Practicability and effectiveness of flood disaster standard operating procedures (SOPs) in Malaysia

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Abstract. The rapid growth of population in urban areas resulted in a higher amount of waste generated yearly. According to the Solid Waste Management and Public Cleansing Corporation (SWCorp), in 2018, Malaysians generated 38,142 tonnes of waste per day with an average of 0.83 kg/capita/day for a household in the urban area. Malaysia, with a population of 32.4 million, 76% of the entire population are living in urban areas (Department of Statistic, 2018), this figure is worrying. This pilot study explores and evaluates the perspectives of governance on waste management processes and practices for urban residents; in a mixed density housing scheme. A survey was conducted on 30 respondents of a mixed density housing scheme in Section 7, Shah Alam, Selangor. The data then analysed through reliability test analysis. There were four (4) key variables being put forward for this study; services and practices, socio-economic and well-being, stakeholders and environment. The result of the analysis has found out that, the variables for waste management services for mixed density housing scheme are reliable with the respondent’s feedback. However, some questions are not compatible to be analysed in parallel with other questions.

1. Introduction
Flood has been the most frequently occurring natural disaster in Malaysia, affecting more than 2 million people nationwide [1]. The country had experienced major floods ever since its pre-establishment. Disastrous floods were recorded in year 1920, 1926, 1963, 1965, 1967, 1969, 1971, 1973, 1979, 1983, 1988, 1993, 1998, 2005 and 2014. Flood had caused extensive damages to properties, infrastructures, agricultural lands, crops and loss of life. It is reported that 40% of the total damages in Malaysia are carried by flood [2]. Flood occurrence is expected to intensify due to the effect of climate changes and rising urbanization. Flood problem becomes more significant when the community affected is less prepared and lack in resilience while facing the hazard thus bringing more serious impacts to life and environment [3]. The problems posed by flood require proper planning and development of the area and integrated approach of flood mitigation program to safeguard the community [4]. In most developing countries, the main administrator for the flood management disaster activities is the government, while related agencies are responsible to coordinate the relief operation [5]. Harmonization and coordination among the agencies are the vital factor during any disaster response to ensure its success in executing the relief operation [6].
Following the major catastrophic flood in 1971, the Malaysian government had established the Natural Disaster Management and Relief Committee (NDMRC) for coordinating the flood relief operations at national, state and district levels [7]. The flood disaster management in Malaysia 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 Malaysian government considers the flood delivery system as an important mechanism and one of the flood policies for non-structural flood mitigation measures [3]. There are three phases of flood delivery system in the country namely: 1) pre-disaster 2) during-disaster and 3) post-disaster. In flood management, the roles of delivery system are used in a holistic manner to provide information and assistance at every phase. However, the success of disaster management depends on its implementation in the affected areas. The current flood disaster management is biased towards the strategies to manage the flood during the disaster. The implementation would normally focus on the rescue, shelter, food and medical supplies for victims.

1.1. Flood Delivery System and Management Model in Malaysia

National Flood Disaster Relief Machinery (NFDRM) is the committee that responds to major floods based on reactive system [7]. The NFDRM is responsible for the operations at national, state, district, mukim and village levels [8]. The relief machinery and emergency flood management cover the flood forecasting and warning system (pre-disaster), flood relief machinery and flood management emergency (during disaster) and finally funding and aid delivery system (post disaster). It was mentioned that the flood disaster relief machinery need to be improved further in terms of its pre-delivery and management system to mitigate the adverse impact and flood damages in the future [7].

For pre-disaster flood management, flood forecasting models have been developed and used by Department Irrigation and Drainage such as Linear Transfer function model and Tank model to forecast for future flood in the flood prone areas [9]. Information from the model has been used for flood preparation at the area potential to be hit. Dissemination tools such as SMS, telephone, warning sirens, fax and website have also been used as flood warning system. Although there is a system for pre-disaster flood management, the data used as input for flood forecasting models is mainly 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. However, telemetric rain gauge stations should also be installed at sparsely populated areas such as highland watershed areas [8].

1.2. Current Scenario and Challenges in Flood Management

Since the first Malaysian Plan (1971-1975), the country’s expenditures on flood mitigation have increased substantially. Many structural and non-structural measures have been implemented for flood control and relief. Nevertheless, there are many more areas that need to be improved [10]. The Malaysian government has introduced a holistic flood management programs inclusive of five strategies namely prevention, protection, preparedness, emergency and recovery [8]. These strategies involve the collaboration between government, private sector, non-government organization (NGO) and community.

However, current flood management model lacks multidisciplinary approach where there is no balanced mixture between structural, non-structural measures and lack of integration among various agencies that are responsible for flood management. The study, which was conducted after the flood disaster in 2014, looks into the effectiveness of the flood management especially on the implementation of SOPs during the flood event, in particular during evacuation process. This study also evaluates the satisfaction and awareness of flood victims on the flood relief operations during flood events.

2. Method

This study was conducted using questionnaires survey and interviews involving a total of 12 agencies in Kelantan that were involved directly and indirectly during the flood event operation and the
headquarters’ offices of each agency at national level. In addition, it also involved a total of 231 flood victims randomly selected from three different districts in three states which are Kuala Krai, Kemaman and Kuantan in Pahang. The selection of related agencies was based on the general guidelines and duties written in PTO, while the flood victims were randomly selected from the hardest flood-hit areas along the east coast of Peninsular Malaysia in year 2014 in Kelantan, Terengganu and Pahang states.

Table 1 and 2 show the summary of questionnaires distributed among agencies and flood victims respectively. The sources of information also include the analysis and review of the existing literature reviews that cover flood relief operation, flood response and rehabilitation process [11].

| Sections | Related questions |
|----------|-------------------|
| A        | This section consists of respondent’s information from various socio-economic backgrounds in term of gender, position status, years of service, level of education, and the name of agency respondent working. |
| B        | This section is on SOPs during the flood event which is divided into eight sections. The first section is related to the evacuation that covers the availability of existing facilities such as functionality of flood warning system. The second section is about the opening and operation of flood relief center in which this section involves the activities that occur at the relief center such as the victims’ registration, counseling service, health and care service, and supply of aids. The third section is about the asset coordination used during flood relief operation. The issues about traffic control and security are covered in the fourth section. The fifth section is about the continuity of supply and services that covers about utility, water and fuel supply. In the sixth section, questions about media control strategy are asked. The seventh section is about the dam management during flood event and the last section is about the operational report. Total of 79 questions are asked in this section. |

| Sections | Related question |
|----------|------------------|
| A        | This section is on respondent information from various socio-economic backgrounds in term of gender, race, age group, occupational status, level of educational, monthly income, type of houses, duration stay at relief center and type of house after leave relief center. |
| B        | This section consists of SOPs of flood during the flood event which are divided into four (4) segments which are segment A, B, C and D. Segment A is related to the existing facilities available such as functionality of flood warning system during flood. Segment B is about the opening and operation of flood relief center where this segment involves activities that occur at the relief center such as registration, counselling service, health and care service. Segment C is about supplies and services at the flood relief center and segment D is on the operation after flooding. Total of 28 items were asked in this section. |
| C        | This section is on the awareness of flood victims on flood relief facilities. Total of 5 items are asked in this section. |

2.1. Method of Analysis
The analysis of questionnaires is divided into two parts. The first part is the analysis on the effectiveness of the implementation of SOPs during flood evacuation operation and the second part is on the satisfaction and awareness among flood victims on flood evacuation operation.

2.2. Analysis of Questionnaires Data
The data obtained from the questionnaires were recorded and analyzed using Microsoft Excel. Simple statistical analysis was used in the analysis to describe the mean score comparison and standard variation. Mean comparison is used to obtain the overall views of a particular phenomenon while the standard deviation is used to detect variation in perception among the entire respondents [12].

The selection of these statistical techniques is considered suitable considering the types of data gathered and hypotheses formulated. Information obtained from the questionnaire survey was in form of quantitative data. Analysis of the mean were conducted to determine the relationship between the variables studied. Table 3 shows the determination of the level procedural fairness and distributive justice in which the classification is divided into high, moderate and low [13].

| Range mean | Level       |
|-----------|-------------|
| 1.00-2.00 | Low         |
| 2.01-3.00 | Moderate    |
| 3.00-4.00 | High        |

### 3. Results and Discussion

#### 3.1 Background Analysis of Respondents from Agencies

67% of respondents work at executive level and the rest are non-executive level. The executive group is normally the one involved in management and decision making during the flood event. While the non-executive group comes from the respondents involved on site during the flood event such as conducting the search and rescue mission or maintaining the relief shelter. 44% of the respondents have worked for more than 10 years with the agency, while 36% of them have worked for one to five years. Respondents with longer working duration normally are more well-versed and have more experience dealing with floods.

#### 3.2 Analysis on SOPs Implemented by the Agencies During the Flood Evacuation Operation

Table 4 shows the 25 SOPs implemented by the related agencies during flood evacuation operation. The level of effectiveness and practicability are moderate for all these procedures, except for procedure of over-supply of aids’ distribution with mean effectiveness score of 1.88.

| No. | Items                                                                 | Practicable (Mean) | Effectiveness (Mean) |
|-----|------------------------------------------------------------------------|--------------------|----------------------|
| 1.  | The activation of warning siren after flood indication                 | 3.09               | 2.89                 |
| 2.  | The adequacy of assets for search and rescue operation                 | 3.40               | 3.50                 |
| 3.  | Presence of detailed SOPs for evacuation                              | 3.22               | 3.25                 |
| 4.  | The presence of special criteria to open the relief center             | 3.10               | 3.11                 |
| 5.  | Health center availability at the relief center                        | 2.87               | 3.00                 |
| 6.  | Vaccination supply to flood victims                                   | 2.67               | 3.00                 |
| 7.  | Raw material supply                                                    | 3.00               | 3.00                 |
| 8.  | Over-supply of aids                                                    | 2.13               | 1.88                 |
| 9.  | The assets deployed for search and rescue (S&R) operation             | 3.31               | 3.25                 |
| 10. | The assets deployed for food distribution activity                     | 3.42               | 3.67                 |
| 11. | Sufficiency of man-powers for search and rescue operation             | 3.71               | 3.57                 |
| 12. | Training of manpower for search and rescue activity                   | 3.50               | 3.63                 |
| 13. | The dissemination of information about closed roads due to flood       | 3.18               | 3.33                 |
| 14. | The main road affected repaired immediately                            | 3.75               | 4.00                 |
| 15. | The temporary bridge built to recover the main access                  | 3.75               | 4.00                 |
| 16. | Information to public about utility cut off and supply duration        | 3.00               | 3.00                 |
17. Continuity supply of clean water at relief center 3.45 3.50
18. Clean drinking water supply for evacuees 3.14 3.25
19. Fuel availability after flood recovery 3.38 3.38
20. Media center provider at PKOB 3.50 3.75
21. The placement of Information Officer as Media Relation Officer 3.50 4.00
22. The guidelines to release water from the dam 3.67 3.80
23. The information to public about evacuation process if the dam water is released 3.29 3.00
24. Submission of situational progress report to PKOB 3.50 3.55
25. The submission of the reports on time 3.46 3.45

Figure 1 (a) shows the problem of practicable and effectiveness on over-supply of aids at relief center. Most of the agencies (67%) agreed that this issue is raised during the flood event. The mean score of the practicable is 2.13 (Table 4) for over-supply of aids which suggest agencies’ agreement about this matter is widely diverging. Supply of aids might not become practicable since there were various agencies involved during the aid collection. Figure 1 (b) shows that the agencies agreed that supply of aid procedure is not practical (50%), only 12% considered as practical and very practical (13%). Hence, all practicability mean score that is higher than 2.0 (limiting value for item elimination) indicates that these procedures are likely practicable to be conducted during flood disaster.

While, the lowest mean score from the effectiveness of supply of aids is 1.88 (Table 4). Mean score value that is lower than 2.0 indicates that supply of aids to flood victims is not effective as shown in Figure 1(c). It follows that over-supply of aids is an issue that needs an attention from the related agencies. Theoretically, aids such as food supplies and clothes are managed by JKM (Directive 20). However, this issue arises when the aid’s supply and distribution’s duty is also carried out by NGOs. The redundant duty by JKM and these NGOs usually will contribute to this issue.

![Figure 1: Availability of supply of aids at relief center](image1)

**Figure 1.** (a) Availability of supply of aids at relief center (b) Practicability of supply of aids at relief center (c) Effectiveness of supply of aids at relief center

### 3.3 Background Analysis of Respondents from Flood Victims

In general, demographic characteristics of the respondent’s shows 68% of them are female and 32% of them are male. Malay was dominating with 97.4%, followed by Chinese 1.4%, Indian and others
respectively 0.4%. Respondents aged 41-50 years old recorded as the highest respondents (35.8%) compared to the other age groups. Respondents under aged of 20 years old are the lowest respondents with only 3.1%.

Housewife (38.9%) is the highest number of respondents. While, student is the lowest number of respondents (3.9%), 36.0% of respondents have income less than RM900. While, 41.2% of them earning between RM901-RM2001 and only 0.9% of them earning more than RM5000.

It was found that 57.4% of respondents stay less than 1 weeks at flood relief center, 40.4% stay at relief center for 2-3 weeks and 2.2% stay more than 3 weeks. 89.3% of the respondents came back to their house after leaving the relief center and 6.7% of them stay at their relatives’ or neighbors’ house. 3.1% of them had stayed at the tent provided and only 0.9% of them stayed at house provided by the government.

3.4 Analysis of the Flood Victims’ Satisfaction on SOPs of Flood

Table 5 shows the 28 questions linked to flood victims’ satisfaction on the SOPs. All items selected were considered since the mean score is close to 3.0.

| No. | Items                                                                 | Mean |
|-----|----------------------------------------------------------------------|------|
| 1.  | Availability of health officer in front of PTKTK to give health care | 3.12 |
| 2.  | Availability of ambulance hospital / hospital field (military hospital ATM) | 3.12 |
| 3.  | Functionality of disaster warning siren in times of flood            | 3.11 |
| 4.  | Availability of water tanks in residential area that not affected by flood. (Refineries were affected by the floods) | 3.08 |
| 5.  | Notification of termination period, expected reconection and disconnection of supply utilities (electricity) | 3.06 |
| 6.  | Availability of health centers and emergency centers                | 3.04 |
| 7.  | Availability of disaster warning system in flood area               | 3.03 |
| 8.  | Dissemination of information through the media about route closed and an alternative route | 3.03 |
| 9.  | Availability of vaccination and immunization (for specific cases)   | 3.03 |
| 10. | Availability of guidance and counselling services provided at relief center | 3.02 |
| 11. | Sufficiency of fuel supply after flood                             | 3.01 |
| 12. | Permission to purchases of fuel in bulk using cash after the flood  | 2.99 |
| 13. | Availability of the evacuation instruction during flood            | 2.97 |
| 14. | Availability of a water tank in relief centers                      | 2.97 |
| 15. | Availability of a flood relief center when flood occurred           | 2.96 |
| 16. | Availability of new flood relief center / additional flood relief center if there a problem at flood relief center registered/ listed | 2.96 |
| 17. | Availability of agencies that carry out rescue operations and evacuation flood | 2.95 |
| 18. | Availability of registration at the relief center                    | 2.95 |
| 19. | Sufficiency of food supply (mineral water, rice, etc.)              | 2.95 |
| 20. | Availability of delivery of aid by boats                           | 2.95 |
| 21. | Availability of clean drinking water in relief centers              | 2.93 |
| 22. | Availability of food preparation by volunteers                      | 2.92 |
| 23. | Availability of clean water supply in relief centers               | 2.90 |
| 24. | The price of goods is still the same (not inflated) after the floods | 2.90 |
| 25. | Sufficiency of goods supply (pillows, blankets, etc.)               | 2.89 |
| 26. | Availability of aid through aircraft                               | 2.84 |
| 27. | Availability of forensic services for the purpose of identification, localization of bodies and documentation evidence (special room) | 2.75 |
| 28. | In overall, level of satisfaction with the flood operation          | 2.79 |
The highest mean score on level of flood victims’ satisfaction on the SOPs implemented is (3.12) which indicates availability of health officers in front of PTKTK to give health care and availability of ambulance/hospital field (military hospital ATM) at the flood relief center. Figure 2 shows that 60% of flood victims claimed that there were health officers in front of PTKTK to give health care and 67% of them were satisfied with the health care service given by the health officer (Figure 3). 50% of flood victims mentioned on the availability of ambulance/hospital field (military hospital ATM) at the flood relief center and 63% of them were satisfied with the service given by the health care at the ambulance. The lowest mean score (2.75) on level of flood victims’ satisfaction was on the availability of forensic services for the purpose of identification, localization of bodies and documentation of evidence (special room). Figure 2 shows 95% of flood victims claimed there were no forensic services at their flood relief center. While, only 5% of flood victims reported there are forensic service at their flood relief center. However, 88% of flood victims were satisfied (Figure 3) with the service provided.

All of the 28 questions of flood victims’ satisfaction on the SOPs implemented had been divided into four (4) segments. The first segment is facilities during the flood event, the second segment is the opening and operating of flood relief center, the third segment is the supplies and services while the fourth segment is facilities after the flood event.

![Figure 2. Availability of facilities and service during opening and operating of flood relief center](image1)

![Figure 3. Level of flood victims’ satisfaction on availability of service and facilities during opening and operating of flood relief center](image2)

3.5 Analysis of Flood Victims’ Satisfaction on Flood Relief Operation
In overall, mean score on level of flood victims’ satisfaction with the flood operation is 2.79. Figure 4 shows that 59% of the flood victims had been satisfied and 14% of them were very satisfied with the flood relief operation. 21% of them were not satisfied and only 7% of them were very dissatisfied with the flood operation.

3.6 Analysis of Flood Victims’ Awareness on Availability of Flood Relief Operation

Table 6 shows the mean analysis on flood victim’s awareness on availability of flood relief operation. In general, the flood victims have awareness on availability of flood relief operation looking at the mean score which is close to 3.

![Figure 4. Overall satisfaction on the flood relief operation](image)

Table 6. Mean analysis for flood victims’ awareness on availability of flood relief operation

| No. | Items                                                                 | Mean |
|-----|------------------------------------------------------------------------|------|
| 1.  | The awareness on the existence of a disaster warning system at flood victims’ area | 3.14 |
| 2.  | The awareness on the existence of agencies involved during flood event | 3.02 |
| 3.  | The awareness on the existence of basic facilities provided the government when flood occurs | 2.95 |
| 4.  | The awareness on the existence of agencies that offer help after the flood disaster | 2.88 |
| 5.  | The awareness on the existence of a flood relief center at flood victims’ area | 2.88 |

From the mean score on flood victims’ awareness of flood relief operation shows that generally flood victims were aware on the existence of a disaster warning system at their area. However, only 39.0% (Figure 5) of flood victims were aware on the existence of a disaster warning system at their area. 56.6% (Figure 6) of them were aware on the availability of a disaster warning system available at their area such as siren and SMS. However, flood victims had fair awareness on the existence of agencies that could offer help after the flood and the existence of a flood relief center at their area with the lowest mean score of 2.88. Figure 5 shows 94.0% of flood victim claimed they were aware on the existence of agencies that could offer help after the flood. At the same time, although 96.7% (Figure 6) of flood victims claimed their awareness on the existence of flood relief center at their area, most of them could not give the name of the flood relief center at their area.
Figure 5. Awareness on availability of flood relief operation

Figure 6. Level of flood victims’ awareness on availability of flood relief operation

4. Conclusion
The results of the study suggest that the procedures that critically need to be improved by the agencies in term of practicability and effectiveness are under section of ‘the opening and operation of the relief center’ and ‘on issue of over-supply of aids’ distribution. Although results show that flood victims are satisfied with current SOPs service provided and have good awareness on the availability of flood relief operation, it can be concluded that the government still need to upgrade the service provided for upcoming flood events particularly for unusual flood event. It is hoped that this study can provide some insights on aspects to be improved therefore contribute to a better flood management SOPs in Malaysia to reduce the flood risks and impacts.

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