

Development of Disaster Waste Management Focusing on Organizational Arrangement

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Abstract

In recent years, large-scale natural disasters have occurred frequently in Asia and the Pacific, resulting in the generation of huge amounts of disaster waste. Failure to take appropriate measures could lead to serious problems such as deterioration of the living environment. The objective of this study is to identify important points of the organizational arrangements for disaster waste management adjusted to the actual and practical situation of each country or region, by reviewing case studies on support for establishing disaster waste management systems in six countries/regions: Japan, Bangkok (Thailand), Indonesia, Lautoka City (Fiji), Honiara (Solomon Islands) and Samoa. The results show that incorporating disaster waste management in normal-time waste management is important for improving community resilience, normal-time waste management skills, capacity and technology, and for maintaining motivation for DWM preparedness. The responsible government agencies often have a dual structure at the national and local government levels, so it is essential to strengthen cooperation between different institutions regardless of the organizational structure. Furthermore, it is effective for small and medium-sized countries or local governments to strengthen cooperation with local residents, and building social capital through disaster waste disposal can be an effective means of that.

Key words: disaster waste management, guideline, master plan, organizational arrangement, social capital

1. Introduction

In recent years, large-scale natural disasters, such as earthquakes, tsunamis and cyclones, have occurred frequently in Asia and the Pacific. As a result, large amounts of disaster waste (DW) have been generated due to their strong destructive force, and we struggle to deal with it. People have very little interest in DW before a disaster occurs. However, once disasters occur, if DW is not properly disposed of, there is a high possibility that the living environment will deteriorate, and sanitary deficiencies will become more serious. This situation results in serious damage to society.

The presence of DW impacts almost every aspect of emergency response and recovery efforts (Brown *et al.*, 2011). During the immediate response, DW can cause road blockages like in the 1995 Great Hanshin-Awaji earthquake in Japan (Kobayashi, 1995). In the longer term, poor management of a clean-up can result in a slow and costly recovery (Brown *et al.*, 2011). The persons in charge must deepen their understanding of disaster waste

management (DWM) first and clarify the importance of preparation to policymakers and citizens, while at the same time drawing up contingency plans, starting with plans for disasters that would directly affect the capacity of regular waste management (WM), thus developing it strategically (Ministry of the Environment, Japan, 2018). Karunasena (2011) suggested that increased resilience against future disasters in a region can only be achieved by working on long-term DW planning and setting goals for economic, ecological and social sustainability.

It is very difficult, however, for many countries and regions to formulate DWM. Brown *et al.* (2011) have already pointed out that DWM seldom exists in developing countries, because financial, technical and expert resources in developing countries are generally a limiting factor in achieving disaster risk reduction goals. In many cases normal-time solid waste management programs do not even exist.

The Ministry of the Environment, Japan (MOEJ) (2018) has therefore compiled a DWM guideline which focuses on effectivity and usefulness as a guide not only

for times of disaster, but also during post-disaster recovery by preparing for DW treatment in advance and making it a smooth process. The MOEJ expects to achieve this, as pre-disaster preparation enables progress in developing normal-time WM systems, reduces disaster risks, and encourages continuous progress during normal times. This guideline recommends that each country or region develop two types of plans, a contingency plan (CP) and an implementation plan (IP) (MOEJ, 2018). A CP is a pre-disaster plan that specifies how to react and proceed with DW treatment when a disaster occurs. An IP is a post-disaster plan, ascertaining the real state of the disaster immediately after a disaster occurs. Asari *et al.* (2013) explain how this guideline works for managing DW in developing countries. The first important point in addressing DW issues on a global scale is that disasters generate a wide range of wastes. The second point is that no legal framework for disaster waste management is available, or there is a lack of financial, technical or institutional capacity to enforce the existing legal framework in some developing countries. The third point is that circumstances vary from country to country.

As Karunasena (2011) points out, the formulation of DWM plans should be carried out considering economic, environmental and social aspects. In this study, social aspects are focused on so as to clarify the differences in administrative organizational systems between different countries and regions. Shimada (2015) and Sanyal and Routary (2016) also studied the role of social capital in different phases of a disaster. The Japan Society of Material Cycles and Waste Management (JSMCWM) has been supporting the establishment of DWM systems in Asia and the Pacific with financial support from the MOEJ. We are holding workshops and other events with relevant parties from six countries/regions (Japan, Bangkok (Thailand), Indonesia, Lautoka City (Fiji), Honiara (Solomon Islands) and Samoa) to create basic policies and support the establishment of organizational structures (JSMCWM, 2021). Although JSMCWM's activities have been limited to the Asia-Pacific region, it

has been supported through trial and error, facing not only differences between countries and regions, but also differences between nations' sizes, socio-economic levels and geographical conditions. The objective of this study is to discuss the important points of organizational arrangements for disaster waste management, adjusted to the actual and practical situation of each country or region.

2. Disaster Waste Management Principles

To fully prepare for the next disaster event it is important to be able to see the entire picture with regard to the function and tasks necessary for DWM, (National Institute for Environmental Studies, Japan (NIES), 2015). Figure 1 lists the organizational functions necessary for DWM. DWM consists of various tasks that are different from the WM of normal times. Many stakeholders are involved, including those not involved in normal-time WM operations. Roles, responsibilities and coordination frameworks should be pre-identified and communicated. Essential organizational functions for DWM consist of operations, command, logistics, finance/administration and planning.

In this study, the author investigated the organizational systems of different countries and regions, focusing on the command and planning functions. As for the command function, coordination with internal and external stakeholders is highlighted. A comparative analysis is conducted on how roles are divided according to the organizational structure during normal times and the circumstances of the country or region. As for the planning function, information on matters such as the state of the disaster, sanitary conditions, residents' complaints and work progress are crucial for DWM. The author investigated how information collection, sharing, analysis and support proceed according to each organizational structure.

| Operations | Command | Logistics | Finance/admin. | Planning |
|----------------------------------|------------------|---------------------|-------------------|-----------------------|
| Collection | Target setting | Human resources | Contracts | Plan marking |
| Separation | Public relations | Equipment | Payments | Information gathering |
| Transportation | External affairs | Facilities | Financial sources | Information sharing |
| Temp. storage | Internal affairs | Systems (incl. ICT) | | Information analysis |
| Intermediate treatment | | | | Information support |
| Final disposal (incl. recycling) | | | | |

Fig. 1 Organizational functions necessary for DWM (JSMCWM, 2021).

3. Case Studies on Organizational Arrangement

3.1 Case 1: Japan

Figure 2 provides a relationship diagram of waste management plans and guidelines against disasters (MOEJ, 2018). In the planning phase, frameworks and role sharing are important. In Japan, after the Great East Japan Earthquake, it was recognized that there had been insufficient advance preparations such as policies and systems, to ensure smooth and prompt processing, and insufficient guidelines and mechanisms to ensure proper processing. Therefore, the central government's control functions were strengthened and procedures for the government to follow were simplified. In addition, efforts were made to establish a system for seamless response to disasters by organically linking the Waste Management Law and the Disaster Countermeasures Basic Law (Japan Environmental Sanitation Center, 2015).

Based on the description of the Disaster Waste Management Guidelines in Asia and the Pacific (MOEJ, 2018), Japan has enacted a DWM policy based on the Disaster Risk Management Basic Law and Master Plan as well as the Waste Management Law. This makes smooth and efficient initial action to handle DW possible, even in the confusion that occurs during disasters. Another feature is the hierarchical approach that has been taken, phased in first by the national government, then prefectural governments and local municipalities, making use of the general administrative system. It is the responsibility of municipalities in Japan to carry out DW treatment. Therefore, it is important for local municipalities to formulate their own IPs. Each IP is formulated based on MSW management plans and local contingency plans at first. IPs by prefectural governments, however, also become important in disasters that exceed the response capacity of local municipalities or when a disaster affects a wide area. To support both levels of government in

formulating their IPs, the MOEJ prepared the Disaster Waste Management Policy and technical data, which can be adjusted appropriately and provide new perspectives.

D.Waste-Net is also managed by the MOEJ with cooperation from member organizations (MOEJ, 2015a). This network organization works to ensure that disaster waste is disposed of properly, smoothly and quickly, depending on the type and scale of the disaster, during normal times and at each stage of a disaster. A human network carries out support activities in response to a request for cooperation from the MOEJ. Its functions and roles during normal times include supporting local governments toward establishing initiatives such as DWM action plan-contingency plans (DWMAP-CPs), personal training and disaster prevention drills; noting and inspecting various responses to DW countermeasures; publishing the findings; and maintaining or improving disaster prevention capabilities through D.Waste-Net member interactions and information exchange sessions. When disasters occur, D.Waste-Net member organizations carry out the dispatch of specialists and technicians to local governments affected by disasters, construction of treatment systems, and dissemination of disposal and sorting methods for residential waste, clean-up waste and other kinds of waste.

As mentioned above, DWM measures in Japan have made dramatic advances since the Great East Japan Earthquake, but some issues still remain to be solved. For example, each local government is required to formulate its own DWMAP-CP by itself. As Suzuki *et al.* (2019) points out, the number of employees in each local government's waste department is estimated to be around 1 per 10,000 people. Currently, small and medium-sized local governments do not have enough personnel to formulate DWMAP-CPs and are also faced with many issues regarding lack of materials, equipment or finances. Although the ratio of governments formulating their own



Fig. 2 Organizational functions necessary for DWM (MOEJ, 2018).

DWMA-CPs has been increasing year by year, it is unclear how effective they are. Kawamoto and Kim (2019) also state that bonders such as families or neighbors collect waste in their homes and neighborhoods. Linkers include individuals from the local government and governmental agencies from external regions who help collect waste in residential areas by bringing in heavy equipment such as backhoes and lifting tools. Kawamoto and Kim (2019) focus on quantifying the role of different modes of social capital to support planning efforts.

3.2 Case 2: Bangkok, Thailand

Figure 3 shows the organizational framework proposed for flood waste management in Bangkok, Thailand. Based on the lessons learned from the mega-flood in 2011 (Singkran & Kandasamy, 2016), international experts recommended the Bangkok Metropolitan Administration (BMA) to arrange a flood waste management task force as shown in Fig. 3. Nakayama *et al.* (2013) stated that provincial authorities and BMA have the Department of Public Cleaning and the Department of the Environment manage municipal waste treatment during normal times in Bangkok. BMA district offices, under the supervision of BMA and the Department of the Environment, are responsible for daily waste collection (Nakayama *et al.*, 2013). Such districts are also responsible for collecting and transporting waste to transfer stations (NIES, 2015). It will therefore be effective to set up a system that matches the organizational structure during normal times. They will give orders, collect reports from operators and inform residents and businesses (NIES, 2015). The Department of Environment (DoE) of the BMA is mainly responsible for managing transfer stations, final disposal and coordination of districts. The DoE will give orders and

information to waste management facilities and collect their reports. The DoE will also deal with the central government, other provincial government departments, and external supporting bodies (experts). As Kim *et al.* (2018) stated, it is important for decision makers to gain insight into the inter-relationship between critical infrastructure and resources, the effectiveness of operating temporary storage sites, and debris removal performance according to different strategies. To minimize miscommunication between the DoE, district offices, waste management facilities (waste transfer stations), and private operators, the roles and responsibilities of these actors need to be clearly defined and then implemented (NIES, 2015).

3.3 Case 3: Indonesia

Law No.18 of 2008 on Waste Management serves as the primary legal framework, establishing the responsibility of the government, local communities, industries and individuals in managing waste (Suprpto, 2022). Guidelines for Cleaning the Environment in Disaster Emergency have been developed by National Board for Disaster Management (NBDM) since 2015 to facilitate organizational coordination and identify local, state and federal agencies involved in disaster debris management (United Nations Environment Program, 2008). The Ministry of Environment and Forestry and Ministry of Public Works & Housing along with the analogous departments at local levels are responsible for policy, coordination and operation on DWM in Indonesia (JSMCWM, 2021). Under the coordination among the NBDM, the Ministry of Environment and Forestry is the lead agency supporting DWM operations at the local level through the Department of Environment and the local Public Works offices on the scene. It is essential to improve the effectiveness of DWM at the local level with

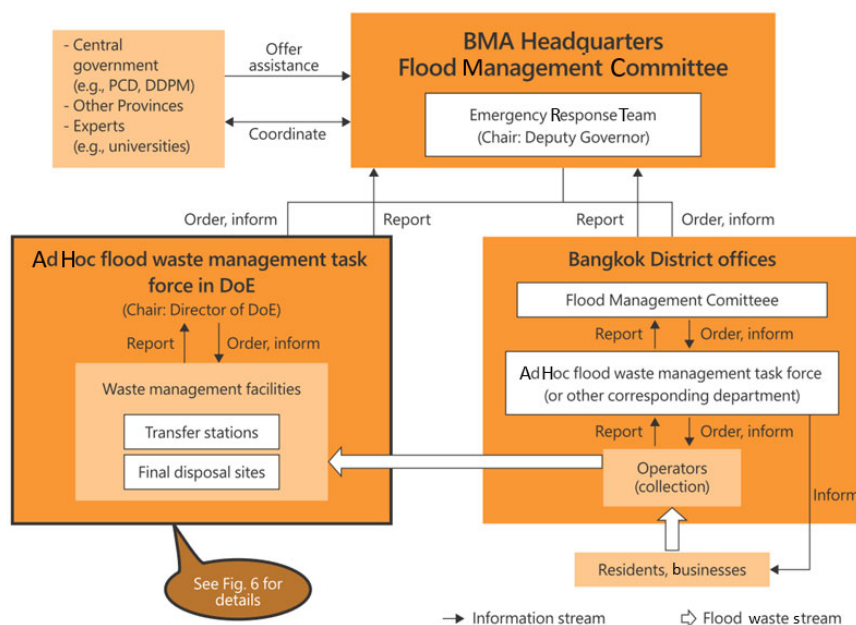


Fig. 3 Organizational framework recommended for flood waste management in Bangkok (JSMCWM, 2021).

strong national support. Fatimah *et al.* (2019) argued that the assessment and estimation of the waste volume, waste type and degree of mixed waste are specific factors. The assessment result is also used to specify vehicle type and determine collection and separation strategies. To achieve this, detailed information collection and analysis is necessary.

3.4 Case 4: Lautoka City, Fiji

Bündnis Entwicklung Hilft (2021) ranked Vanuatu as the country with the world's highest disaster risk, Tonga as second and the Solomon Islands, Papua New Guinea and Fiji, fifth, eighth, and fifteenth, respectively (Pacific Waste Plus, 2021). Pacific islands have much higher disaster risks, so addressing disaster waste is crucial there. DWM is the responsibility of local governments in assistance with activities supported by the National Disaster Management Office (NDMO). The Lautoka City Council conducts DWM (JSMCWM, 2021). Fernandez *et al.* (2023) stated that the capacity development project helped generate significant interest in disaster waste management within the disaster risk reduction, environmental management, solid waste management and climate change stakeholder communities not only in Fiji and the Philippines, but also in other parts of the world.

3.5 Case 5: Honiara, Solomon Islands

Figure 4 outlines Honiara's pilot project on multilateral stakeholder involvement for DWM in the Solomon Islands. A DWM pilot project was established by the Honiara City Council (HCC), Ministry of Environment, Climate Change Disaster Management and Meteorology (MECDM) and Ministry of Health and Medical Services (MHMS) with assistance from the J-PRISM Project funded by Japan International

Cooperation Agency (JICA) (JSMCWM, 2021).

Basic functions such as command and planning in DWM are supported by MHMS and MECDM, but HCC plays the central role. On the other hand, the functions of operation and logistics are divided into two departments. A rational organizational structure has been established to respond to the actual situation on the ground. On the other hand, it is important to harmonize them (JSMCWM, 2021). Under the Environmental Health Division, community-based 3R activities (composting, use of wooden material, etc.) have been developed. A mobile chainsaw team has been organized to cut wooden materials to be utilized in communities as fuel and firewood. One of the important arrangements highlighted is to make appropriate arrangements in-country with local recyclers for the recovery of recyclable materials as well as with existing road maintenance and rubbish collection contractors to assist with the rapid management of waste (Secretariat of the Pacific Regional Environment Programme, 2019). Brown and Milke (2016) also stated that disasters have significant community impacts and, where possible, it is good to consider not only economic and environmental aspects but the potential social benefits of recycling as part of a wider recovery framework. Environmental Protection Agency (2019) also suggests that community participation has a greater role in effectively removing and treating the waste during earlier phases of disasters. The Solomon Islands' efforts have yielded notable results that contribute not only to DWM but also to improvement of disposal site operation and management in normal times. They have also accelerated discussion toward establishing an individual Waste Management Division in the HCC and having that mandated and duplicated among the Environmental Health Division and Works Division. They have promoted

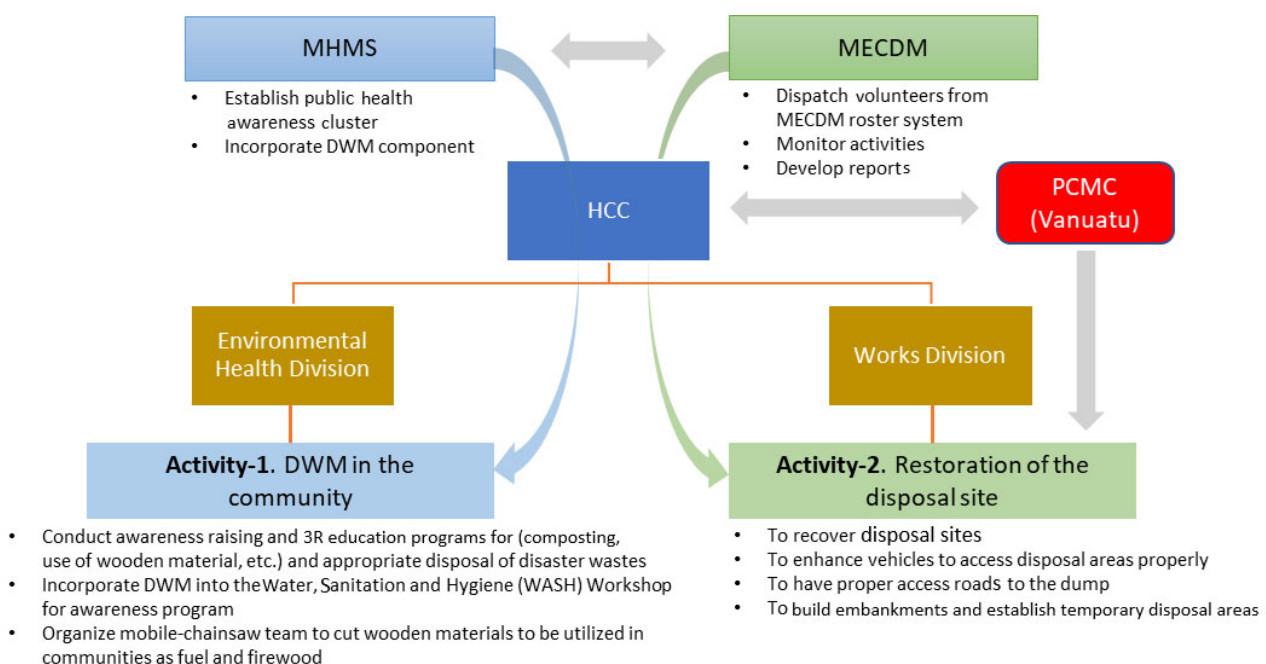


Fig. 4 Institutional arrangements for conducting DWM pilot project in Honiara, Solomon Islands (JSMCWM, 2021).

discussion of the importance of DWM at the national level, especially for MECDM and MHMS, which have moreover promoted discussions for establishing a DWM committee as one of the clusters at the national level.

3.6 Case 6: Samoa

The Samoan people were originally self-sufficient and their lifestyle was not one that produced waste. However, due to the recent importation of food products, the quantity and nature of their garbage has changed. Waste disposal has become impossible to keep up with, resulting in piles of garbage in the fields (Japan International Cooperation Agency, 2021). Mimura (2021) suggested that segregation and reuse of disaster waste are a priority due to the limited domestic market for recyclables, land for disposal and capacity of municipalities.

Samoa does not have local governments, which means the national government covers all services to the communities directly, including waste management in normal times. The tourism group from the economic sectors and environment groups from the social sectors are responsible for DWM according to the National Disaster Management Plan 2017–2020, with the assumption that the environment groups will play the main role in DWM. Environment group members' roles in DWM will be coordinated by the Ministry of Natural Resources and Environment. The role of each member is for the Land Transport Authority to clear debris from the roads and bridges, for the Samoa Waste Authority to clear it from the rivers, for the Electric Power Corporation to clear it from electric lines, for the Ministry of Works, Transport Infrastructure to clear away building debris and for the Ministry of Women, Community and Social Development to promote awareness and ensure debris clearance in affected communities.

3.7 Discussion

Based on the above six case studies, the following can be noted, focusing on differences in organizational structures and functions.

Incorporating DWM in normal-time WM is important for improving community resilience, normal-time waste management skills, capacity and technology, as well as for maintaining motivation for DWM preparedness. For example, Fatimah *et al.* (2019) stated that Indonesia still has a big problem with its regular waste management, as waste management in this country has been inadequate to meet daily waste collection and handling needs. It is necessary gradually and repeatedly to make improvements starting from normal operations.

Except for countries that do not have local governments, such as Samoa, the responsible government agency often has a dual structure at the national and local government levels. Therefore, it is essential to strengthen

cooperation between different institutions. Forming a collaborative organization like D.Waste-Net in Japan or a task force in Bangkok, Thailand would be effective.

Command and planning functions are often carried out by institutions entrusted with central functions. The larger the organizational structure, the more important it is to strengthen its central functions, and to strengthen its coordination with related organizations.

As for the command function, on the other hand, routine work itself during normal times is usually carried out by separate organizations. Therefore, it is important to build coordination with internal stakeholders while keeping in mind the division of roles in operations during normal times. Regarding on-site operations such as collection, transportation, processing and disposal, it is natural that the same organizations that are in charge of normal-time operations also take on the practical functions when disasters occur. There are some cases in which each waste treatment facility is responsible for its own management function, and other cases in which a central management department is responsible for the management function. Furthermore, there are cases where the department that handles collection and transportation is not the department that handles processing and disposal, so it is important to build a flexible organizational structure while taking advantage of normal-time operating systems. In this case, coordination of collection and transportation is important. As Nakayama *et al.* (2013) stated, the BMA asked private companies to provide trucks and drivers to collect waste after Thailand's flood. Some companies declined the request because they themselves were affected by the disaster; they were unable to cooperate.

It is thus essential to create a collaborative organization that skillfully incorporates intentions at the field level and optimally allocates limited resources. Brown *et al.* (2011) stress the importance of further investigations into how best to integrate waste management into the overall disaster recovery operation, including coordination with rebuilding activities, allocation of shared resources and work prioritization.

Normal-time operations, however, do not include operation of temporary storage sites (TSS). Several agencies have emphasized the importance of TSSs for effective management. However, unsuitable TSS locations in areas near playgrounds, swamps or rice paddies have been cited as potentially damaging to the environment and affecting the livelihoods of people in communities (Kim *et al.*, 2018). There are a wide variety of topics that need to be discussed in advance, including consideration of whether or not it is necessary to establish TSSs, the location and required surface area, the necessary materials and equipment, their mode of operation, and so on. One important issue is who will be responsible for considering the operation of TSSs.

Furthermore, small- and medium-sized nations such

as island countries and small and medium-sized local governments are expected to experience significant shortages, including of personnel, materials, equipment, and finances. These same issues can be seen in small and medium-sized local governments in Japan (Suzuki *et al.*, 2019). It is therefore essential to strengthen cooperation with local residents, and building social capital through disaster waste disposal can be an effective means of that.

4. Conclusions

In this study, the important points of organizational arrangement for disaster waste management adjusted to the actual and practical situation of each county or region were examined. Six case studies, Japan, Bangkok (Thailand), Indonesia, Lautoka City (Fiji), Honiara (Solomon Islands), and Samoa, were carried out.

The results show that it is desirable for organizations responsible for normal-time operations to engage in disaster waste treatment, making as much use of their experience in normal-time operations as possible. However, since large-scale disasters often require consideration at the national level, strengthening collaboration between separate organizations would be effective.

On the other hand, with regard to separation, collection, transportation, processing and disposal, it is necessary to develop measures in line with the actual situation on the ground. It is thus important to have a cooperative system not only with government officials but also with private businesses, experts and others. It is necessary to create an organizational structure in which a bottom-up approach from the front line and a top-down approach from central functions are carried out in a well-balanced manner. Obtaining cooperation from local residents can also be highly effective, depending on the size of the country or region, and scale of the disaster.

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