Participation type and conduct group classification from consideration items of field and meeting. We also evaluate enrichment of the plan contents by the group and clarify one of the factors that are a high enrichment in the groups.

7.7 Evaluation of Enrichment of the Plan Contents by the Groups

In this chapter, we focus on Public Participation type and conduct group classification from consideration items of field and meeting. We also evaluate enrichment of the plan contents by the groups and clarify one of the factors that are a high enrichment in the groups.

Table 7.11 shows consideration items for field and meeting. The group classification was conducted in the following process. In the case of consideration items for the field are 1 or more and consideration items for the meeting are 1 or more and less than 4, it is field group. In the case of consideration items for the field are 0 or more and consideration items for the meeting are more than 1, it is meeting group.

Table 7.11 Consideration items for field and meeting

	Considerations items
Field	Confirm evacuation route in field work
	Confirm evacuation place in field work
	Confirmation of evacuation zone and evacuation spot in field work
Meeting	Task extraction
	Conduct before the evacuation starts
	Evacuation bag
	Information acquisition method
	Evacuation method of healthy person
	Evacuation method of supported person
	Plan determination and consensus

Table 7.12 Group classification by municipality

Municipality	Field	Meeting	Group classification result
A	0	3	Meeting group
B	3	2	Field group
C	0	5	Meeting group
D	0	7	Meeting group
E	3	3	Field group
F	3	7	Integrated group
G	1	2	Field group
H	0	4	Meeting group
I	3	5	Integrated group
J	0	3	Meeting group
K	3	1	Field group
L	3	4	Integrated group
M	3	3	Field group
N	3	7	Integrated group

In the case of consideration items for the field are 2 or more and consideration items for the meeting are 4 or more, it is an integrated group.

Evaluation of enrichment of the plan contents from group classification was conducted on contents that were considered to affect enrichment of the plan contents from consideration items. The evacuation routes, dangerous zones, the dangerous spot were considered as the consideration items related to the field. Evacuation bag, evacuation method, and information acquisition method were considered as the consideration items related to the meeting.

The enrichment of the plan contents was evaluated with six contents. Classification result by the municipality is shown in Table 7.12. We classified field group was six municipalities, meeting group was five municipalities, and integrated group was six municipalities. The indicator was in the same way for evaluation method of enrichment of the plan contents. It was the description ratio to be described in the plan and

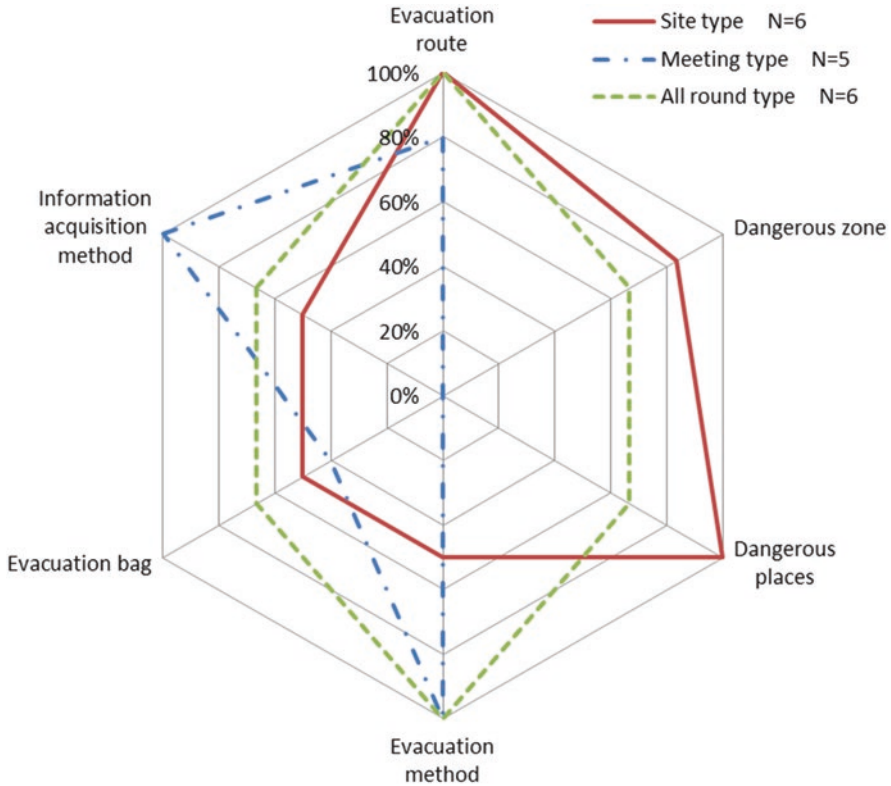


Fig. 7.8 Description ratio of planned content by type

detail of the contents. Figure 7.8 shows description ratio of planned content by type. In the same way of the previous chapter, calculating method of description ratio is description ratio of each population group.

7.7.1 Evaluation of the Enrichment of Plan Contents by the Groups

- Field group

The ratio of evacuation route, dangerous zone, and dangerous spot was high. On the other hand, evacuation method, evacuation bag, and information acquisition method were about half, and these were lower than the other groups. In other words, field group was considered to be understandable to describe in the plan to confirm the evacuation route, dangerous zone, and dangerous spot in field walk. However, as it was attached important to consider items of the field for evacuation route, dangerous zone, and dangerous spot in the field work, items to be considered in evacuation

method, evacuation bag, and information acquisition method at the meetings were lower than the other groups. The overall balance was better

- Meeting group

The ratio of evacuation routes, evacuation methods, and information acquisition methods was high. On the other hand, there was no description of dangerous zone and dangerous spot. As evacuation routes were important contents, these were considered at the meeting. Evacuation bag was at a low ratio of 40%, and as for meeting group, it was found that evacuation bag was not considered important as considerations items. In other words, meeting group was not confirmed items of the field by field work, but information acquisition method and evacuation method of healthy volunteers and supported persons were considered at the meeting. Therefore, the content items were plain to describe in the plan. The overall balance was bad.

- Integrated group

The overall ratio was high, and the balance was good. In comparison with field group, the plan contents for field items were low. In the case of compared with meeting group, enrichment for plan contents of the meeting was almost the same. Therefore, in the case of a number of consideration items increased, it was found that enrichment of the plan contents was high. It was because disaster awareness of the local residents was high and became one of the factors that considered many items.

As a result of evaluating enrichment of the plan contents by the groups, it was found that enrichment of the plan content was the highest in integrated group. Overall balance was good, and it was higher as the number of considerations items increases. Also, in the case of considering many items relating to the field, it was found that the enrichment of the plan contents was higher than the case of considering many items relating the meeting and the overall balance was improved. Therefore, we consider it is possible to improve enrichment of the plan contents by many consideration items or by confirmation of field work.

7.7.2 Factors of Field Group and Integrated Group

In the previous section, enrichment of the plan contents was evaluated by the groups. As a result, in the case of field group or integrated group, it was found that enrichment of the plan contents was higher. In this section, we analyze the relationship between Tsunami height and determination subject by the groups and clarify the factors that make field group and integrated group. Definition of Tsunami height and determination subject is the same as those described in Sect. 7.6.3.

First, we analyze the relationship between Tsunami height and the groups. Table 7.13 shows the relationship between Tsunami height and the groups. In the case of Tsunami height is 10 m or more, it was in many cases of field group and integrated group. As a factor, the awareness of the local residents was high in the

Table 7.13 Relationship between Tsunami height and the groups

Number of responses (%)				
Tsunami height (x)	$1 \text{ m} \leq x < 5 \text{ m}$	$5 \text{ m} \leq x < 10 \text{ m}$	$x \geq 10 \text{ m}$	Total
Field group	0 (0.0)	4 (66.7)	2 (33.3)	6 (100)
Meeting group	1 (25.0)	4 (75.0)	0 (0.0)	5 (100)
Integrated group	1 (16.7)	2 (33.3)	3 (50.0)	6 (100)
Total	2 (11.8)	10 (58.8)	5 (29.4)	17 (100)

Table 7.14 Relationship with the determination subject and the groups

Number of responses (%)			
Determination subject	Municipality	Local residents	Total
Field group	1 (16.7)	5 (83.3)	6 (100)
Meeting group	4 (75.0)	1 (25.0)	5 (100)
Integrated group	0 (0.0)	6 (100)	6 (100)
Total	5 (29.4)	12 (70.6)	17 (100)

case of Tsunami height was high, and we consider it was because of considered many items in the field work and meeting. There was no difference in other Tsunami height.

Next, we analyze the relationship between determination subjects by the groups as shown in Table 7.14. The ratio of municipalities that determined the meeting group was high. Field group and integrated group were high ratios of the local residents. In the case of determination subject was the local residents, they were actively engaged in activity such as fieldwork and evaluating items to be considered at the meeting.

In this chapter, we focused on Public Participation type and evaluated the enrichment by classifying the groups from consideration items. As a result, in the case of field group and integrated group, we found enrichment of the plan contents was high. Later, to know the factors that make field group and integrated group, we analyzed the relationship between Tsunami height and determination subject by the groups. As a result, field group and integrated group are found to be many in the case of Tsunami height was more than 10 m and the local residents are the determination subject.

7.8 Conclusion

The main findings obtained by this study are as follows. For municipalities in the Chubu region, we clarified the actual situation of the plan formulation and problems in determination. We confirmed contents to be described in the plan from description ratio of the plan and the guidelines developed by the country and the prefecture. Contents to be described in the plan from the guidelines were evacuation route, dangerous zone, dangerous spot, evacuation recommended area, evacuation method

and evacuation bag. Also, we extracted the method of evacuation drill for the effectiveness of the plan in evacuation drills after the plan determination and summarized the situation of each the plan contents by the prefectures. Also, we confirmed detail of the contents to be described in the plan from the guidelines.

From the questionnaire survey results, we categorized the determination method in Planner type, Public Hearing type, Public Participation type, and clarified the actual situation of the determination method. To clarify the method of determination, we evaluated the enrichment of the plan contents by the types. As a result, in the case of determining in Public Participation type, the enrichment was highest and overall balance was good. Then followed by Public Hearing type and Planner type.

We clarified that enrichment of the plan contents was high in case of participation of the local residents increased. Notably, it was only Public Participation type that contains a description of dangerous spot and determination of Public Participation type was effective. Also, Public Participation type was found to be understandable to coordinate with the local residents because the plan determination unit was neighborhood association and the planning area was not wide. Also, to know the factors to be Public Participation type, we analyzed the relationship between determination method and Tsunami height. In the case of determination subject was the local residents, it tends to be Public Participation type. Later, we focused on Public Participation type. To know determination subject was the local residents, we analyzed the relationship between determination subject and Tsunami height. Although there was no noticeable difference between the determination method and the Tsunami height, the relationship between the determination subject and the Tsunami height tend to be determined by the local residents in the case of more than 10 m of Tsunami height.

After that, we focused on Public Participation type and evaluated enrichment of the plan contents by the types to field group, meeting group, and integrated group from consideration items of field and meeting. As a result, the integrated group was the most enrichment of the plan contents, and the overall balance was good. Also, enrichment of the plan contents tended to be higher as the number of consideration items increase. It clarified that confirmation by field work was effective. To know the factors to be field group and integrated group, we analyzed the relationship between Tsunami height and determination method by the types. Relationship with Tsunami height tended to be field group and integrated group in the case of more than 10 m, and disaster awareness of the local residents tended to be high in the case of the Tsunami damage estimation was large. The relationship with determination subject tended to be field group and integrated group in the case of determined by the local residents.

Therefore, when the plan was determined, it is concluded that consideration of many items and confirmation by field work is effective in Public Participation type. It is important that determination of the plan be carried out by neighborhood association on community and one of the factors for high enrichment of the plan contents is Tsunami height above 10 m. Also, it is crucial that determination subject is the local residents.

As for the future issues, it is not yet clear how the consideration items for field and meeting are affected by the community. It is necessary to analyze the awareness of local residents and what groups are participated in the determination. It is also necessary to analyze from the survey of the actual community situation and the guideline.

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