

# Flood Disaster Management in Malaysia: Standard Operating Procedures (SOPs) Review

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**Abstract** Flood is a natural weather-related disaster frequently occurring in Malaysia. One of the greatest challenges that Malaysia faces today is recognizing the magnitude of risks posed by flooding. The public, private and NGOs should deliberate the amount of investments required to reduce the flood risk, including making appropriate emergency preparations, strengthening the existing Standard Operating Procedures (SOPs), and finding new solution for minimizing risk related to flood disaster. The current existing SOPs indicate that there is still lack of holistic flood risk management system to minimize this problem. The country should be committed to establish a national policy on flood risk management that requires effective, economical, sustainable, and consistent management of flood risk to people, properties, and communities. Risk management has been established as a well-defined procedure for handling risks due to natural, environmental, and man-made hazards. A risk management can be applied at every level of the action: planning, design, and operation level. A holistic flood risk management system will evaluate the potential risk before, during, and after the flood disaster. The paper reviews the current SOPs implemented by the agencies dealing with flood disaster in Malaysia.

**Keywords** Flood · Standard operating procedures (SOP) · Flood risk management

## 1 Introduction

Almost every end of the year during the northeast monsoon, the east states of Peninsular Malaysia will be inundated by flood water. Flooding is the most significant natural hazard in Malaysia, as evidenced by the history recorded since 1920, in which the country had experienced major floods in 1926, 1963, 1965, 1967, 1969, 1971, 1973, 1979, 1983, 1988, 1993, 1998, 2005, and most recently was in December 2014. The main causes of flood occurrence in Malaysia are the

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abundant amount of rainfall, in addition to other factors such as deforestation, tidal effect, lack of maintenance to the river system, and increased number of urbanized areas with inadequate drainage that cannot support the amount of flow during the heavy rainfall. The combination of natural and human factors has produced different types of floods such as monsoon, flash, and tidal flood. Flood had caused extensive damages to property, road and railways system, agricultural land, crops, and loss of life. Following the disastrous 1971 flood, the government had established the Disaster Management and Relief committee (NDMRC) in 1972 for coordinating the flood relief operations at national, state, and district levels.

The main purpose of the study is to produce a holistic flood risk management system (HFRM) for flood disaster in Malaysia. The HFRM system can become a very useful tool for the public, private, and other related agencies to assess the risk before, during, and after the flood disaster. In Malaysia, National Security Council (NSC) together with other agencies such as Department of Irrigation and Drainage (DID) are the responsible parties for coordinating all relief operation before, during, and after flood events. To achieve this aim, the study will examine the current SOPs related to flood disaster. The focus of this paper was to review the current SOPs implemented by the country and assess the need of HFRM system to improve the flood management in the country.

## 2 Flood Disaster Management in Malaysia

Disaster had and will always be a part of life so long as hazards and risks exist. Many developed countries nowadays are still challenged with problems when faced with the flood disaster although they are well-equipped with sophisticated structural and non-structural measures and defense systems. The flood hazards are almost certain; what we can do is to minimize the impact of disaster in order to save people and properties. Risk assessment and validation of flood disasters are a worldwide problem in the field of natural science and technology.

In Malaysia, floods occur frequently in urban or rural areas and cause the greatest damages among all natural disasters. The damages caused by floods estimated annually were MYR 1 billion that affect 21 % of Malaysia's population [1]. Floods occurred at varying severities in East Coast of Peninsular Malaysia especially in Kelantan. There are three types of flood in Malaysia: the monsoonal flood, flash, and tidal flood [2]. Monsoonal flood is due to heavy rainfall usually occurs in a longer period from one week to a month. In urban areas, flash floods normally occur during a short period within two or three hours due to highly intense rainfall.

Floods are not new to the country, but what have been done to mitigate and manage this disaster. There is a need to understand the concept of disaster and what it entails, as well as the country's flood risk management system which covers the activities before, during, and after a flood disaster tragedy.

In Malaysia, the Natural Management and Relief Committee (NDMRC) coordinates flood relief operations at every level: national, state, and district levels [3].

The flood disaster management is based on National Security Council (NSC) Directive No 20 and Fixed Operating Regulations (PTO). It describes the responsibilities of various agencies and the cooperation of these agencies in managing disaster. The National Flood Disaster Relief Machinery (NFDRM) is the committee that reacts to major floods based on reactive system [3]. This committee is responsible for operations at national, state, district, mukim, and village levels [2]. The relief machinery and emergency flood management covers the flood forecasting and warning system (pre-disaster), flood relief machinery (during disaster), flood management emergency (during disaster), and funding and aid delivery system (post disaster).

### 3 Malaysian Flood Disaster Management Model

For pre-disaster flood management, flood forecasting systems have been developed and used by the Department of Irrigation and Drainage such as linear transfer function model and tank model to forecast for future flood in the flood prone areas. Information from the model was used for flood preparation to the potential area to be hit. Dissemination systems such as SMS, telephone, warning sirens, fax, and Web site were also used as flood warning system. Although there is a system for pre-disaster flood management, the data used as input for flood forecasting models are only based on river level and rain gauge data. The total number of telemetric stations for rainfall and river flow seems large enough at populated area, and telemetric rain gauge stations should also be installed at sparsely populated areas such as highland watershed areas [2].

Integrated flood forecasting and river monitoring (IFFRM) is a project that integrates flood forecasting model and monitoring the water resource-related issues such as water quality, drought, and debris flow. Through this project, a total of 88 hydrological stations have been set up across Klang River Basin to record and monitor rainfall, water level, soil moisture, water quality, water flow, and weather (using met stations). These data will be used as input for flood forecasting model to give efficient and accurate flood forecasting and warning to relevant agencies related to water, namely DID Kuala Lumpur, DID Selangor, Kuala Lumpur City Hall (DBKL), Local authority, dam operators, and media. With this information, the agencies can make decision and make preparation for incoming flood to reduce the impact of flood in the affected area.

Flood mitigation policy in Malaysia has progressively improved. Since the first Malaysia Plan (1971–1975), the country's expenditure on flood mitigation has increased substantially. Many structural and non-structural measures have been implemented for flood control and relief. However, there are many areas that need to be improved. The government has introduced a flood management program using holistic approach with respect to five strategies, namely prevention, protection, preparedness, emergency, and recovery [2]. These strategies involve the collaboration among government, private sector, non-governmental organization

(NGO), and community. However, the success of this flood disaster management depends on its implementation on the affected areas.

The current flood disaster management is focusing on the strategies to manage the flood disaster during the flooding. The implementation normally is focusing on the rescue shelter, food, and medical supplies for the victims during the flood events. There is no risk management system in place to evaluate the disaster before, during, and after the flood disaster. Current flood management model also lacks multidisciplinary approach, in which there is no balanced mixture between structural and non-structural measures. In addition, there is lack of integration among various agencies that are responsible for flood management.

## 4 Disaster Management Mechanism

In general, any disaster management mechanism should involve four stages. First, preparation before disaster includes flood event forecasting, early flood warning, and decision making by experts to prevent further problem [4]; secondly, preparation for the arrival of the disaster; thirdly, the disaster emergency response; and fourthly, the disaster recovery response [5].

In Malaysia, the National Security Council (NSC) is the coordinating body in disaster management and also the lead policy maker. All activities involved in the disaster prevention, preparedness, response operation, and recovery are coordinated by the NSC [6]. The National Security Council had established the Directive No. 20 to integrate and coordinate the management of disasters on land in an organized and systematic way. The directives provide comprehensive set of guidelines during disasters in Malaysia based on Hyogo Framework for Action as Malaysia is a member to the World Conference [7]. The guidelines become the main instrument in activating flood management with the support of various other legislations though it is not specifically enacted for flood management [8]. Other related acts such as Land Conservation Act 1960, Town and Country Planning Act 1976, Environment Quality Act 1974, Local Government Act 1976, Irrigation Areas Act 1953, Drainage Works Act 1954, National Forestry Act 1984, and Uniform Building By-Laws 1984 are important in the flood disaster management [8].

The disaster management in the country is dependent on the assessment of the current situation. The assessment shall be based on the complexity and magnitude of the disaster, destruction, and damage caused by the ability of financial resources, manpower and equipment, expertise, assistance, and the time frame for response (Directive 20, MKN). The Directive 20 advocates an integrated management of responsibilities and functions of various agencies involved. Three levels of management are established to manage the disasters based on the severity level of the disaster itself. The directive is also supported by other Standard Operating Procedures (SOPs) stipulated by various agencies which outline the mechanism of disaster management as well as their duty and responsibility [6]. The three levels of management and their scope are shown in Table 1.

**Table 1** Disaster management committee level

Disaster level	Management
Level I District Disaster Management Committee (DTCP)	Chaired by District Disaster Management—to ensure all actions are standardized asset and human resources are enough, communicate with mass media
Level II State Disaster Management Committee (JPBN)	Chaired by State Government Secretary—to give aids to the affected area such as monetary aids, asset, and human resource
Level III Central Disaster Management Committee (JPBP)	Chaired by the Minister at Department of Ministry to determine the national disaster management policy, the assets, financial, and human resources

*Source* Disaster Management in Malaysia, NSC, 2011

**Table 2** Action procedures and relief operation at each level of Disaster Management Committee

Action at each level
<b>District level</b>
<p>(i) Any disaster incident at initial stage should be managed by the relevant agencies by means of the facilities and resources at District Level Management</p> <p>(ii) On receiving a disaster report, District Police Officer Chief and District Fire Brigade Chief should take suitable steps by the assistance from key rescue agencies and subsidiary agencies and other organization and voluntary bodies in charge in giving aid and rehabilitation to disaster victims. District Police Officer Chief and District Fire Brigade Chief would be commander and deputy commander of disaster operation, respectively</p> <p>(iii) District Disaster Management Committee (JPBD) which is led by District Officer should be organized to ensure all activities of search and rescue operation, taking over, and preparation of facilities and machinery and other emergency aid, i.e., food and treatment could be implemented and managed in good order and fully coordinated</p> <p>(iv) JPBD Chairman together with the commander and deputy commander would evaluate the disaster to identify the level of the disaster and capability of local agencies at District Level in handling it. After evaluation is completed and initial step is taken, but it is found that the disaster could not be handled at district level or needs assistance from state level, JPBD should inform State Disaster Management Committee (JPBN) to get quick help and taking over the disaster management</p>
<b>State level</b>
<ol style="list-style-type: none"> <li>The whole management and control of Level II Disaster will be taken over by the State Level Authority or by mobilizing some sources beneath the state control. State Police Chief and Director of State Fire Brigade will be a commander and deputy commander of disaster operation, respectively, at this stage</li> <li>JPBN lead by State Secretary should be mobilized to ensure that all disaster management run efficiently and coordinated. For Federal Territory of Kuala Lumpur, the chairman of JPBN is the mayor while for Federal Territory of Labuan is the Director of Administration Federal Territory, Labuan</li> <li>JPBN on assistance by Disaster Operation Commander shall decide on capability rescue agencies to handle disaster incident as required, so JPBN should notify Central Disaster Management Committee (JPBP) instantly through a fixed information and communication channel</li> </ol>

(continued)

**Table 2** (continued)

Action at each level
<b>Central level</b>
<ol style="list-style-type: none"> <li>1. When the disaster administration is taken over by central level (Level III Disaster), all correlated agencies and sources that include search and rescue team, emergency assistance, etc., at district and state level shall be united to face disaster that occurred under JPBP. The Director of Internal Security and Public Order, Royal Malaysia Police (PDRM), and Deputy Chief Director of operation, JBPM, respectively, will be the commander and deputy commander of disaster operation</li> <li>2. JPBP headed by a minister selected by the prime minister should be mobilized to guarantee that entire aspect with respect to policy and decision in search and rescue operation is carried out in a professional and effective manner</li> </ol>

The action procedure and the relief operation by the government authority level for each stage in overcoming the disaster are shown in Table 2. As with the case in Kelantan on December 2014, the disaster management had gone up to Level III, the Central Level headed by a minister appointed by the Prime Minister. The operation had been implemented satisfactorily though there are many unexpected problems due to the unprecedented scale of the event such as insufficient shelter, food, and rescue transport. The action procedures and relief operation had also been implemented to its optimum capability and capacity regardless of the different party that rule the state.

## 5 Roles and Duties of Agencies

Various agencies need to work together to ensure flood victims safety and relief during a flood event. Ref. [7] has the opinion that the government officials involved during flood event are purely exercising their standard official responsibility as members of the civil service, army, or police. Table 3 lists the responsibilities of various agencies during a disaster.

Table 4 shows the SOPs from different agency involved in disaster management referring from document PTO (Peraturan Tetap Operasi) Flood Disaster Response (Tindakbalas Menghadapi Bencana Banjir). As shown in Tables 3 and 4, the roles and responsibilities of the agencies are well established and it is only a matter of good coordination during a disaster that will ensure these operating procedures are effectively executed.

**Table 3** Various agencies and the related roles and responsibilities

Responsibilities of agency
<b>Special Malaysia Disaster Assistance and Rescue Team (SMART)</b>
To search and rescue victims in any disaster which need the help of special skill, expertise, tools, and equipment
<b>Royal Malaysia Police (PDRM)</b>
<ol style="list-style-type: none"> <li>1. To inform the relevant agencies of the occurrence of the disaster</li> <li>2. To coordinate disaster operation at the scene of incident with other agencies</li> <li>3. To establish Control Post on Scene</li> <li>4. To control and cordon special areas at the sight of incident</li> <li>5. To search and rescue lives and properties</li> <li>6. To control movement at the scene of disaster</li> <li>7. To carry out investigation on the disaster</li> <li>8. To protect unclaimed properties and to trace their owner</li> <li>9. To help in protecting lives/properties.</li> <li>10. To collect and protect information and exhibits for the use of investigation/litigation.</li> <li>11. To give air transport service through the PDRM Air Unit whenever necessary.</li> </ol>
<b>Malaysian Fire and Rescue Department (JBPM)</b>
<ol style="list-style-type: none"> <li>1. To search and rescue victims</li> <li>2. To prevent incident from being spread by fighting the fire, control any chemical leakage, and other dangerous situation</li> <li>3. To collect information and study the risk in order to advice the police on evacuation step</li> <li>4. To cooperate with the police in establishing operation border/zone (inner cordon) around the proper place of incident to enable JBPM carry out surveillance and control operation</li> <li>5. To ensure the security of workers involved in rescue operation</li> <li>6. To take into account the incident effect on environment and take action to reduce the effect of incident</li> <li>7. To cooperate with incident medical officer and other medical officer and the ambulance in helping the victims who need such help and removing patients from place of incident</li> <li>8. To support the police in searching killed victims</li> <li>9. To carry out investigation whenever necessary and prepare report and evidence</li> <li>10. Always being ready at the proper place of incident to ensure that the situation is safe and under control</li> </ol>
<b>Malaysian Armed Forces (ATM)</b>
<ol style="list-style-type: none"> <li>1. To support by offering services of members from all ranks during disaster</li> <li>2. To support in providing transportation vehicles for land, air, or sea at all levels of disaster</li> <li>3. To assist with preparing machinery equipment facilities to be used in relation to disaster at all levels</li> <li>4. To provide skilled services, such as experts in explosive, engineering, communication, and any form of aid if necessary</li> <li>5. To assist with construction works if needed to facilitate the operation during a disaster</li> <li>6. To provide divers services</li> <li>7. To carry out search and rescue operation based on necessity during a disaster</li> <li>8. To prepare Air Ambulance as first aid and to evacuate victims</li> <li>9. To provide liaison officers at all levels</li> <li>10. To offer emergency relief services when ATM is the first agency to reach the place of incident and will only hand over the responsibility when official authority on disaster arrived to continue works according to the issued directive</li> </ol>

(continued)

**Table 3** (continued)

Responsibilities of agency
<b>Emergency medical services</b>
<i>I. Emergency and rescue services</i>
1. To offer skilled services on emergency treatment in rescue operation hand-in-hand with rescue workers from other agencies
2. To give emergency treatment service to the trapped victims
3. To provide ambulance, pre-hospital, and transport services
<i>II. Medical depot service</i>
1. To provide emergency treatment service to victims and rescuers
2. To give forensic services including identification, morgue and evidence documentation
3. To give medical supply
4. To give health services and to control infections disease
5. To give psychological services, such as post-trauma disorder, psychotherapy, counseling, and debriefing
<b>Civil Defense Department</b>
1. Assisting in operations to save life and property
2. Assisting in preparation and maintenance of evacuation centers and provision of food for the victims
3. Assisting in providing first aid service to the victims, if necessary
<b>Public Works Department (JKR)</b>
1. Providing stores, transport, and work force from JKR to do the jobs of cleaning up the scene of incident and transportation
2. Providing temporary shelter as canopy or tent
3. Supplying water and to raise water pressure at places where such services are needed (where water supply is under the supervision of JKR/Water Supply Department (JBA)
4. Providing technical and skill services in the fields of forensic, geotechnics, structures, etc., as in landslide or structure failure cases
<b>Social Welfare Department (JKM)</b>
1. Prepare and maintain the evacuation centers
2. To make an arrangement and distributing food, clothing, and other necessities
3. To carry out registration on the victim for the purpose of rehabilitation
4. To offer guidance, advice/counseling to victims
<b>Malaysia Red Crescent Society (PBSM)</b>
1. To assist the Social Welfare Department with maintaining evacuation centers, cooking and serving food, distributing clothes, blankets and doing registration, and rehabilitation works for the victims
2. To assist other agencies with rescuing and evacuating victims
3. To assist emergency medical service (hospital) with offering first aid and other emergency relief and health care at the evacuation centers

Source [6]



**Table 4** SOPs of various agencies

Standard operating procedures (SOP) by agency
<b>JKM</b>
<ol style="list-style-type: none"> <li>1. Identify evacuation centers in accordance with the type of disaster</li> <li>2. To inform the public in a region the location of evacuation centers that has been determined</li> <li>3. Facilities are sufficient and in a satisfactory condition</li> <li>4. Determine the layout (by lot) in the relief center to ensure the victims' comfort</li> <li>5. Determine the layout of the work area (where the prayers, the woman, a cook, a registration period, the activities, etc.) in the evacuation centers</li> <li>6. Determine supervisors as the leader of staff at each relief center</li> </ol>
<i>Bilik Gerakan Bencana</i> will be opened 24 h after Level II was announced by National Security Council
<i>Supply stock at keeping depot</i>
<ul style="list-style-type: none"> <li>• The front base is added to optimum level</li> <li>• The numbers of stocks at front base satisfy the requirement set (5000 victims × 3 days used)</li> <li>• Adequate list of suppliers to support relief operation</li> </ul>
<i>Short-term relief</i>
– Food relief; dried food, mat, blanket, and disaster kit are given as soon as possible to victims at the relief center
<i>Long term relief</i>
– Aids for victims' recovery will be announced in not more than 30 days from the date of request after the disaster has end
<i>Counseling and psychology</i>
– The result to get counseling and psychology service will be announced not more than 5 days from the date of request
Source Customer Charter Achievement Report (2015)
<b>DID</b>
<ol style="list-style-type: none"> <li>1. To run State and Federal Bilik Gerakan for 24 h</li> <li>2. To observe more frequently telemetry and river gauges and river gauges to ensure the system works properly</li> <li>3. To give report about the water level routinely and to advise indication for immediate evacuation action</li> <li>4. Disseminate widely the information to the public</li> <li>5. Review the effectiveness of RTB project to reduce disaster risk and assess additional needs RTB projects. Study non-structural measures to reduce disaster risk</li> </ol>
<b>MKN</b>
<ol style="list-style-type: none"> <li>1. To be the lead agency (focal point) in the national disaster management regional and international levels</li> <li>2. Remove the strategy, direction, action plans, and policy direction in Disaster management</li> <li>3. Ensure the adoption and implementation of policies and management mechanisms Disaster running smoothly</li> <li>4. To monitor and make auditing in disaster management run by government agencies and ordered improvements to enhance the effectiveness of the national disaster management</li> <li>5. Provide secretariat services to committees disaster management at all levels</li> <li>6. Manage and move SMART teams for search and rescue at home and abroad when necessary</li> <li>7. Manage KWABBN subject to financial rules and procedures in force from time to time</li> <li>8. Coordinate the handling of practical sessions and search and disaster management rescue from time to time</li> </ol>

(continued)

**Table 4** (continued)

Standard operating procedures (SOP) by agency
9. To monitor and ensure the implementation of measures reduction disaster to prevent or reduce the impact of disasters are ongoing by government agencies
10. Plan, coordinate, and monitor the implementation of educational strategies, training, and awareness to officials and members of government agencies, agency statutory, private and voluntary bodies, and the public in face and reduce the risk of disasters.
11. To provide advice on the conduct and management of disasters
12. Provision of post-mortem handling of the aftermath of disasters held a disaster
13. Evaluate, coordinate, and lead a humanitarian aid mission and Disaster response abroad
14. Evaluate and coordinating humanitarian assistance from foreign countries
(Directive 20, MKN)
Also in charge in:
– Coordination of air asset
– Disaster statement through Portal Bencana
– Update and finalize the list of names of the victims that were moved to evacuation centers
– Update and finalize the list of names of victims who are not moved to evacuation centers
<b>Private sectors</b> <b>(Tenaga Nasional Berhad TNB)</b>
1. Suggest together with the justification for the proposal to stop the supply of utilities should be communicated immediately to the PKOB
2. The implementation of contingency plans for ensuring continuity of supply
3. The utility area/important facilities disclosure of the period dismissal, the expected duration reconnection, and rational stopping the supply of utilities to the public
<i>Source</i> Peraturan Tetap Operasi Tindakbalas Menghadapi Bencana Banjir
<b>JPNB/JPBD</b>
1. Ensuring that all logistic assets can be operated
2. All assets are placed in an area (staging point) that has been set
3. The area is divided into sub-regions and determined government agency responsible
4. Aircraft placed at strategic locations
5. The role of each aircraft has been assigned according to priority situations
6. Designated areas to facilitate the operation
7. Directory roles, according to the specific functions and roles
8. Update the contact directory regularly

## 6 Flood Risk Management

The process to manage flood risk situation involves activities that are intended to improve the capability in coping with the flood event [8]. In flood risk management, recovery process after a disaster is equally important as the process to reconstruct and rehabilitate after the flood [7]. The objective of having a holistic flood risk management is to control any flood event, in terms of flood preparedness to reduce the flood impact [8]. This includes the process of risk analysis, which offers the basis for elongated term management decisions for the present flood protection system.



**Fig. 1** The critical water level at flood warning station. *Source* Kesiapsiagaan Bencana Semasa Monsun Timur Laut, MKN

Figure 1 shows The Critical Water level at Flood Warning Station. The water levels are divided into several stages which are the normal level, the caution level, the warning level, and the danger level. Based on these levels, the specific appropriate acts can be identified. This kind of information is critical in providing early warning of flood risks for improved flood preparedness. Besides that, different organizations are responsible for warning and evacuation orders for different disaster as shown in Table 5.

**Table 5** Organizations responsible for warning and evacuation orders

Severe weather phenomena	Organization responsible for warning	Organization responsible for evacuation order
Tropical cyclone	Malaysian Meteorological Department	National Security Council of Malaysia
Heavy rain	Malaysian Meteorological Department	National Security Council of Malaysia
Strong wind	Malaysian Meteorological Department	National Security Council of Malaysia
River flood	Department of Drainage and Irrigation Malaysia	National Security Council of Malaysia
Storm surge	Malaysian Meteorological Department	National Security Council of Malaysia

*Source* [6]

Effective disaster risk management contributes to sustainable development. To achieve sustainable development, resilience and disaster risk reduction must be part of urban design and this requires strong unions and broad participation [9]. Resilience can be defined as the capability of a system, community or society to struggle, absorb, accommodate to, and recover from the impact of a hazard in a timely and efficient manner, (UNISDR 2009).

## 7 Conclusion

The paper presents a comprehensive information and review on the flood disaster management in Malaysia. The roles and responsibilities of the leading and supporting agencies involved in the flood rescue and relief operation are described. The current SOPs are also listed for each agency involved. In general, the flood disaster management in Malaysia is well defined and established, comprising district, state, and central levels and the supporting agencies with their comprehensive SOPs. However, the records show that the flood disaster management in the country is still having problem. There is a need to identify the best coordination system between all the agencies including non-government organizations (NGOs). The currently executed SOPs had not shown good coordination among the NGOs. Based on the previous experience especially during December 2014 flood, the involvement of NGOs is huge and significant. Future work is going to be executed in defining and establishing holistic risk management system in Malaysia. Hopefully with this kind of system, the coordination in managing flood disaster in Malaysia will be enhanced.

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