# Integrated Solid Waste Management Disaster Guidance (Case study: Mega Flood in Thailand, 2011)

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## ABSTRACT

Mega flood in Thailand, in the year 2011, solid waste management during flood was huge problem that needs to correct and prevent, in order to response in the next disaster. In Thailand solid waste management is in responsibility of the local administration. Therefore the objective of this study is preparation the proper guideline for solid waste management disaster in case of longtime flooding. This study collected data information from the existing experiences of the flooded municipalities in the Northern and Central Region of Thailand to provide the proper guideline. This guideline has been passes 2 times of public participation. The guideline for integrated solid waste management disaster has 3 important steps as follow: Step I. Preparation and Planning before flood exist that have to concern on evaluation flood damage level, study on solid waste management during flood period, establish the center of flood protection and committee (include solid waste management), estimation the volume and characteristic of solid waste, evaluation the potential of surround municipalities for supporting and helping, preparation temporary site for waste storage and transfer and communication to people in the flooded area. Step II. Implementation during flood and after flood that have to concern on waste collection, transport, separation, disposal and rehabilitation temporary site. Step III. Evaluation the solid waste management after water receded by municipality and stakeholders in order to use experience for developing the best practice in the next coming flood.

**Keywords**: solid waste management, disaster, flood

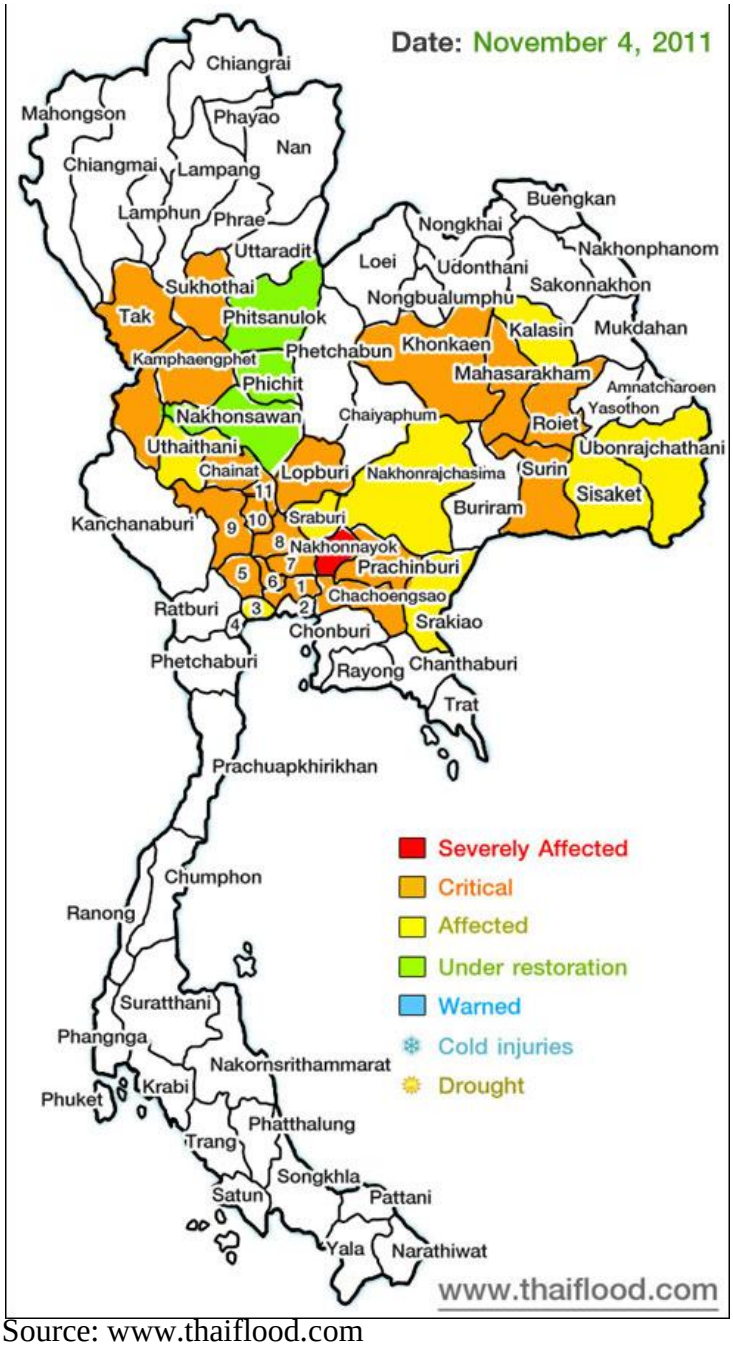
## 1. INTRODUCTION

The mega 2011 flood disaster in Thailand began on July 25, 2011. Brought about by the tropical storm "Nock-Ten", it has had an impact in many areas and caused 65 provinces to be announced emergency disaster (flooding) areas. The number of deaths reached 815 people [1]. Many areas have been flooded severely and extensively (Figure 1). Some of its major effects include economic, social and environmental repercussions. The World Bank estimated the worth of damage to more than 640,000 million Baht. Solid waste issue has been one of the problems both during flooding and since the water level has decreased. Garbage containers floated away, the garbage trucks couldn't collect waste as usual and solid waste management systems in some local administrations received damage from flooding. This caused a deposit of solid waste dirtying flooded areas. Additionally, an abundance of furniture waste appeared after the water level dropped, such as tables and cabinets, as well as the books and documents that were stored in them. Corrective solid waste management guidelines will help the agencies responsible for solid waste management to prevent and manage flood waste effectively. Including preparation for solid waste management for pre-flooding, during flooding, post-flooding and rehabilitation after flooding, can help to

effectively and rapidly decrease the risk to the population's health and relieve the impact on the environment during that time. The Solid Waste Management Guideline is created for this purpose.

## 2. LITERATURE REVIEW

Pollution Control Department (2010) has created the Solid Waste Management During Flooding Manual [2] to be a primary operation guideline for local administrations. They can process solid waste management during flooding effectively and rapidly. Also, they can determine guidelines/standards for short-term and long-term solutions by identifying problems of solid waste management during flooding. Previously the emergency situation made them focus on helping flood victims as a priority, and didn't prioritize on solid waste management problems. There were no prevention plans or guidelines on solid waste management during flooding and people were lacking of knowledge, understanding and awareness of solid waste problems during flooding. The flood waste components that are commonly seen during the water level decreasing include household waste (biodegradable waste, general waste and hazardous waste), construction/lumber and sediment soil/sand. The local administration should take measures such as flooding preparation, solid waste management solution guidelines and should follow-up and verify results after improvement/rehabilitation.



Source: www.thaiflood.com

**Figure 1** Flooding Area in Thailand 2011

Integrated Disaster Information Management Center (2011) (www.K4flood.net) has mentioned in the Waste and Garbage Management in Flooding Situation Guideline [3] that the goals of waste management methods are: reduce quantity of waste, minimize storage area and to stop people throwing waste in the flooded areas. These methods will help reduce putrefaction of the water and epidemic disease.

Department of Disease Control (2011) has identified hazardous waste found in households after the water level dropped such as household cleaning substances, paint and related products, chemical or engine fluid, electronic waste, cosmetics, medicines and other things including light bulbs. The proper standard for removing hazardous waste from the house after the water level has

decreased is to separate hazardous waste from general waste, to open doors and windows for better ventilation and to put on proper personal safety equipment during cleaning.

OCHA, MSB and UNEP (2011) have categorized solid waste management from disaster management framework into 4 phases. These are Emergency Phase, Early Recovery Phase, Recovery Phase and Contingency Planning. The crucial considerations of solid waste management teams in a flooding situation include staff health and safety on duty, integrating with related workers in waste management, communication and public relations and risk of hazardous waste in the flooding situation.

US.EPA. (2008) have decided that composition of solid waste management from disaster planning should consist of: [6]

1) Activities that must be conducted before planning solid waste management during flooding such as study processes or guidelines of solid waste management in flooding situations from relevant agencies, establishing committees to work on local solid waste management, consideration of the timeframe to have a proper adjustable plan and always be up to date.
2) Activities must be conducted during planning such as estimating type and quantity of waste from flooding, creating a list of related rules, procedures and suggestions, considering equipment and personnel needs, considering current local administration capability on solid waste management from flooding, considering initial temporary storage waste area, creating a plan of communication and public relations, and providing a plan for damage prevention from flooding.
3) Solid waste management plan for the flooded area such as separations, transferring plan, hazardous waste separation and management, and solid waste disposal solutions.

## 3. METHODOLOGY

Providing the solid waste management in flooding situation guideline has been conducted as follows:

3.1) Study and review solid waste management during flooding situation and after, including other current related processes used domestically and internationally.

3.2) Prepare a draft of a manual that acts as a guideline on solid waste management in flooding situations in Thailand.

3.3) Provide meetings for domestic specialists and the 20 local administrations that are responsible for solid waste management to discuss the draft of the guideline on solid waste management in flooding situations in Thailand.

3.4) Improve the draft of the guideline on solid waste management in flooding situation in Thailand as comments from the meetings for domestic specialists.

3.5) Provide workshops with 60 attendees inviting domestic and international specialists such as those from Japan, Indonesia and the Philippines to discuss their opinions on solid waste management during flooding situations in Thailand.

3.6) The domestic specialists should improve the draft using comments from the workshop meeting for the most suitable implementation of solid waste management in flooding situations.

## 4. RESULT

The result of the study on the process of solid waste management in flooding situations divides into 3 stages as follows:

Stage 1 Preparation/planning on solid waste management in flooding situations which are in pre-flooding stage.
Stage 2 Implementation during situation and after.
Stage 3 Evaluations are processed after the water level has dropped by comparing outcomes with the prepared plan.

The plan includes the process of activities as show in Figure 2; each stage consists of the following:

4.1 Stage 1 Preparation/planning on solid waste management in flooding situation

Preparation/planning on solid waste management in flooding situations is detailed as follows:

1) Activities that must be conducted before planning, consisting of:
   - Assessing the severity of the flooding will help to estimate possibly affected areas, as well as estimating the quantity and components of the waste.
   - Study process or guideline on solid waste management in flooding situation from agencies who have provided assistance.
   - Establish a special agency center of flood prevention and solutions by setting up the solid waste management committees during flooding.
2) Activities that must be conducted during the planning stage, consisting of:
   - Estimate quantity and components of solid waste caused by flooding.
   - To assess capability of local administrations in solid waste management during flooding, including personnel and equipment.
   - Considering capability of local administrations in nearby areas and related agencies by creating a list with details of agencies that can provide support in solid waste management during flooding.
   - Waste containers and waste trucks transfer plan.
   - To protect disposal area or solid waste transfer center by building up soil wall or wall to prevent flooding. Protect solid waste from spreading by nesting around the area.
   - To provide temporary site for solid waste when the area is flooded and flooding may have damaged the disposal area or solid waste transfer center of local administration. The disposal area may not have been damaged but the entrance to the area or the center may not be able function because of flooding or damage. Therefore, they need to provide temporary solid waste storage management area during flooding as suggested by agencies such as US.EPA. (2008). Figure 3 shows the sample of temporary solid waste area layout.
   - To provide communication and public relations plan, including determining information that needs to be announced.
3) Flood solid waste management plan such as:
   - Solid waste separation plan.
   - Solid waste transferring plan.
   - Identifying hazardous waste and managing it.
   - To consider disposal solutions for solid waste.
   - Implementation of the prepared plan.

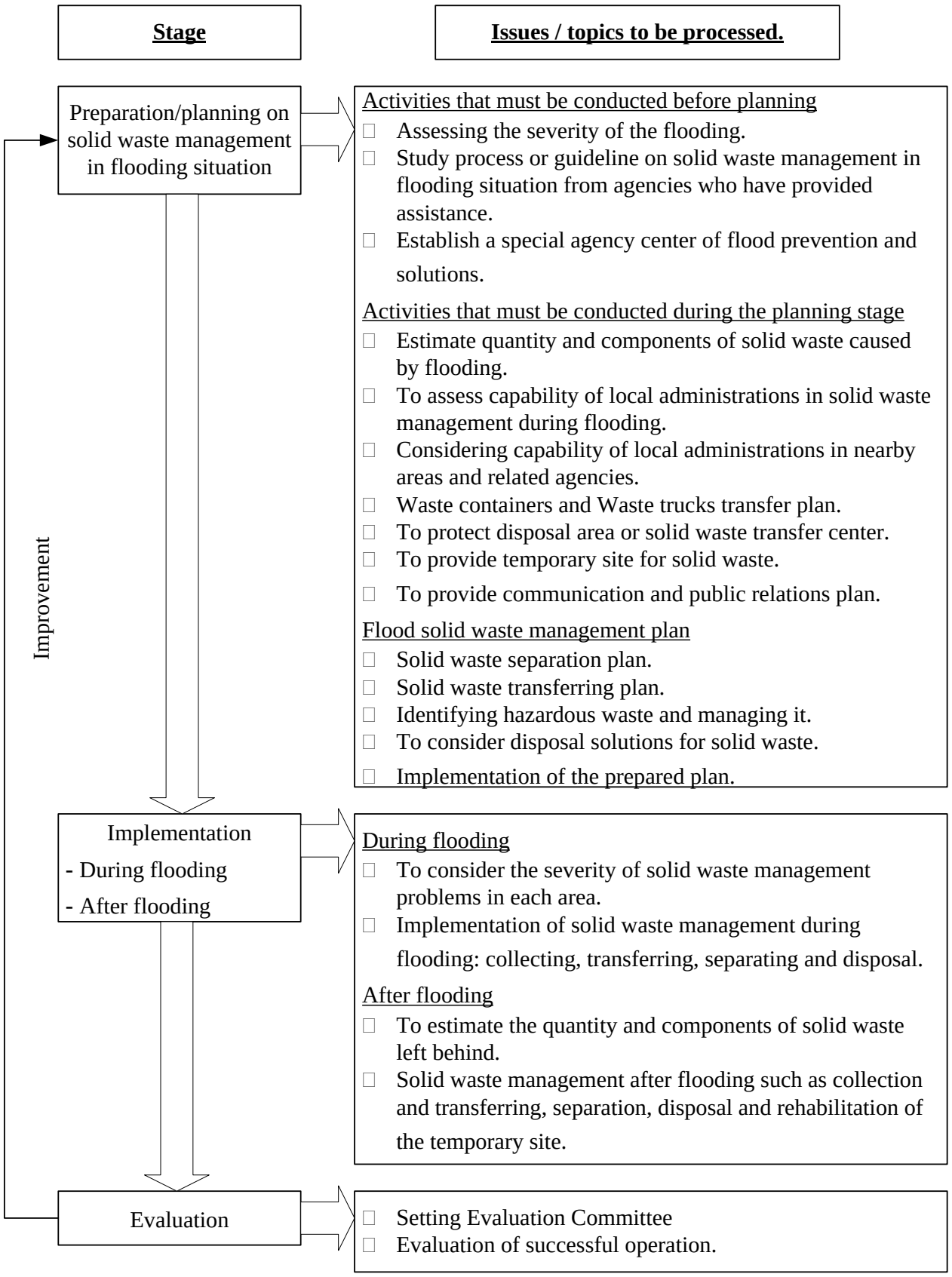



**Figure 2 Solid Waste Management in Flooding Situation Stage**

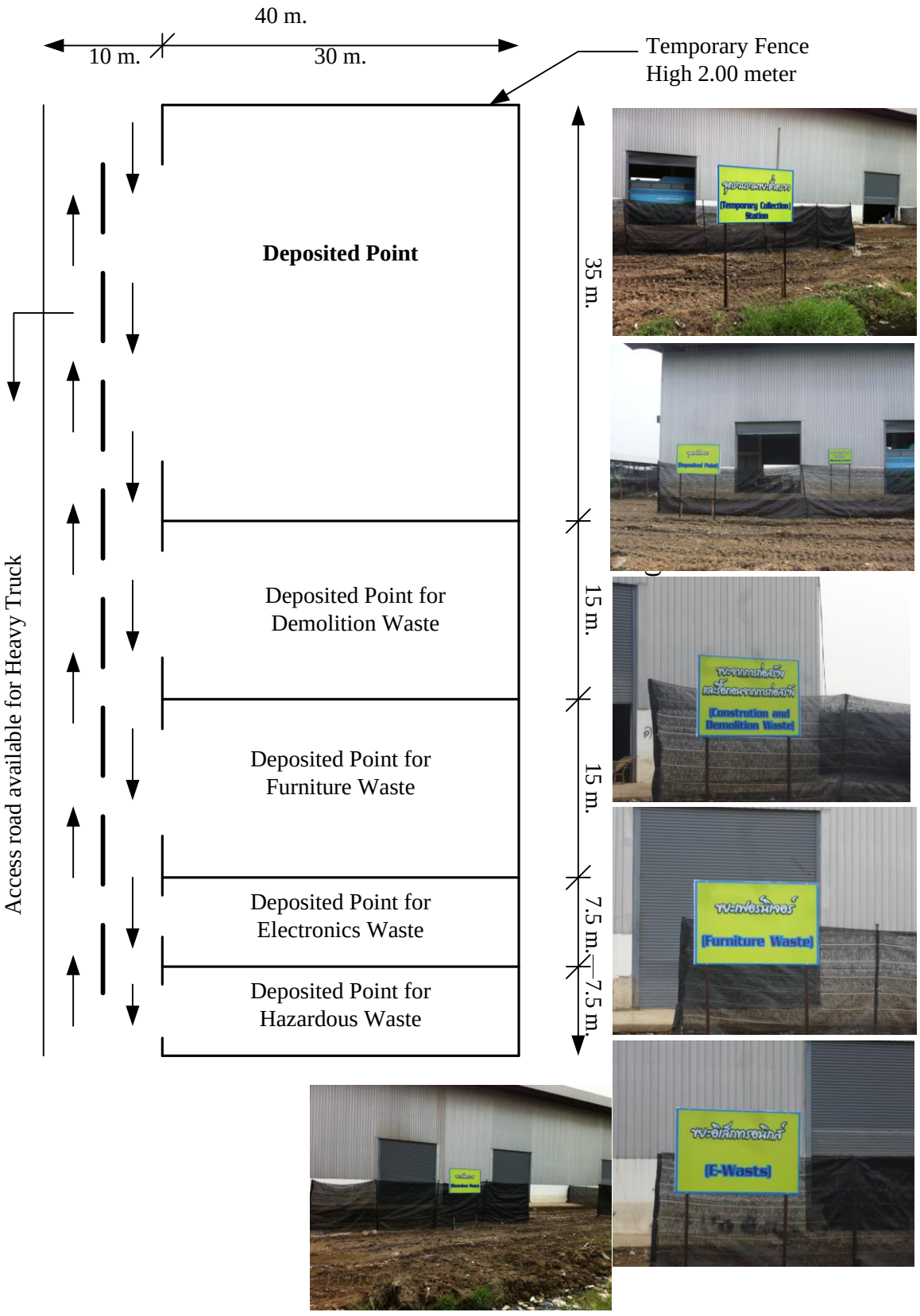



**Figure 3 Temporary Site Demonstration**

4.2 Stage 2 Implementation

Implementation process consists of 2 periods,

1) During flooding (the water flooding)
   - To consider the severity of solid waste management problems in each area.
   - Implementation of solid waste management during flooding: collecting, transferring, separating and disposal.
2) After flooding (the water level has decreased)
   - To estimate the quantity and components of solid waste left behind.
   - Solid waste management after flooding such as collection and transferring, separation, disposal and rehabilitation of the temporary site.

4.3 Stage 3 Evaluation

After processing the preparation/planning stage and implementation stage during and after flooding, the evaluation must be conducted and compared with the determined plan. The evaluation has to cover the following issues at minimum:

1) The result of operations for solid waste management in the flood situation that just occurred, including collection and transferring, separation (by types and quantities), solid waste disposal and rehabilitation of temporary solid waste area.
2) The budget for solid waste management during the flood.
3) To assess the negative consequences of the solid waste management system.
4) Problems and obstacles in the implementation of solid waste management during the flood.
5) Solutions to aforementioned problems and obstacles.
6) The key success factors for the implementation of solid waste management during the flood.
7) Evaluation of the indicators set out in the plan

Evaluation method, having committees monitor and evaluate performance from preparation/planning during and post flood.

## 5. CONCLUSION

To provide a solid flood waste management guideline for agencies that are responsible for local solid waste management to be prepared and able to manage solid waste properly, rapidly, efficiently and can reduce the quantity of solid waste which the locals will dispose of during flooding. It has to cover the phases of pre-flooding, during flooding and rehabilitation after flooding. Including implementation of evaluations to be compared with the prepared plan.

Therefore, implementation will consist of 3 stages such as:

Stage 1 Preparation/planning of solid waste management in flood situation

Stage 2 Implementation

Stage 3 Evaluation

For providing implementation of solid waste management plans in flood situations, each local administration will provide a proper manual to suit their own area for the most effective operation.

## 6. ACKNOWLEDGEMENT


- Pollution Control Department (PCD), Ministry of Natural Resources and Environment, THAILAND
- United Nations Environment Programme (UNEP)
- Korea International Cooperation Agency (KOICA)


## 7. REFERENCE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