

CHAPTER II

LITERATURE STUDY

2.1. General

Natural disasters are catastrophic events triggered by natural hazards, causing widespread injury and damage. Disasters overpower local resources and require considerable support outside of the local community. Vulnerability of population is the root cause of disasters. Vulnerability is a potential loss of people and goods as a consequence of a damaging phenomenon, social and economic conditions and perceptions, institutions and policies of the society. Hence, there is no such thing as an entirely natural disaster (UNESCO, 1995).

2.2. Non-Structural Measure for Floods Management

The definition of disaster management is an event, natural or man-made, sudden or progressive, which impacts with such severity that the affected community has to respond by taking exceptional measures. (Carter, 1991)

Non-structural method for disaster management is a method to mitigate disaster without construct technical building to control the disaster. Non-structural measures consist of monitoring, forecasting, warning, and evacuation system, etc. This method is might be more effective to overcome disaster problems than structural method and its less finance needed. Because involve public participation and optimal the land-use (the maintenance of inventories of resources and the training of personnel) to develop an effective disaster management.

The existing disaster treatment usually only a structural measure, but the fact, it is not optimally solve the problem (only solve the problems in partial part and the result are not optimal) and it needs a lot of money. Implementation of non structural and structural method integrally will solve the disaster problems and reduced the losses. Non-structural measure of disaster management also follows

the sequence of management, included: Planning, Organizing, Directing, Coordinating, Controlling, Supervising, Budgeting, and Financing.

At present, especially for flood disaster become greater then before. Increasing on population and property values in flood-threatened lands has brought the problem into sharper focus in recent years. If river has reached its maximum discharge because of greater floods, then unexpected worst disaster can happen. The measures that already done were only solved the problems in partial, because it is only focus on physic measures, it is not solving whole disaster problem. According to the fact, structural method could not overcome all of the disaster impact. Therefore, non-structural method is might be the one for public view of disaster mitigation. The aspect of disaster reduction, the measures in terms of non-structure measures are a management cycle. The disaster management cycle illustrated on figure 2.1 below:

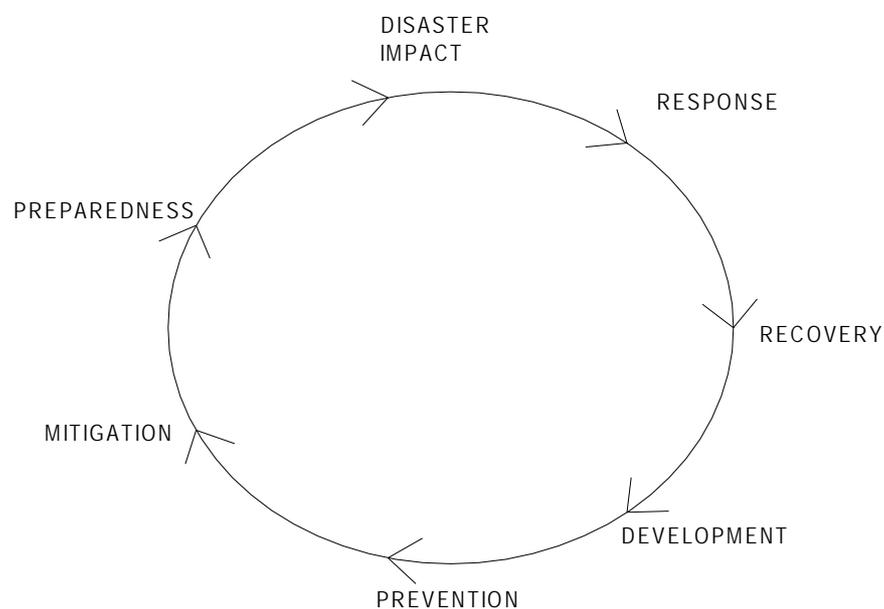


Figure 2.1 The basic format of the disaster management cycle

2.2.1. Prevention

Prevention measures aimed at impeding the occurrence of a disaster event and / or preventing such an occurrence having harmful effects on communities. The following major considerations which apply to disaster preventions (Carter, 1991):

1. National development planning

Disaster and national development are in reality close related. This especially applies if the disaster threat is significant. National development planning needs to take into account the possible effect which disaster may have on the various programs and projects involved. However, such programs and projects may affect the nation's ability to cope with disaster, because whilst some of them may reduce risk and vulnerability, other can actually increase it. Nations usually gives priority to programs such as medical and health, education, economic development and so on. Also, considerations affecting disaster prevention may be given limited priority in national development plans, or may be omitted together from such plans. Thus, measures of prevention do not receive adequate/appropriate attention in national planning. In fact, national development projects may actually increase disaster risks, rather than help to prevent them.

2. National disaster management policy

There is need for a clear and comprehensive national disaster policy which addressees the total disaster management spectrum, including consideration of all aspects of prevention. Within this policy there must be a readiness on the part of government to institute preventive measures (especially where these affect the national interest) regardless of their popularity. National disaster management policy must relation with the other national policies. Therefore other national policies could support national disaster management policy, so that the prevention programs will success.

3. Disaster legislation

Legislation provides a formal foundation for disaster action generally. In other word, it formally supports plans, organizational arrangement, preventions measure, mitigations, and so on. Consideration of future disaster prevention usually come a lower priority, if indeed, any consideration is given to it at all. That is also the relevant point that over many years priorities in international disaster assistance tend to be given to relief and recovery measures, rather than preparedness, mitigation, and prevention. So, it needs a balance in disaster management to give priority to prevention to less the victims. In implementing disaster legislation does not need to be complicated in order to be effective.

4. Counter-disaster planning

The purpose of counter disaster planning is to anticipate future situations and requirement thus ensuring the applications of effective and coordinated counter measure.

2.2.2. Mitigation

Mitigations actions are taken usually in the form of specific programs to reduce the effects of a disaster on a nation or community. The term normally implies that whilst it may be possible to prevent some disaster effects, other effects will persist and can be modified or reduced if appropriate action is taken. There are seven major for non structural mitigation components (Carter, 1991):

1. Legal framework

Land use planning and the application of building codes provide some legal basis for successful mitigation.

2. Incentives

Incentive can often provide better inducements for mitigation than legal impositions. Insurance can provide useful incentive. For instance,

insurance companies may be persuaded to offer reduce premiums for building, once hazard resistance measure have incorporated.

3. Training and education

If mitigation is to be successful, its requirements must be widely known and understood. Therefore, there is a need to train and educate all those involved, including disaster management officials, construction specialists, and the general public. In this regard public awareness programs can provide an important foundation by informing people generally of the need for and benefits of mitigation programs. In more specific sense, programs of training and educations are necessary to ensure that mitigations programs will be supported and properly implement. Four target groups are especially important (Carter, 1991):

- a. Public official who play vital role in disaster management.
- b. Appropriate training modules should be incorporated with their career-path programs and opportunities provided to them to attend specialist courses.
- c. Technical student whose professional educations should include disaster mitigation course.
- d. School children who should be introduce to simple mitigation measures in the context of environment studies, natural science or geographical.

4. Public awareness

Public awareness is an important for cope the disaster, because awareness is needed to succession of plan overcoming disaster. Public awareness including: a good public knowledge and understanding of local hazards and vulnerabilities, public awareness of the kind of mitigation measures which can be applied, public awareness of policy and public participation in community preparedness programs.

5. Institution building

Strong institution can play a vital role in various aspects of mitigation, such as promoting public awareness programs, training at community levels and monitoring hazards and vulnerabilities.

6. Warning systems

Dissemination of warnings should use duplicate systems to ensure effectiveness. It might use radio message backed up by siren warnings, warnings flags backed up by house-to-house visits by local government, or can used a traditional tools such as *kentongan*.

7. Agricultural mitigation measures

This measure usually done on plantations area, or in up stream of watershed. These measures include: The planting of shelter breaks, comprised of trees and shrubs to reduce wind effects, crop diversification, adjustments to crop planting/harvesting cycle, and food storage programs to insure against shortage arising from disaster.

Mitigating means planning, programming, setting policies, coordinating, facilitating, raising awareness, assisting and strengthening. It also understands educating, training, regulating, reporting, forecasting, warning and informing. Guarding against floods has received much attention due to the damage that floods cause. The Natural Hazard Research and Applications Research Centre (1992) list four basic strategies for floodplain management:

- Modify susceptibility to flood damage and disruption (zone or regulate land use in the floodplain).
- Modify the flooding (use flood control reservoir).
- Modify the impact of flooding on individuals and the community (uses mitigation techniques such as insurance and flood proofing).
- Restore and preserve the natural and cultural resources of floodplains (recognize the values of floodplains and use them for recreation and other appropriate activities).

There are three concepts of flood mitigations (UNESCO, 1995):

- Flood preparedness

Community flood preparedness is an analysis of possible disaster scenarios for determining how authority and responsibility for action should be delegated, what local human and material resources exist, and how these can be deployed. Flood preparedness plan is a series of sub-plans, including emergency response planning and training, raising public awareness, flood forecasting and warning, setting development policy, land use regulation, flood proofing, setting alternative plans, and local social structure. Individual preparedness planning is based on raising public awareness. Realistic treatment of flooding related problems is a prerequisite for building confidence, confusion during evacuation, disruption of daily routine, strain on families removed from their homes, distress, altered social relationships, loss of feeling of security, personal vulnerability and many others are real psychological issues that need to be addressed in this planning stage and treated as inevitable events and a quite normal behavior.

- Emergency response

Emergency response can be considered as a series of sub-plans that address communication and public information management, search and rescue co-ordination, shelter management, stockpiling and distributing of food and supplies, contacting and requesting additional support, debris management, financial management, volunteers coordination and donations management. The foundations of a flood emergency action are a mobilization plan, comprehensive disaster plan and well coordinated and trained flood fighting corps. A flood fighting corps may be mobilized to a state of alert with various stages: mobilization, preparation and stand-by and dismissal. It is useful to have powers to call up the inhabitants when high water threatens, with preference given to volunteers. Organization and training of search and rescue teams are done locally, regionally or nationally but in real flood conditions, participation of volunteers, citizens and relatives is significant, thus requiring the co-ordination to develop as the action proceeds.

- Rehabilitation

Post-flood management problems can be pre-planned. In order to achieve this, objective surveys need to be carried out during the flood for preparing the situation report covering human casualties and material damage. These surveys are needed for making decisions on the actions during the immediate emergency and in the period that follows. Later on, a thorough study needs to be made in order to perform a formal assessment of the damage. Rehabilitation is providing services and facilities that will restore the former living standard and encourage adjustments to changes caused by the flood. Restoring morale is one of the most important factors in rehabilitation. Rehabilitation should be carried out separately for the flood victims and the disturbed public services.

Therefore, regulations by central and local government are needed for supporting and strengthening the right measures should be taken. They should provide leadership and assistance in developing a comprehensive multi-level hierarchical flood management plan where responsibility and authority of each participant in flood fighting is clarified. The central government initiates elaboration of the flood preparedness program. This program is based on flood hazard studies and mapping, flood forecasting and warning, public education, and response planning.

The local government is then responsible for implementation and maintenance of the site-specific programs. All preparedness measures need to be supported by appropriate legislation in a form of the national flood control laws, regulations, and local ordinances. Legislation for flood reduction measures should be incorporated within the technical legislation covering urban development, regional development, environmental management, resource management, communication, housing etc.

2.2.3. Preparedness

Measures which are enable governments, communities and individuals to respond rapidly and effectively to disaster situations. Preparedness measures include the formulation of viable counter-disaster plans, the maintenance of inventories of resources and the training of personnel (Carter, 1991). Preparedness measure tends to be more strongly oriented toward action by individual and government organizations or non government organization. The maintenance of effective disaster preparedness is a dynamic requirement. Therefore, to fulfill this requirement preparedness needs (Carter, 1991):

1 National Disaster Policy

There need for clear and comprehensive national disaster policies which cover all aspect of disaster management and which ensure that preparedness is given proper consideration and priority. So that preparedness measures has foundation to be implemented.

2 Disaster Legislation

Special disaster legislations may necessary to ensure that preparedness aspect of national policy are adequately covered and implemented.

3 Organizational Structure

There is also needs to be clear and workable organizations structure, so that levels of disaster preparedness are identified. Disaster legislation helps to formalize this aspect. There is also need within the organizations structure for some form of national disaster management section or office.

4 National disaster Management section

In the relations to preparedness, some form of disaster management section or office is vitally important. Thus, there need to be continuous process of monitoring applied to the wide range of necessary preparedness activities. This can be done most effectively by a specialist section.

5 Assessment of Preparedness Actions

Adequate arrangements for identifying, assessing and monitoring the disaster threat are also necessary. In turn, this enables a reasonable forecast to be made of the likely effect arising from disaster. Preparedness is vitally concerned with this effect, because they constitute the actual circumstances, events and problems against which preparations need to be made. Usually, these effects are many and varied. Therefore, preparedness measures to deal with these effects need to be determined and put in the place before disaster strike.

6 Planning Framework

If preparedness measures are to be fully effective, they need to be clearly set out in appropriate plans. Such plans usually need to apply at national, province, and local government levels. If preparedness measures are set within this planning framework, responsibilities for them can be clearly and officially defined. This also helps to ensure that measures can be systematically monitored and kept up to date.

7 Training

Training is obviously a most important component in preparedness. If possible, a permanent training system and program is desirable. This should cover not only the needs of government officials but also those of non government organizations or residents. In addition, training is required for persons who may fulfill or assist the disaster management roles during times of emergency (such as volunteers from within community).

8 Public Awareness and Education

Awareness, alert and informed public is a most valuable asset for preparedness. Public awareness programs can be presented in a variety of forms, to suit particular circumstances.

2.2.4. Response

Response measures are usually those which are taken immediately prior to and following disaster impact. They are directed towards saving life and protecting property and to dealing with the immediate damage and other effects caused by the disaster (Carter, 1991). There are certain characteristics which typically apply to response effort, these include (Carter, 1991):

1. The type of disaster

Depending on its type, the onset of disaster may provide long warning, short warning or no warning at all. This will obviously influence the effectiveness of activations, mobilizations and application of response effort. In other words, type of disaster determines response which will be taken.

2. The severity and extent of disaster

This represents the size and shape of the response problem and particular affect aspect such as:

- a. The ability of response effort copes with the problem.
- b. The urgency of response actions and the priorities which are applied.
- c. Exacerbation of disaster effects if appropriate action and the priorities which are applied.
- d. Requirement for external assistance.

3. The ability to take pre impact action

If warning time and other conditions permit pre action to be taken, this may have a major effect on success of response overall.

2.2.5. Recovery

Recovery is the process by which communities and the nations are assisted in returning to their proper level of functioning following a disaster (Carter, 1991). The process are assisted in returning to their proper levels of functioning

following a disaster by which communities and the nation. The recovery process can be much protected, taking 5-10 years, or even more. Recovery is usually taken as including other aspects such as restoration and reconstruction.

2.2.6. Development

Lessons and experience gained from disaster event can be utilized to improve many aspect of disaster for the future. Therefore, development is needed to arrange the new disaster management system which expected can reduce the impact of disaster in the future.

2.3. Tools for Non-Structural Measures

There are some strategies in implementations non structural measures, the strategies as follows (Grigg, 1996):

- **Modify Susceptibility to Flood Damage and Disruption**
 1. Floodplain regulations.
 - a. Provincial regulations for flood hazard areas.
 - b. Local regulation for flood hazard area.
 - Zoning.
 - Subdivision regulations.
 - Building codes.
 - Housing codes.
 - Sanitary and well codes.
 - Other regulatory tools.
 2. Development and redevelopment policies.
 - a. Design and location of services utilities.
 - b. Land right, acquisition, and open space.
 - c. Redevelopment.
 - d. Permanent evacuations.
 3. Disaster preparedness.
 4. Disaster assistance.

5. Flood proofing.
 6. Flood forecasting and warning systems and emergency plans.
- **Modify the Impact of Flooding on Individuals and the Community**
 1. Information and education.
 2. Flood Insurance.
 3. Tax adjustments.
 4. Flood emergency measures.
 5. Post-flood recovery.

 - **Restore and Preserve the Natural and Cultural Resources of Floodplains**
 1. Floodplain, wetland, coastal barrier resources regulations.
 - a. State regulations.
 - b. Local regulations.
 - Zoning.
 - Subdivision regulations.
 - Building codes.
 - Housing codes.
 - Sanitary and well codes.
 - Other regulatory tools.
 2. Development and redevelopment policies.
 - a. Design and location of services and utilities.
 - b. Land rights, acquisition, and open space.
 - c. Redevelopment.
 - d. Permanent evacuations.
 3. Information and education.
 4. Tax adjustments.
 5. Administrative measures.

2.4. Establishment of Institutional Setup for Flood Warning and Evacuation

Flood warning systems and its associated procedures, must be clearly defined and written down in plans, standard operating procedures and all other relevant documents. It must be known to and understood by all key government ministers, disaster management organizations and officials, other relevant persons and the general public. The warning system must possess the capability for:

- Receiving international warning.
- Initiating in-country warning.
- Issuing warning at national and other government levels, and at community level.

Flood warning system must be possessed by all part of institutions and persons to know what action should be taken. Process evacuation is depending on the extent of flood disaster. This will obviously influence the effectiveness of activation, mobilization and application of evacuation efforts. Evacuation had two types (Carter, 1991):

- *Precautionary*. In most case undertaken on warning indicators, prior to impact, in order to protect disaster-threatened persons from the full effects of the disaster.
- *Post-Impact*. In order to move persons from a disaster-stricken area into safer, better surroundings and conditions.

One of major aspect which relates to evacuation is a really clear and detailed understanding of flood damage. An evacuation decision-maker should fully understand about floods hazard, so they can make accurate decision. Therefore, the government should establish an institutional setup for flood evacuation to helps accuracy of evacuation decision and make it easier to handle.

2.5. Development of Flood Monitoring and Dissemination Facilities

An endemic floods region must have flood monitoring equipments to predict sudden rainfall and using it for early flood warning system. It has capability to forecast the intensity and period-time of rainfall that can combine with watershed characteristically measurement to approximate the mass of floods.

An automatic flood monitoring facilities such as water level gauging station should be installed on the river in one watershed system to record the data. It gauges daily rainfall and water level information for floods prediction (water level monitoring and warning improvement). Flood warning system can be assembling by connecting the automatic rainfall measuring instrument (rainfall gauge), automatic water level recorder / AWLR in upstream, automatic water level recorder / AWLR) in down stream which is connected with the post center of control which observed by operator continuously.

2.5.1. Observation Systems on Rainfall Gauging Stations and Water Level Stations

The floods monitoring system use rainfall gauging stations and water level stations. Rainfall gauging stations used to gauges the daily rainfall and records its data. While water level stations is used to record the data increasing of water level. Both of them are using as floods prediction and information of warning system.

2.5.2. Development of Flood Monitoring Systems

Monitoring water level using water level gauging stations are applied for general river flow in watershed area. It is required to replace the water level measuring to forecasting the river discharge. It needs at least two water level stations. The first water level station is located in the upper area and the second one is located in down stream area or flood-prone area.

The graph combination of water level and floods discharge are determined of its period-time coming. Floods discharge in upper reaches area is detected, an approximate period-time increasing of water level would be detected by the gauges. Afterward, the time of flood for reaching on downstream area could be predicted. Monitoring with rainfall gauging stations is needed to predict floods more early, especially for endemic area. It placed in danger certain river of one certain watershed. The systems will automatically record the rainfall data (the intensity) and send them to rainfall processing stations that will give floods-forecasting earlier.

2.5.3. Development of Dissemination Facilities

Dissemination of rainfall gauge stations in one certain watershed should be on different height area and certain distance to get rainfall data accurately. While, water level gauge stations are placed in rivers with certain flood discharge to get water level data. All the data must represent the condition of the area to support an accurate decision, then using it for:

- a) Monitoring/forecasting of peak discharge.
- b) Warning to inhabitants about the disasters risk.
- c) Adequate evacuation.
- d) Information of disaster prevention.

2.6. Development of Flood Warning System

To protect the densely populated area from inundations, it is necessary to develop flood warning system. Therefore, flood warning system will reduce the susceptibility of floods damage on assets, social infrastructures and agricultural land even life. Flood warning system in principle has meant that society which living in flood prone area can obtain earlier information about floods magnitude which possible happened, gives adequate time to evacuate victim so that minimize the losses. The magnitudes of flood are included: peak of discharge, time of discharge. Flood warning also provides information about inundations which

possible happened, furthermore can make decision for procedure of the evacuation. Platform dekser was installed on river to gauge the water elevation. Hence, it would be detected flood occurrences. Base on Ministry of Public Work Department's resolution no.392/KPTS/1998, flood warning system divided into three level of announcement as follows.

Table 2.1 Level of status on warning system

| STATUS | TIME OF ANNOUNCEMENT | |
|--------|-----------------------|---------------------------|
| | Status PU-PB Province | Status PU-PB Sub District |
| SIAP | 6 hour | 1 hour |
| SIAGA | 3 hour | 1 hour |
| AWAS | 0,5 hour | 0,5 hour |

(Source: Ministry of Public Work Department's resolution no.392/KPTS/1998)

2.6.1. Current Systems for Flood Warning Systems

An effective system of warning is vitally important for successful response measures. The main needs for warning system are:

- Initial detection, as early as possible, of the likelihood that flood will occur.
- Origination of the warning process as early as practicable, bearing in mind false or unnecessary warning needs to be avoided
- Effective means of transmitting warning information
- Facilities to receive and assess warning information
- Response decisions, as a result of assessing warning information
- Dissemination of response decisions and, as appropriate, broadcast of warning information to the public.

2.7. Public Participation for Disaster Prevention

Public participation is important issue to overcome the disasters. Its aim is to promote an informed, alert and self-reliant community, capable of playing its full part in support of and in co-operation with government in disaster prevention.

2.7.1. Public Participation for Disaster Prevention in Semarang City

Prevention effort was very important for disaster mitigation. This effort will mitigate the effects of floods. Public participation need to be clearly defined to place responsibility among the public. The residents and other who has affected of flood occurrence should take part in this participation. Successful this effort is determined by public awareness. Therefore, public participation was needed. The disaster prevention efforts involve public participation, such as:

- a. Cultivating of vegetation on watershed.
- b. Maintain the river and river banks.
- c. Maintain the drainages system.
- d. Regulate construction building on river banks.
- e. Law enforcement.

2.7.2. Measure for The Strengthening of Public Participation

Mitigating flood disaster effects need public participation to make success promotion. For strengthening public participation the government must create some regulation to enhance public awareness of their environment and to reduce the losses caused by disaster, that is:

- Create regulations on flood disaster mitigation.
- Environmental regulations to prevent over exploitations.

2.8. Development and Dissemination of Flood Hazard Map

Making flood hazard map needs flood magnitude of inundation include width, depth, and time of inundation representatives by a map. The relationship of rainfall intensity with flood magnitude changing could be used to predict the inundation fluctuation in flood hazard area. Therefore, flood hazard map on flood prone-area is needed for flood mitigation. It is not only improved public awareness but also control flood prone-area and minimize the floods damage. The main benefits are:

- Mapping floods areas give early warning to resident and moreover for relocation plan.
- Updating of floods mapping to evaluate treatments that had been taken on floods management.
- Reducing mistakes on finance allocation for the program especially rehabilitation.

2.8.1. Inundation Area in Recent Years

The list of place and depth of floods the inundation is needed for flood-prone area. It needs for create an appropriate solving of flood impact. In recent years, the inundation area becomes larger than before (increasing in quantity and quality) and failures of environment management make it worse. So, this problem like unsolved. Based on floods inundation mapping, changing of wide, depth, and time of inundation could be seen. Furthermore, flood mapping is used for making decision to support system in flood fighting and flood mitigation for short term and long term project.

2.8.2. Items to be Adopted for The Flood Hazard Map

In floods hazard mapping there are some variable to be consider for ensuring floods mitigation, they are:

- Land use
According to the existing data, Semarang city land-use consists of: non-crop field 33.414,09 hectare (89, 11 %) and crop field 3.956,30 hectare (10, 59 %).
- Climatology
Based on BMG the yearly average temperature on Semarang city is 27,4°C (from 21° C to 35°C) and yearly rainfalls from 1800 mm to 2600 mm and the rainfall tend to increase in hill area (south area).
- Topography and Geology

Semarang consists of three regions which are very differing. There are hilly region (+2.050m from MSL with sediment-volcanic rocks), lowland region (+10m from MSL with alluvial sediment), and transition area (+50-200m from MSL).

- Wide and form of watershed

The wide and the type profile of watershed had influence the run off velocity, because have correlation with time concentrations and rainfall intensity.

- Society problem

Semarang is high rapid population city. (Density: 1,51% year in 2000). (BPS, 2005; Suripin, 2003).