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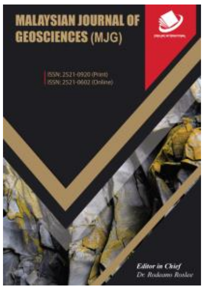

INCEPTION OF 3Es IN PROMOTING DISASTER RESILIENT COMMUNITIES LIVING NEAR HYDROPOWER DAMS OF PENINSULAR MALAYSIA

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ABSTRACT

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Excessive rain pattern has been the major cause contributing to flooding of low land due to excess water release from affected dams. This deliberate measure has to be taken to prevent the catastrophic effect of a dam break scenario. Therefore, this kind of disaster is considered as a local phenomenon. The local communities are the vulnerable population to face the immediate impact of such disaster. Needless to mention that they are also first emergency responders which is crucial for saving lives. It is therefore imperative for the involved stakeholders to improve local communities' resilience to dam related disasters. This resonates well with the Hyogo Framework for Action, which identify local communities as integral cornerstone for saving lives and livelihoods. In the case of communities living near main hydropower dams owned by Tenaga Nasional Berhad, an initiative known as Integrated Community Based Disaster Management (ICBDM) has been launched in May 2015. This initiative adopts the concept of 3Es; embrace, educate and empower. The priority is to ensure the vulnerable communities embrace the reality, being educated to face any upcoming situation as well as being empowered to take charge of immediate live saving efforts in the future. The initiative involves five key scopes encompassing technical and non-technical areas and promotes the strategic partnerships between dam owner, authority and the community. It is anticipated that this initiative will build the resilience of communities to dam related disaster.

KEYWORDS

Dam, disaster management, embrace, educate, empower.

1. INTRODUCTION

Disaster risk reduction is one of the important aspects that need to be seriously concerned by everyone. With the increasing number of disaster happened around the world, exposing the community of the affected area to the high risk and vulnerabilities [1]. Post disaster reconstruction and rehabilition is a complex issue with several dimensions [2]. Government, nongovernment, stakeholders and international organization have their own outlines in disaster recovery program and the unity must be establish among them as well as the community. In order to minimize the damage cause by the disaster, various effort were taken care. Participation from the community is an important aspects to ensure that the effort in disaster management sustainability will last longer. Without the sustainability disaster management will not preserve. The most common elements of community involvements are partnership, participation, empowerment and ownership by the local people [3].

On 2013, Malaysia was shocked by the catastrophic flood that hit Bertam Valley in Cameron Highlands. Due to the heavy rainfall, the mud flood have occur causing the release of water from Sultan Abu Bakar dam as it reached the danger level. The flood cause many destructive damage to the area in term of loss of human life, damage to the property, destruction of stocks and many more. Taking into the action through this disaster, Tenaga Nasional Berhad (TNB) took an initiative known as Integrated Community Based Disaster Management (ICBDM) for their hydroelectric dam scheme. The disaster that occur in Cameron Highlands gives a wakeup call as it leads to the development of better mechanism for disaster rescue operations could be performed in such efficient and effective manners [4]. Although proper notification mechanism to the authority (relevant district, state and federal agencies) has been clearly outlined in the ERP, the inclusion of the members of public (community) is still at minimal stage.

Integrated Community Based Disaster Management or ICBDM is a conceptual framework which aims to synergy between three major stakeholders; the community, relevant authorities and related agencies, to minimize loss life and property damages in the event of flood related disaster. Therefore consistent consequence estimation approaches must be achieve to identify those assets within this critical infrastructure sector whose failure or disruption could potentially lead to the most severe impacts. The initiative looked into five main aspect comprises of technical and non-technical areas such as a 2-D modelling, life safety models, community based early warning system, community based training and awareness and lastly, stakeholder's engagement programs.

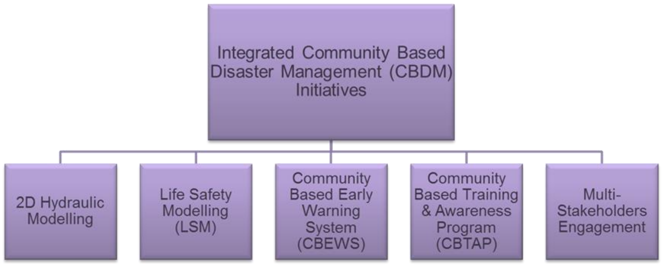

Figure 1: Integrated Community Based Disaster Management Initiative (ICBDM)

A 2D model for flood can be able to grasp the movement and areas affected by flood waters in an incident of dam failure as it was done previously at the Kelantan River Basin [5]. This is important later on to develop a life safety model that acts as a guideline for evacuation procedures [6]. Based on both models, researcher believe it will help with the process of identifying location to establish early warning system and will be a great form of help to the community as well as authorities to be well informed of an impending danger [7,8]. Additionally, importance is also placed in giving training and spreading awareness among the community on dam related disaster, as it is believe that infrastructure without knowledge is meaningless [9]. This also acts as an initiative to conducting real life evacuation drills to prepare and educate in case of a real emergency.

The recent incident at Sultan Abu Bakar (SAB) dam has proven that loss of life could also be contributed by dam associated flash floods which are obviously not rare compared to dam failure flooding. Dam failure and associated flash floods can result in high fatality rates, when flooding overwhelms an unsuspecting group of people. However, dam failures that produce slowly rising floods tend to result in lower fatality rates.

2. LITERATURE REVIEW

Dams have huge importance in the modern day living, which includes providing energy that helps in the development as well as improving living standards. Besides being an energy production structure, dams also acts as a reservoirs for large quantities of water. Dams contributes significantly to the economic growth of the nation but are not immune to risk of failure due to its diminishing lifespan and natural hazards [10]. Dam failures are hard to predict and can come unexpectedly even with great effort placed into design, construction, operation and maintenance. Dams also have to be safe as it is usually constructed within close proximity to populated areas [6]. Dam failures can cause catastrophic damages to nature, infrastructure and even loss of lives. Because of that, an emergency response system is essential to minimize the negative effects and optimize resources [11].

One example of a catastrophic dam disaster that occurred was the 1975 Banqiao Dam failure in China. It was one of the worst recorded dam failure that took an estimate of 171,000 lives and displaced 11 million others [12]. The dam failure was believed to be caused by the collision of Typhoon Nina [13]. The consequences of a catastrophic dam failure are enormous with lives, properties, communities, economy well-bring and nature at stake.

Malaysia has more than 50 dams under different ownerships where 60% of these dams are earth fill dams [14]. Dams have periodically failed throughout history, as they are not build to last forever. Dam failures are rare but causes large consequences. Fortunately, there have not been many dam disasters in Malaysian history. However in October 2013, Bertam Valley, Cameron Highlands have been woken up by a tragedy accompanied with the loss of life of four individuals that came into the way of discharge water from the Sultan Abu Bakar Dam [15].

This disaster event have raised the question for the need for mitigation of human risk in dam related disaster that very well affects the communities living below dams that are high risk of experiencing flooding. Dam owners are asked to make life saving decision during a crisis as well as to provide early warning and assist in evacuation procedures in case of a dam disaster [6]. The time available for evacuation was one of the important factors to consider in any operation. Additionally, many believe that educating and warning the community about dam safety is equally important and have to be addressed [16].

As dams in Malaysia continue to age, more attention is being places upon the dam safety and the emergency responses during disaster to minimize loss of life and damages to the community. To ensure humans are at less risk of a disaster event, effective collaboration and shared understanding on the dam risk among stakeholders, authorities and community have to be optimized in order to come out with the best plan for evacuation procedures and logistics [17].

3. METHODOLOGY

3.1 2D Flood Modelling

In order to prepare emergency response plans, revise dam operation strategies, priorities dam rehabilitation, etc., it is important to assess the consequences of possible dam break in terms of the affected areas, the time available to evacuate people and the damage which the flood wave will cause. This can be most effectively assessed through model studies and flood mapping.

Critical aspects for the flood risk analysis of a dam break event are:

i. Failure moment: at a specific time or related to certain hydraulic conditions.
ii. Failure mode: breach development, piping failure leading to erosion, or erosion through overtopping. The failure mode has a significant impact on the outflow hydrograph (flood wave). The worst case is instant removal of the dam, while the peak discharge would be considerably lower if the breach develops gradually.
iii. Hydraulic conditions in the river and floodplain downstream.

3.2 Life Safety Model

Floodwater released when a dam fails can be a devastating force. Dam failures have historically taken many lives and have destroyed much property. By the same token, a number of dams fail each year in the United States without a single life lost. Physical and human factors both contribute to potential life loss, as does a certain amount of chance [18]. Critical factors that affect potential life loss in dam failure scenarios:

i. Number of people occupying the area inundated by a dam-break flood.
ii. Amount of warning provided in relation to the time required to move to a safe location.
iii. Intensity of the flow to which people are exposed.
iv. Timing of the dam failure (e.g. day or night). Timing can affect both the number of people downstream and the amount of warning time available.

3.2.1 Determination of Predicted Life Loss

Once the dam breach and flood characteristics have been assigned and the population at risk identified, there are two basic types of analysis to estimate life loss: one is notional, empirically based on a small number of past instances, while the other employs simulation that attempts to model people's response to the situation. Fatality rates for both the notional and simulation methods depend on flood severity, which can be tied to flood depths and velocities. The recommended fatality rates from any method can be adjusted when justified by extenuating circumstances. If a particularly devastating earthquake is responsible for dam failure, it is quite likely the earthquake has also devastated infrastructure and communications in population centers in the vicinity. Every aspect of warning (i.e. detection, decision, notification, and dissemination) may be affected, and evacuation routes may be compromised. Emergency management personnel would be responding to several situations and will not be able to devote their entire attention on a developing situation at a dam. It may be reasonable to increase the fatality rates for this case.

3.2.2 Simulation Modelling

Simulation method utilizes computers to combine models of dam break, flood routing, warning dissemination, evacuation, and life loss. Safe areas are designated, populated zones are assigned warning times and choices regarding means of travel (e.g. by car or walking), road and intersection capacities are assigned, and the computer model determines how many people are likely to successfully evacuate. Whereas fatality rates for Reclamation's notional method are multiplied by the initial population at risk, the simulation methods multiply the fatality rate by an estimated fraction of the initial population at risk who might be remaining within inundation boundaries at the time the flood wave arrives. These fatality rates depend on flood severity and upon an assigned shelter survivability category.

3.3 Community Based Early Warning System (CBEWS)

CBEWS is a system operated and maintained by the communities themselves. While establishing the system, the community will explore external support from different individuals, communities, organizations and institutions. It is essential that the community develops and maintains close coordination and links with these stakeholders. The performance of early warning systems can be assessed via performance parameters such as timeliness, accuracy, reliability, user friendliness, flexibility, and costs & benefits, as shown below in figure 2:

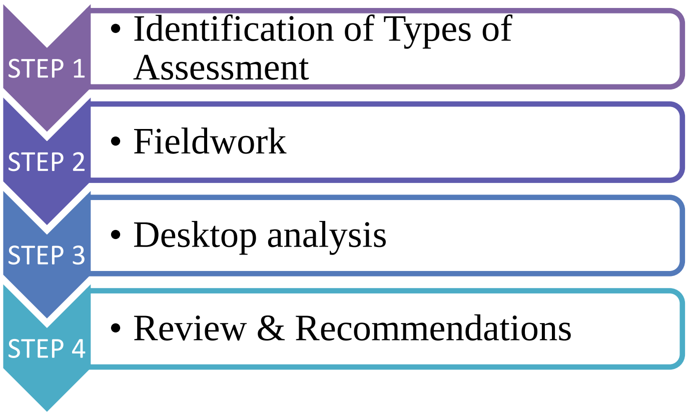

Figure 2: Four Steps in EWS Feasibility Study

The typical components of an EWS are:

- *Monitoring* involves the collection of meteorological data and hydrological data, e.g. real-time and historic measurements.
- *Forecasting* entails utilising monitored data to model future situations and thus give a forecast, e.g. where and when will certain water levels occur.
- *Warning* incorporates receiving flood forecasts, interpretation of the data and subsequent issuing of warnings based on preset trigger criteria.
- *Response* involves informing the public, coordination of emergency response activities.
- *Evaluation* assesses the overall performance of the aforementioned components individually as well as combined (e.g. carry out flood emergency exercises) and results in feedback regarding the *Improvement* of the EWS. As such Evaluation and Improvement are often considered separately.

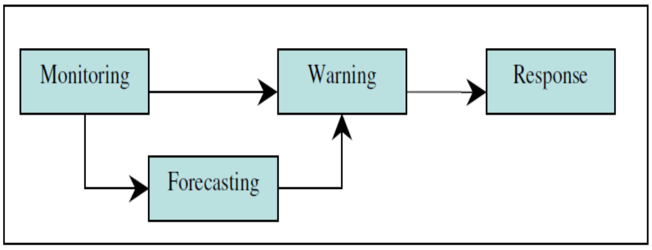

Figure 3: Main Components of an Early Warning System

3.4 Community based Training and Awareness Program (CBTAP)

Effective community engagement has real and considerable benefits for both the governing bodies and agencies as well as the community alike. On the other hand, there is a significant challenge in being able to provide avenues for involvement that are inclusive, productive and cost-effective, within the parameters of our system of government and the diversity of our society. Whilst feedback is often positive, it also sometimes indicates that approaches to communication and consultation have not been as good as might be expected. A key task for public agencies and officials in planning community engagement is to assess which engagement techniques are most appropriate in particular circumstances. Involving stakeholders in the planning stage will help create a sense of ownership of the issue and enable clients, citizens, communities and governments to work together to determine the most appropriate approach to engagement. CBTAP proposes three distinct phases for effective planning and implementation of the Integrated Community-Based Disaster Management (ICBDM).

Table 1: Three different phases for CBTAP

Phase I: Inception And Informative	Phase II: Community Engagement	Phase III: Active Participation
Information provision is a one-way relationship in which authority disseminates information to community. It covers both passive and active access such as mass media, web sites, education and awareness activities	Engagement is a two-way relationship in which agency, authority and key figures seek and receive the views of communities on programs that affect them directly or in which they may have a significant interest.	Active participation recognizes and acknowledges a role for community in proposing and/or shaping the desired program. Deliberative processes often take time and numerous resources since participants need to build their awareness and knowledge about the issues in order to contribute effectively.

3.5 Multi-Stakeholders Engagement Program (MSEP)

Stakeholder engagement is crucial to risk, adaptation, and vulnerability assessments. Stakeholders can be characterised as individuals or groups who have anything of value that can be affected by natural disaster phenomenon or by the actions taken to manage disaster risks. Individual and institutional knowledge and expertise are the principal resources for adapting to disaster. The adaptive capacity can be developed if stakeholders have time to strengthen networks, knowledge, and resources, and of course if they have the willingness to find effective solutions. Approaches to stakeholder engagement vary in a large area from passive interactions (the stakeholders only provide information) to the level where the stakeholders themselves initiate and design the process. Stakeholder involvement represents an integral part of a stepwise process of decision-making by sharing information, consulting, dialoguing, or deliberating on decisions. MSEP proposes two phases for effective planning and implementation of the Integrated Community-Based Disaster Management (ICBDM).

Table 2: Two different phases for MSEP

Phase I: Data Collection	Phase II: Engagement and Development
Data collection is important and helpful in determining the appropriate level of stakeholder's engagement level. This is done through preliminary discussion, the contact with or the observation of target stakeholders groups and also the review of statutory requirements	Engagement is a multi-way relationship in which agencies, authorities and key figures sits together and manage emergency situation when disaster occurs

4.FINDINGS

From the methodology above, it is clearly stated that the ICBDM research framework stands upon five pillar that support the studies. A 2D flood modelling is conducted in the initial phase of this study to see the impact of dam release on flooding. The modelling can provide analysis of timing and quantity release and be used to test whether different operating procedure could yield different consequences. Detailed knowledge both in spatialy and temporally such flow downstream, depth of floodwaters, and flow velocity can be valuable information that will enhance the preparedness planning.

The results obtained from 2D flood modelling will be used to carry out the numerical loss of life using Life Safety Model (LSM). LSM will exhibit the effect from road closure, warning dissemination, safe havens and awareness. LSM also can model the fatalities, injuries, vehicle being swept away and building destruction. The dynamic interaction between people, vehicles and building could be the elements to estimate the flood risk to people in terms of loss of life and injuries, evacuation time and improvements in emergency planning.

Once the computed results have produce, the preliminary study is develop for identification of appropriate early warning system to minimize the casuallity and property damages. The early warning system is us as a measure for community to be both alerted and notified of the pending emergencies. The key factor for effective warning system is that the community are alerted,that will bring them to an understanding of the emergency situations which are guided to appropriate actions in the appropriate time frame.

From the informations of three pillar of ICBDM could designated the community awareness program which aim to explained the nature of the emergency and community shall be empowered by the information given to act according to nesessity to maximize the personal safety and protect their belonging. It is necessary that the community engagement program could deliver the message or information about the potential consequences from dam related disasters.

The involvement of multiple parties engagement could be carried out in term of tabletop exercise to measure the readiness of emergency plans and response capabilities during emergency crisis. A shared risk responsibiities shold be developed between dam owners, authorities and public.

5. CONCLUSIONS

From the studies above, the ICBDM framework aims to the synergy between three major stakeholders; loca authorities, agencies and communty. The key important aspect in this framework is participation and support from the communities. The communities is the one that facing the situation when the disaster happen. It is important for the profesionals in disaster management area to share informations on disaster preparedness and increase the awareness to minimize the loss of life. In the end, our hope is that each individual can take responsibility and initiative for save lives when a disaster occurs

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