

Strategy to Promote Residents' Behaviors for Appropriate Disaster Waste Management

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Abstract

This paper aims to clarify appropriate disaster waste management behaviors by citizens based on an understanding of frequently experienced problems in past disaster waste management cases. We also discuss methods and strategies to promote citizens' behaviors based on examples in disaster risk reduction fields. From our results, we have identified three problems that have often occurred in past disaster waste treatment: generation of large amounts of mixed disaster waste, creation of unauthorized temporary storage sites, and insufficient support for clean-up. In municipalities where large open spaces for temporary storage sites for disaster waste are difficult to find, residents also have to establish and operate the community's storage sites in cooperation with other residents. To promote these behaviors among citizens, there are three key factors: preparedness by municipalities for disaster waste management, citizens' understanding and motivation, and the existence of community networks. Based on examples of public involvement in the disaster risk reduction field, participatory training and planning involving citizens is effective at promoting their understanding and proper behaviors for disaster waste management. We propose three strategies to implement participatory methods and promote appropriate disaster waste management behavior by citizens. Firstly, seizing existing opportunities such as disaster drills would be a promising approach to communicating with residents and implementing participatory methods. Secondly, it would be important to identify citizen groups active in disaster risk reduction or waste management activities and collaborate with them. Thirdly, leveraging experience with disasters would be an effective way to promote disaster waste management because citizens' awareness of disaster waste issues is enhanced after disasters.

Key words : collaborative behaviors, mutual help, participatory training and planning, public involvement

1. Introduction

Natural disasters have occurred frequently in Japan in recent years, and each time, a large amount of disaster waste, such as damaged household goods and demolished houses, has been generated. If we fail to implement disaster waste management (DWM), sanitary conditions in the damaged area become very poor and restoration is delayed. The national government of Japan has promoted policies for DWM especially since the Great East Japan Earthquake in 2011. Municipalities that have responsibility for DWM have also promoted measures for effective DWM such as preparedness planning and capacity building (Tajima et al., 2019).

In the field of Japanese disaster risk reduction, it is said that three aspects of preparedness are important: self-help, mutual-help and public help. "Self-help" refers to actions by individuals and families, "mutual help" to collaborative actions among citizens, and "public help" to countermeasures by government (Wada, 2018;

Yamashita, 2010). So far Japanese policies for DWM have focused on public help. It is very difficult, however, to manage disaster wastes properly and promptly because devastated municipalities have to allocate their very limited resources to various disaster response activities in the confusing situation after a disaster. Therefore, self-help and mutual help become important.

What kinds of self-help and mutual help are expected for appropriate DWM? And how can we promote them? This paper clarifies citizens' behaviors as self-help and mutual help for DWM based on experiences with DWM in past disasters. We also discuss methods and strategies to promote self-help and mutual help for DWM by reviewing examples of public involvement in activities for disaster risk reduction.

2. Frequent Problems in DWM

When a disaster strikes, DWM starts with the disposal of damaged household goods by the affected

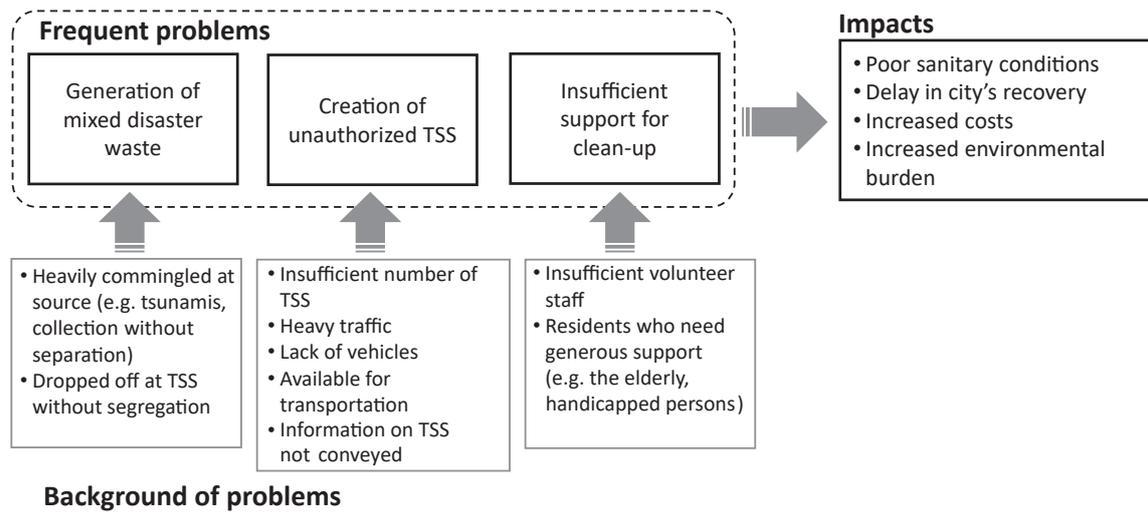


Fig. 1 Frequent problems in DWM and their impacts and backgrounds.

people. These disaster wastes are typically transported by the affected people to temporary storage sites (TSS) or collected by the local government. Subsequently, damaged houses and buildings are repaired or demolished, generating additional disaster wastes. This paper focuses on the phases of disposal (clearing) from damaged houses and transportation to the TSS since these phases are closely related to citizens' behaviors.

The problems that have typically occurred in the clearing and transportation phases of past disasters are shown in Fig.1, along with their impacts, and their backgrounds. One of the most frequent problems is the generation of large amounts of mixed disaster wastes at the TSS. If the disaster waste is separated properly, more of it can be recycled or reused.

Perishable wastes should be separated and incinerated first. Once mixed disaster wastes are generated, the separation process takes more time, and waste treatment facilities will not accept them without separation. Increased processing results in higher costs and time requirements. The burden on the environment also increases since recycling rates decrease and the amount of waste going to landfills increases. Different types of disaster wastes get mixed when they are heavily commingled at source (e.g., in cases of tsunami disasters or when damaged household goods are collected with no consideration for separation), or when they are dropped off at the TSS without segregation.

A second frequent problem is the creation of unauthorized TSS, i.e., TSS set up by local residents but unknown to the municipality. In many cases at this kind of storage site, cleared wastes are mixed improperly, generating foul odors and vermin which may harm human health. It also costs money to collect and treat mixed waste. This has become an issue due to various factors including but not limited to: insufficient numbers of TSS established by the municipality, heavy traffic in the stricken area that hinders the ability to transport disaster waste to a TSS located at a distance, lack of

vehicles (e.g., small trucks) available for transportation and failure to inform the people affected by the disaster about the location of the TSS.

A third frequent problem is insufficient support for cleaning up. Disaster volunteer activities have become popular in recent years and many volunteers enter disaster areas to help affected people clean up their houses after disasters. However, it is difficult to get enough support from volunteers if the disaster causes widespread damage and there are requests for help from many places, which was the case after the heavy rain disaster in western Japan in 2018. In addition, elderly and handicapped residents and those who have young children need generous support since it is difficult for them to clean up their damaged houses and transport large amounts of disaster wastes.

3. Citizens' DWM Behaviors

What kind of citizens' behaviors can mitigate the impacts of the frequent problems mentioned in Chapter 2. We discuss citizens' DWM behaviors both before and after disasters.

3.1 Following Separation and Clearing Rules

Separation of disaster wastes at source and at TSS can only be achieved by appropriate waste disposal behavior by citizens. For this, information on separation and clearing rules should be provided to them. Collaborative action to share correct information about rules using bulletin boards or SNS in the community is important, too. However, getting to know the rules and following them are not as easy after disasters occur, because of the confusion in the disaster area with people who have been harmed physically or mentally by the disaster. Therefore, it is important to check rules predetermined by one's municipality before disasters occur. It is also important to discuss information sharing schemes in the community before disaster strikes.

3.2 Storage at Community TSS

In some municipalities that have high-density population areas, it is difficult to find large open spaces for disaster wastes TSS. In such areas, the use of small open spaces such as local playgrounds as TSS may be a solution, provided that they are properly managed in collaboration with neighbors. Because it is quite difficult to decide on community TSS locations and management rules once disasters have happened, ideally discussions on where to establish community TSS and how to manage them in the community should be held before disasters occur.

3.3 Clean-up by Mutual Help

Cleaning up houses damaged by disasters is very tough work. The amount of waste is large and the weight of some household goods such as soaked carpets and tatami (traditional Japanese straw floor mats) is very heavy. Thus, the residents of disaster areas can help each other and collaborate with volunteers to clear and transport disaster wastes. Community meetings before disasters to discuss collaboration among residents and support systems for vulnerable neighbors could enhance mutual help after disasters. Such community meetings would be effective not only for DWM but also comprehensive disaster preparedness of the community overall because collaboration among residents is needed in various ways after disasters, such as for evacuation and management of the community's shelters.

4. Key Factors for Promoting Citizens' DWM Behaviors

4.1 Preparedness by Municipalities for DWM

When disaster strikes, some municipalities cannot decide on and announce rules for separation and clearing immediately because they lack advance preparation. As of 2019, about the half of Japan's municipalities had not developed a DWM preparedness plan (Ministry of the Environment, 2020). The residents living in such areas will not be able to get information on rules immediately. Therefore, preparedness for DWM by municipalities is one of the most important key factors in promoting citizens' DWM behaviors. Ideally, separation and clearing rules should be announced to the residents before disasters because it is difficult to distribute information to residents during times of disaster. Some municipalities have communicated with their residents by brochures or public relations magazines (Sakai City, 2017; Kawasaki City, 2019).

4.2 Gaining Citizens' Understanding and Motivation for DWM

Obtaining citizens' understanding and motivation for DWM is important in promoting citizens' DWM behaviors because people do not always take action even

if they know the rules. Hirose (2015) advocated a two-phase model for pro-environmental behaviors based on the theory of planned behaviors by Ajzen (1991) and proposed that risk perception of the problem, responsibility for dealing with the problem, and perceived effectiveness of the desired behavior influence people's intention to contribute toward solving the problem. There are many existing studies using Hirose's theory. Asato and Kimiya (2008) found that a sense of responsibility for dealing with problems has a strong positive influence on behavioral intentions toward cooperation with separation and collection of municipal wastes. Matsui et al. (2004) revealed that the perceived effectiveness of a behavior is one of the most important determinants of recyclable waste separation behavior. These studies indicate that having citizens understand the risks associated with poor DWM, i.e., health risks and hindrance of reconstruction, is an effective way to promote appropriate DWM behavior by the citizens. This may be further enhanced by recognizing that these risks can be reduced by following rules of separation, storage and transportation.

Educational materials on disaster wastes are a possible tool for promoting citizens' understanding. Some municipalities provide their residents with brochures for disaster preparedness (Tokyo Metropolitan Government, 2015). Information about proper clearing and transportation of disaster waste is needed because existing brochures on disaster preparedness do not mention disaster wastes in many cases. It may be effective to include information about disaster wastes in the existing educational materials on disaster risk reduction because people tend to have considerable interest in information regarding disaster response in general. More study is needed to clarify effective ways to provide information about disaster wastes.

To promote citizens' motivation not only for self-help such as checking pertinent rules before disasters but also for mutual help such as discussion at community meetings, the citizens have to know what mutual help for DWM is and how to perform it. Mori and Tasaki (2019) pointed out that a sense of responsibility for collaborative behaviors and perceived effectiveness of collaborative behaviors have strong positive influences on behavioral intentions toward collaborative behaviors. Therefore, it is important to provide them examples of mutual help before and after disasters and foster the cognition that mutual help is a meaningful action for citizens and an effective means of appropriate DWM. Ideally citizens' recognition of their stake in mutual help for DWM should be fostered through dialogue or disaster drills in the community.

4.3 Community Networks

Community networks are important to have especially for promoting mutual help among residents.

Mutual trust among community members fostered through regular communication is the basis for helping each other in difficult times. It may also promote effective sharing of information on separation and clearing rules among residents after disasters. Common risk perceptions toward disasters in communities are also important because the residents will have higher motivation for DWM if many of them share a sense of crisis about disasters.

Matsumoto et al. (2012) revealed that making pro-environmental behaviors, such as waste reduction behaviors at schools, visible to other citizens, strongly influences social norms, i.e., cognition of other people's behaviors and expectations for proper behaviors from family, friends and neighbors. Social norms affect people's behavior strongly in communities in which the residents know each other. Therefore, social norms will have a positive influence on promoting residents' appropriate clearing of disaster wastes in communities that have rich networking.

5. Methods for Developing Capacity in the Disaster Risk Reduction Field and their Applications in DWM

To promote citizens' DWM behaviors, it is important to foster their understanding of DWM and develop community networks. How can we put that into practice? We refer to examples of public involvement in the field of disaster risk reduction and discuss their application to DWM.

5.1 Disaster Drills with Stakeholders

Disaster drills constitute pre-training in which disaster situations are simulated to promote proper behaviors in times of disaster. Disaster drills such as evacuation drills and emergency communication exercises are very popular in Japan. The residents can simulate their situation in a disaster and experience collaborative actions such as emergency food cooking and shelter operation through disaster drills. Some studies have pointed out that experiencing collaborative actions can enhance a sense of capability in collaborative action and promote greater collaborative efforts (Chawla & Cushing, 2007; Mori & Tasaki, 2019). Therefore, experiencing collaborative actions through disaster drills may be an effective way to promote mutual help after disasters.

Disaster drills for DWM are not yet common, but there are a few examples. One is a field exercise that involves setting up and managing a TSS using a real site and actual waste, conducted by Kakegawa City, Kikukawa City and the sanitation facility associations of both cities (National Institute for Environmental Studies, 2017). The residents who participate in this TSS exercise, gain an appreciation of how big an effort separating and

transporting large amounts of disaster wastes can be and the importance of cooperation among residents. More study is needed to find effective methods of implementing disaster drills for DWM.

5.2 Imagination Games and Map Exercises

Disaster Imagination Games (DIG) are a popular type of simulation training in Japan. Participants break up into small groups and make notes of the high-risk places on their town's map, then discuss with each other how to avoid or reduce the risks (Cabinet Office, Japan). The Meguro Method is another imagination tool for disaster simulation developed by Dr. Kimiro Meguro (Meguro, 2001). People imagine and write down their specific situation and behaviors in a disaster along a time axis. This method is useful for gaining an understanding of individual risk. It also has the effect of increasing the community's or organization's readiness for disasters if participants share their results and discuss them with each other (Abe & Meguro, 2005). Participatory disaster map making is another popular method. This method includes not only discussion at a table but also walking around the town to find disaster risks and consider measures. Toyoda and Kanegae (2012) studied the effect of participatory disaster map making and found it to be effective at enhancing participants' disaster awareness and promoting action for disaster preparedness.

Studies and practices on these methods in the disaster risk reduction field indicate that to imagine individual concrete disaster situations and behaviors, on top of general knowledge about disaster situations, is an important way to enhance citizens' disaster awareness. Therefore, imagination drills simulating clearing and transporting of disaster wastes may be effective. For example, participants examine the possible disaster wastes in their house on the assumption that they have flood damage with inundation above the floor level. Then, they imagine and discuss how they would clear and transport their disaster waste to the planned TSS. However, information and support by disaster experts is essential because it is difficult for residents without disaster experience to form a concrete image of a disaster situation.

5.3 Risk Communication in Workshops

There are some studies on workshop methods involving stakeholders. Nomura et al. (2013) conducted a workshop targeting municipal government staff and residents who had experienced the Noto Peninsula earthquake in 2007 and found that by promoting risk communication they could help residents gain an understanding the importance of self-help and mutual help. Ushiyama et al. (2009) developed a workshop method focusing on risk searches in the community and revealed that it was effective at promoting people's disaster risk reduction actions. These examples focused

on risk communication. Workshop methods are effective not only at promoting communication among stakeholders but also at enhancing people's understanding and actions. Therefore, workshops for residents that include discussion of local DWM risks and production of items such as maps and action lists in cooperation with other participants would also be effective in the field of DWM. If the residents can grasp concrete DWM risks and share this understanding with other community members through workshops, residents' DWM actions can be promoted.

5.4 Preparedness Planning with Stakeholders

To enhance people's sense of responsibility for disaster wastes, participatory planning provides a good reference. Tamura et al. (2004) developed a planning method for disaster risk reduction using workshops with stakeholders and revealed that their planning method could enhance the participants' proactive attitude toward disaster management issues and foster a sense of ownership. Not only in the disaster risk reduction field but also in the city planning field, public involvement in planning is known as an effective way of enhancing residents' sense of ownership in activities (Kinoshita et al., 2018).

Many municipalities face the risk that they will not be able to provide sufficient public services because of depopulation and staff shortages. Therefore, it becomes more important for the residents to realize that they have important roles in waste management, not leaving everything to their municipalities. Many DWM plans have been made without the residents' involvement. It would be helpful for residents to get involved in development of DWM plans and discuss effective ways to clear disaster waste with their municipality. Additionally, residents can hold discussions in their community about preparing operation manuals for creating and managing a community TSS or support scheme for people needing special assistance in clearing and transporting disaster wastes. Such activities would be an effective way to enhance residents' sense of ownership with DWM. Collaboration with the municipality and support by experts would be indispensable for the success of this kind of activities.

6. Strategies to Promote Residents' DWM Behaviors

Figure 2 gives an overview of the discussion in the previous chapters. It depicts targets and residents'

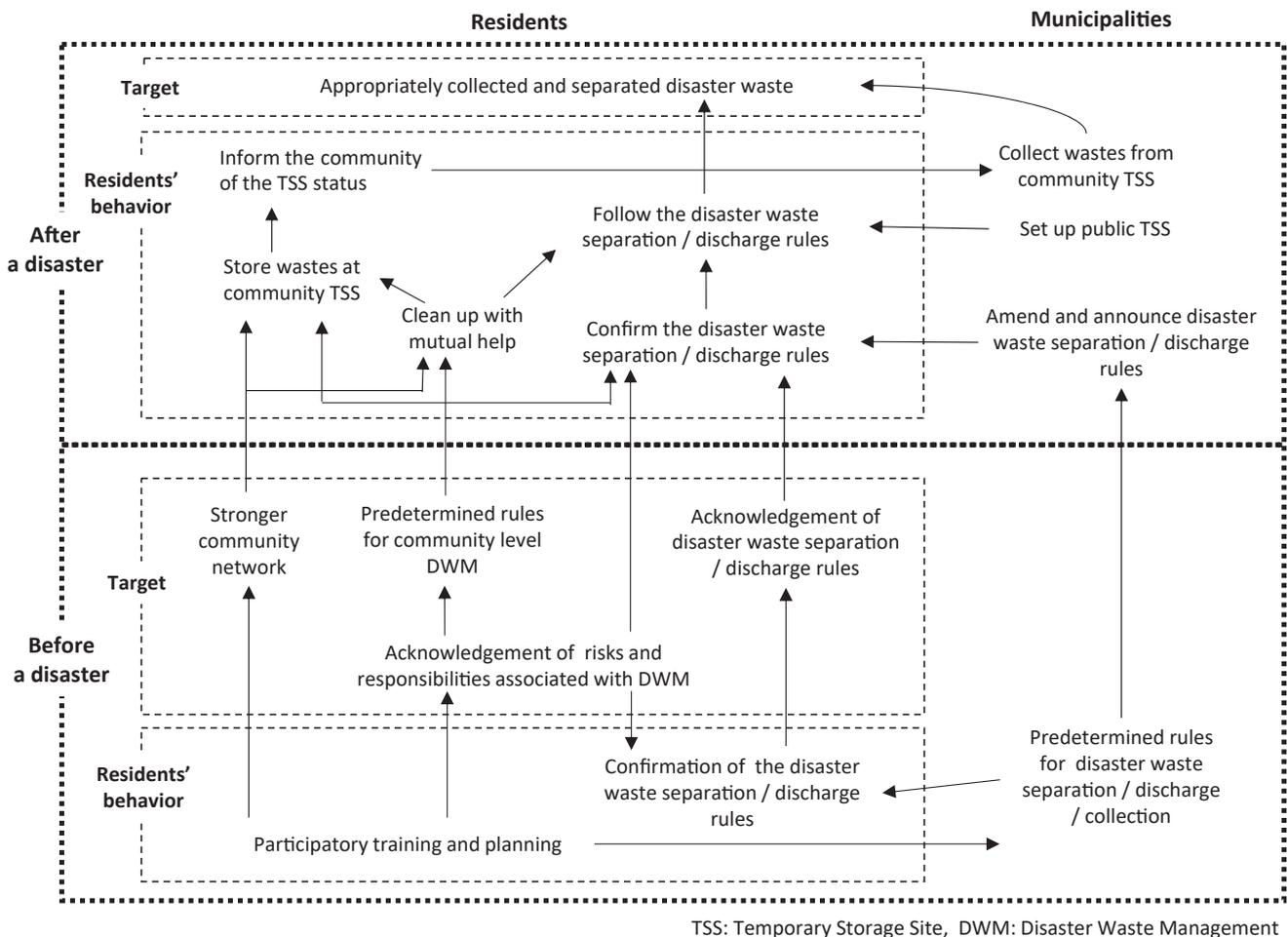


Fig. 2 Targets and related behaviors of residents and municipalities.

behaviors and related actions by municipalities before and after disasters. Based on examples of public involvement in the disaster risk reduction field, participatory methods involving the residents such as workshops, DIG and creation of map and plans are helpful in developing networks among stakeholders and promoting residents' understanding and behaviors. Therefore, implementation of participatory methods for the residents is desirable from the standpoint of promoting residents' DWM behaviors. Below, we discuss three aspects of strategies to implement participatory methods for the residents: seizing existing opportunities, identifying and collaborating with the groups driving community's DWM, and leveraging experience from disasters.

6.1 Seizing Existing Opportunities

One promising way to implement participatory DWM methods is to incorporate some exercises involving disaster wastes in existing disaster drill opportunities. For this, it is important to hold discussions with related stakeholders at an early stage.

It is also possible to use existing events for promoting public awareness to promote waste management as well. For example, Yokohama City has exhibited posters and created games involving disaster wastes at open days at the city's incineration plant. These open days are held once a year, and many residents living around the incineration plant visit (National Institute for Environmental Studies, 2020). This example is not a participatory method. It is an effective way, however, to help the residents recognize disaster waste problems and serves as a first step toward implementation of a participatory method. If a festival or event related to environmental problems is held regularly, it is possible to use it as an opportunity for raising awareness about disaster waste problems.

6.2 Identifying and Collaborating with Citizen Groups Active in Disaster Risk Reduction or Environmental Activities

The citizens groups active in disaster risk reduction or waste management activities play an important role in implementing participatory methods and promoting residents' DWM behaviors. Possible groups that could energize communities' DWM include neighborhood associations and local NPOs working on environmental problems or disaster risk reduction. If there are such groups in the community, collaboration with the municipality and these groups would be an effective way to implement participatory DWM methods. Mori et al. (2020) tried a workshop on DWM for the residents of Kawasaki City in collaboration with a local NPO (Fig. 3). The participants of this workshop were residents engaged in local activities to resolve environmental problems or for disaster risk reduction. The aims of this workshop



Fig. 3 Residents' workshop for DWM in Kawasaki City.

were not only to promote understanding of DWM but also to foster key persons for promoting the community's DWM and developing a network. It was effective especially for developing a network of participants because most of the participants started planning original activities together after the workshop.

Municipalities should take the initiative to implement participatory methods and promote residents' DWM behaviors if there are no groups active in disaster risk reduction or waste management activities. It may be difficult to implement participatory methods from the outset. Thus it would be helpful to start communicating with residents using existing opportunities such as disaster drills or public events. Such communication activities would be useful for finding future collaborators or partners to implement participatory methods.

6.3 Leveraging Experience of Disasters

Once a municipality suffers from a natural disaster, local politicians, governmental staff and residents have great interest after that in DWM. Experiencing a disaster is tough and unfortunate, but it is important not to miss the opportunity when everyone's awareness of disaster waste problems is high. Kurashiki City was severely damaged by heavy rain in 2018 and many problems related to disaster wastes occurred. After this disaster, the Kurashiki City municipality conducted interview surveys on disaster waste treatment with the afflicted people to learn about problems they had had with DWM. Based on this survey, they made a handbook for residents about disaster waste disposal (Kurashiki City, 2020). Moreover, they plan to make a DWM instruction manual for early phases of disasters in collaboration with stakeholders. Their work is a good example of promoting DWM for residents by leveraging their experience in the disaster.

7. Conclusions

This paper has attempted to clarify appropriate DWM behavior by citizens based on an understanding of frequently experienced problems in past DWM cases. We have also discussed methods and strategies of promoting

these behaviors based on examples in the disaster risk reduction field.

From our results, we could identify three factors key to promoting citizens' DWM behaviors for before and after disasters. Firstly, preparedness for DWM by municipalities is indispensable. Secondly, encouraging citizens' understanding and motivation for DWM is crucial to promoting their DWM behaviors. Thirdly, community networks must be developed to promote mutual help before and after disasters.

Based on examples of public involvement in the disaster risk reduction field, it is thought that participatory training and planning involving citizens is effective at promoting their understanding and encouraging DWM behaviors. We have discussed three strategies for implementing participatory methods for citizens: seizing existing opportunities, identifying and collaborating with citizens groups active in disaster risk reduction or waste management activities, and leveraging experience in disasters.

DWM implementation using the proposed methods and strategies in real communities and evaluation of their effectiveness should be topics of future research.

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