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Development of a Monitoring, Evaluation, Accountability and Learning Framework for Early Warning System for Landslides

Leslie Jamie C. Cobar
Philippine Institute of Volcanology and Seismology

Roy Albert N. Kaimo
Philippine Institute of Volcanology and Seismology

Roger S. Savella
Philippine Institute of Volcanology and Seismology

Arturo S. Daag
Philippine Institute of Volcanology and Seismology

Abstract:- Due to the devastating impacts of landslides worldwide, various mitigation projects such as establishment of community-based early warning systems are being initiated. Monitoring, evaluation, accountability and learning (MEAL) is integral in ensuring the success of these projects to achieve their goals. Despite the increase in projects and funding for disaster risk reduction, there are insufficient research in understanding the effectiveness of MEAL systems for disaster risk reduction projects, particularly for early warning system for landslides (EWS-L). This study aims to develop a framework for MEAL for EWS-L through a systematic review of the available literature. The issues and recommendations derived from the systematic review were adopted to craft the guiding principles of the framework with the project goals and objectives. This framework provides a novel approach by providing guidelines on planning, designing and implementing MEAL not only for early warning system projects but also in disaster management and development projects in general.

Keywords:- *Monitoring; Evaluation; Landslides; Early Warning.*

I. INTRODUCTION

A landslide is described as a downward movement of a mass of rock and debris on a slope. Over the 20th century, there have been around 26 landslide events worldwide which resulted in deaths ranging from 54 to 100,000 people [28]. These catastrophic landslides are enumerated in Table 1. Heavy rainfall, earthquake, snowmelt and volcanic eruption were identified as the triggering factors in the events.

The Philippines is considered as one of the most disaster-prone countries in the world. Annually, it experiences an average of twenty typhoons which result in secondary disasters such as landslides. Table 2 lists the recent major landslide events in the Philippines, most of which are aftermaths of typhoon events.

Due to the devastating impacts of landslides, there has been an increase in programs and projects devoted to climate change adaptation (CCA) and disaster risk reduction (DRR). Apart from the international initiatives such as the Hyogo and Sendai Frameworks, Kyoto Protocol and World Bank's Global Facility for Disaster Reduction and Recovery, an initiative specifically for landslides is the International Programme on Landslides. It is being implemented by the International Consortium on Landslides and aims to promote partnerships through provision of authorization and advice on landslide mitigation projects [11]. The National Aeronautics and Space Administration and the United States Geological Survey also provide services through provision of a knowledge base and remote sensing datasets to support landslide hazards research [17]. The European Commission, through the European Soil Data Center, is also doing the same initiative on research as landslides are a major hazard in the continent [8].

In the Philippines, CCA and DRR are being prioritized through the Republic Act 10121 namely the Philippine Disaster Risk Reduction and Management Act of 2010, the institutionalization of the Climate Change Commission under the Office of the President, and inclusion of DRR aspect in national development planning [22]. Specifically for landslides, efforts from the Department of Science and Technology's Philippine Institute of Volcanology and Seismology (DOST-PHIVOLCS) such as the Dynaslope Project, formerly Development of Early Warning Systems for Landslides (DEWS-L), are being implemented to empower communities make them resilient against landslides through low-cost early warning systems. Early warning systems are essential in preparedness of the communities against disasters to prevent fatalities [24]. One of the characteristics of an effective early warning system is where the recipients or communities receive reliable warning information through proper flow of information from the monitoring sources down to the local responders [6].

It has been widely accepted that monitoring, evaluation, accountability and learning (MEAL) is being implemented in order to achieve the goals of programs and projects. Monitoring & evaluation (M&E) is being executed to check the progress, evaluate the achievement of outcomes and make adjustments in the next planning phase of the project [10][19][21]. Recently, there has been an emphasis on learning and accountability as important aspects or purpose for M&E [23]. M&E systems have been revised into various approaches such as results-based [27], participatory [5], and stakeholder-based [29] in order to

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meet different goals of programs and projects in accordance to the welfare of its recipients.

Despite the increase in climate change adaptation (CCA) and disaster risk reduction projects and amount of funding available globally, there are insufficient initiatives on the examination of the utilization of M&E for CCA and DRR [23].

More specifically, there is a lack of research on M&E focusing on disaster early warning system projects.

Recognizing the importance of M&E of early warning system projects, the goal of this study is to develop a framework for creating a MEAL system for early warning system for landslides (EWS-L). The questions which the study aims to answer are 1.) what are the issues in terms of designing and implementing M&E for EWS-L?; and 2.) what recommendations or approaches can be adopted for the development of MEAL framework and plan for EWS-L? In order to assist in the answering of questions, the objectives of this study are 1.) to identify issues in M&E by systematic analysis; and 2.) to adopt recommendations in the development of a MEAL framework and plan for EWS-L.

II. RESEARCH FLOWCHART

Figure 1. explains the flowchart of the study which also served as the basis for the conceptualization of this study. The items inside the rectangle symbol represents the objectives of the study, the document symbol represents the data source, the arrow represents the method, and the parallelogram represents the results. The first objective of the study is to identify issues and recommendations in MEAL through systematic review of literature. Results from the review will be utilized in order to design a framework for MEAL for early warning system.

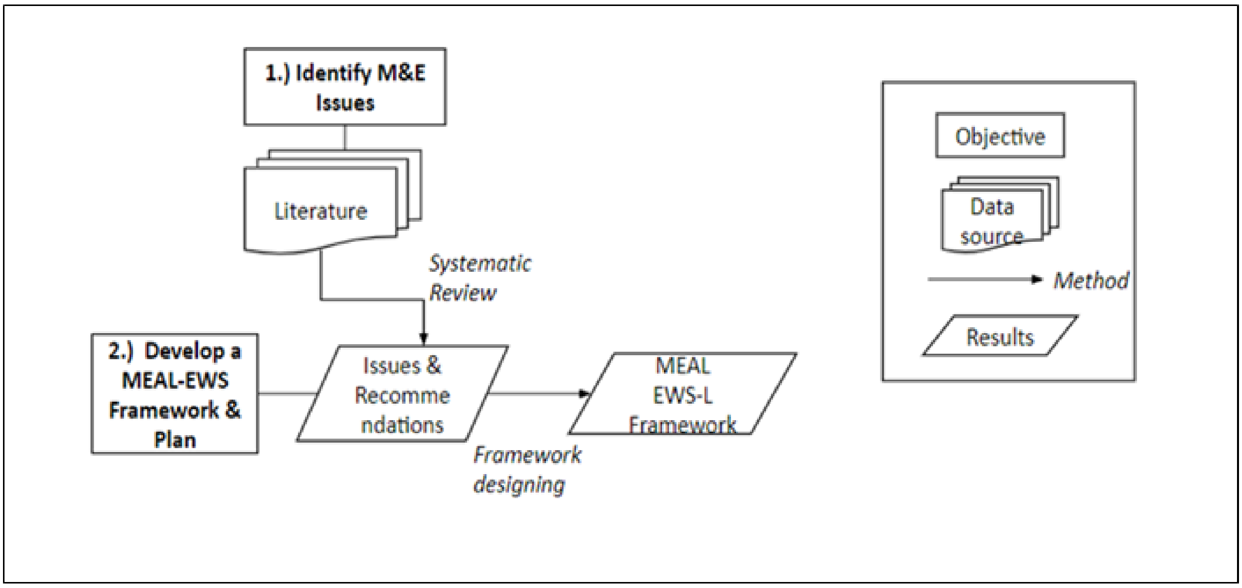

Fig 1:- Flowchart for the development of MEAL for EWS-L

Year	Location	Triggering Process	Impacts
1911	Usoy rockslide, Tadzhik, USSR	Usoy 7.4 magnitude earthquake	54 killed
1919	Kalut lahars, Indonesia	Eruption of Kalut volcano	5,110 killed
1920	Haiyuan earthquake, China	Haiyuan earthquake	100,000 killed
1921	Kazakh Republic	Snowmelt	500 killed
1933	Deixi landslides, China (Schichuan)	Deixi 7.5 magnitude earthquake	6,800 killed
1939	Mount Rokko, Japan	Heavy rain	505 dead
1949	Khait rockslide, Tadzhik, USSR	Khait 7.5 magnitude earthquake	12,000-20,000 killed
1953	Arita river slides and debris/mud flow, Wakayama, Japan	Heavy rain	460 dead
1953	Minamiyashiro landslides, Kyoto, Japan	Heavy rain	336 dead

1958	Kanogawa slides, Shizuoka, Japan	Heavy rain	1,094 dead
1962	Nevados Huascaran debris avalanche, Ancash, Peru	-	4,000-5,000 dead
1963	Vaiont Reservoir Rockslide, Italy	-	2,000 killed
1964	Alaska landslides, Alaska, USA	Prince William Sound 9.5 magnitude earthquake	Estimated US$280 million (1964 $) damages
1965	Rock slides, Yunnan, China	-	444 dead
1966	Rio de Janeiro slides, avalanches, debris/mud flows, Brazil	Heavy rain	1,000 dead
1967	Serra das Arasas, Brazil	Heavy rain	1,700 dead
1970	Nevados Huascaran debris avalanche, Ancash, Peru	7.7 magnitude earthquake	18,000 dead
1974	Mayunmarca rock-slide debris avalanche, Huancavelica, Peru	Speculated rainfall or river erosion	450 killed
1980	Mount St. Helens rockslide-debris, Washington, USA	Volcanic Explosivity Index 5 eruption	5-10 killed; major destruction of homes/highways
1983	Thistle debris slide, Utah, USA	Snowmelt & heavy rain	Destroyed major railroads and highways
1983	Saleshan landslide, Gansu, China	-	237 dead
1985	Nevado del Ruiz debris flow, Tolima, Colombia	Eruption of Nevada del Ruiz	Four towns and villages destroyed
1986	Papua New Guinea	Bairaman 7.1 magnitude earthquake	Village destroyed by debris flow
1987	Reventador landslides, Napo, Ecuador	Reventador 6.1-6.5 magnitude earthquakes	1,000 killed
1994	Paez landslides, Colombia	Paez magnitude 6.4 earthquake	271 dead
1998	Flooding, landslides, debris flow in Honduras, Guatemala, Nicaragua, El Salvador	Hurricane Mitch	Approximately 10,000 killed

Table 1:- Catastrophic Landslides of the 20th Century - Worldwide [27]

Year	**Location**	**Number of Persons Affected**
1999	Cherry Hills, Antipolo, Rizal	60 dead
2003	Panaon Island, Southern Leyte	154 dead
2006	Guinsaugon, Saint Bernard, Southern Leyte	1200-1500 dead
2006	Mayon Volcano lahar	526 dead, 740 missing
2009	Cordillera (Benguet, Baguio, Mountain Province)	120 dead
2012	Pantukan, Compostela Valley	42 dead
2012	New Bataan, Compostela Valley	128 dead, 450 missing
2014	Catbalogan, Samar	9 dead
2017	Biliran Province	42 dead
2018	Itogon, Benguet	58 dead
2018	Naga, Cebu	29 dead

Table 2:- Recent Major Landslide Events in the Philippines [4][18]

III. METHODOLOGY

A. *Data Collection*

Literature in the form of scientific articles, manuals, handbooks, guidelines, and technical reports from academic, non-government and funding organizations were collected online and reviewed. Literature both for generic M&E, disaster risk management and climate change adaptation were reviewed as literature specific to M&E for both early warning systems and landslide projects weren't available. The researchers also considered the terms "Monitoring and Evaluation (M&E)", "Monitoring", and "Evaluation" in searching and collection of literature due to the lack of available resources specifically for MEAL.

B. *Analysis and Framework Development*

Systematic review of literature was performed for the collected resources. This approach stems from the social sciences and uses existing studies to answer questions [12]. After the review of collected literature, issues and recommendations were consolidated, then clustered into cross-cutting themes. These were adopted for the design and development of the MEAL framework for EWS-L [1][7]. The developed framework was in line with the goals and objectives of community-based early warning system for landslides, and desired to be utilized in the development of a MEAL system in the future.

Findings from the review were summarized through Microsoft Excel by acquiring issues and challenges and recommendations from each source.

IV. RESULTS

A. *Issues and Recommendations on MEAL Systems*

- *Designing Monitoring and Evaluation Systems*

It has been mentioned that the context of monitoring and evaluation particularly for CCA lacks a practical guide or approach in developing an M&E system [24]. There are also issues in terms of the inability of M&E practitioners to link planning and budget priorities [14]. Focusing too much on indicators instead of context of projects also make the M&E problematic in the achievement of higher impact of projects [14]; Ramos et al., 2004). Setting of definitions and baselines is also crucial in the design and implementation of M&E [24].

- *M&E Complexity*

Another issue on M&E implementation is that the M&E plans are too complex for the stakeholders involved, and the implementation takes too much time and effort [24][28]. Concepts such as "Theory of Change" are being suggested as the commencing stage in formulating MEAL plans, yet not all of the M&E staff understand how it is being done. This complexity is also related to the M&E as an expensive and difficult activity [3]. These characteristics can be detrimental especially to the recipients of projects such as the community and local governments that lack the capacity to implement M&E systems.

Some of the data being collected for M&E are incomplete in entirety [28] which may result in lapses if these will be utilized in the project managers' decision-making processes.

- *Institutional Problems*

Problems in the institutions are also factors in terms of determining success in implementing M&E in projects. One of the problems identified is the capacity of the personnel to implement monitoring and evaluation responsibilities [15][28]. There was also a high turnover of personnel involved especially projects where high risks are involved [28]. Funding for M&E activities and M&E skill shortage were also cited as challenges in M&E [15]. The capacity of the personnel in charge of M&E should also be built and improved.

A means to address problems in institutions is to ensure political support as a means to gain support from the public [29]. Stakeholder commitment is a factor in terms of successful implementation [14] as they are not being consulted in the M&E decision-making process. In addition, coordination and cooperation is also seen as problems in terms of efficient implementation of M&E [14].

- *Indicator- and Baseline-Setting*

During the development of framework, indicators must be improved by identifying both the quantitative and qualitative aspects [21]. It is also recommended to involve the community in setting the indicators in the achievement of outcomes [28]. Making the community involved in defining indicators makes the process more participatory and relatable for them, which contribute to the achievement of the goals of the project. There is also a need to coordinate with stakeholders to identify the appropriate baselines of indicators [13].

- *Use of Technology in Reporting*

Utilization of technology in recording, reporting and evaluation of outputs is suggested to efficiently gather data for M&E for proper tracking, consolidation and analysis [25] [2]. An example on the utilization of technology for data processing is through geographic information systems and web-based applications [16][13]. Encoding data in uniform templates and report outlines is also instrumental for easier facilitation of data [25]. There should also be a proper system of reporting, summarizing data, and dissemination of an automated timely response in order to streamline data collection [16][25].

- *Outcomes as the focus of disaster risk management capacities*

A rigorous monitoring system should always base on outcomes rather than outputs [13]. For disaster risk management capacity, there should be an outcome-based generic framework in M&E of disasters in order to provide flexibility for project managers and for them to focus on the sustainability of the projects [20]. The proposed framework identified the following sub-outcomes which disaster risk management capacity projects should aim for: 1.)

Knowledge and behavior change in the community; 2.) DRRM included in the local institutional framework; and 3.) Creation of an enabling environment;

➢ *Lack of consideration of the local and dynamic contexts*

As regards M&E for climate change adaptation and resilience, the spatial factors of measuring resilience must be considered [3]. Site-specific intricacies must be considered in the planning and implementation of M&E [23]. Indicators and targets should also be iterative & dynamic [23][2]. Uncertainty regarding future climate change impacts is also a factor in the creation of M&E as adaptation targets may change despite the existence of sophisticated climate models to predict and simulate future impacts of climate change [23].

B. Developed MEAL EWS-L Framework

After a comprehensive review of both the common issues and recommendations of MEAL, the framework developed for MEAL for EWS-L was formulated in Figure 2. The design of the MEAL plan and its implementation will be framed after the project's goal. The project's objectives will be the guide for the achievement of projects by performing activities that support them. In order to successfully implement the MEAL Plan, the guiding principles shall be the pillars in each stage of the MEAL cycle.

➢ *MEAL Cycle: Planning, Monitoring and Evaluation*

The MEAL cycle in this framework comprises of three phases: 1.) planning; 2.) monitoring; and 3.) evaluation. Planning is the phase where the setting of goals, objectives, indicators, and resources are being performed. This includes completion of the results framework or logical framework. Monitoring is the phase where the progress of the project implementation are being assessed in terms of the utilization of inputs to achieve outputs and intermediate outcomes. Evaluation is where the assessment of progress towards the achievement of project outcomes is being undertaken. Accountability and learning are classified under evaluation as stated in various literature. The results of feedback and learning sub-phases will be utilized in the succeeding planning phase.

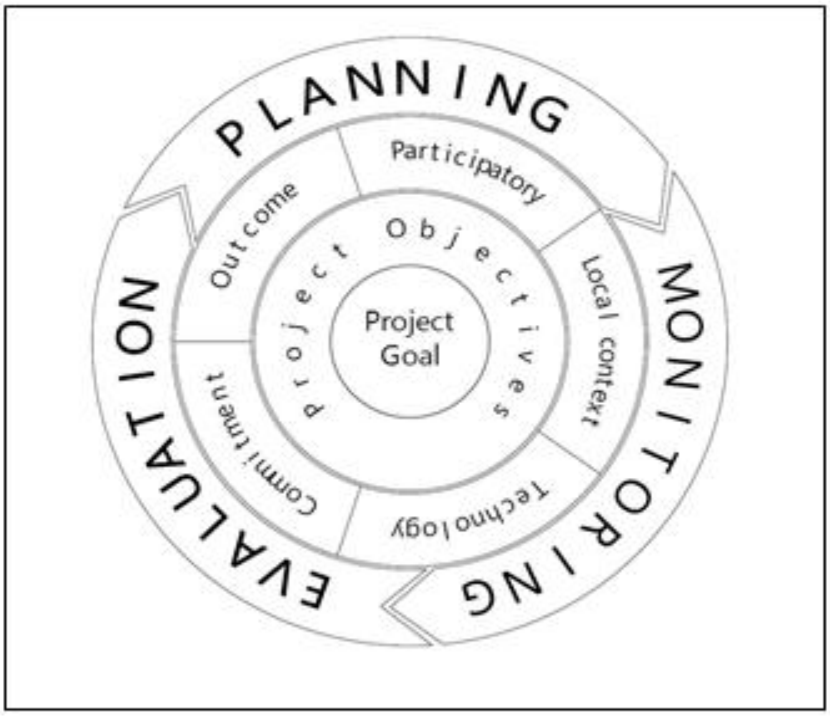

Fig 2:- MEAL Framework for EWS-L

➢ *MEAL Framework Principles*

The following principles of the MEAL framework are defined in the following paragraphs. The principles are not linear and all-encompassing in nature and can be utilized as a guideline in the development of MEAL systems for EWS-L.

- *Outcome*

Focusing on outcomes has been mentioned in most of the literature on M&E. The goal of the MEAL system should be to see the changes in behavior of people [5]. Early warning system for landslides initiatives are being integrated into the way of life of the community, ordinances and policies of the locality, and providing an enabling environment by which community-based EWS can be implemented easily [20].

Achievement of outcomes and impact is also the pillar of results-based monitoring and evaluation by which management methodologies are patterned after development results. [26].

- *Participatory*

Participation of various stakeholders has been widely accepted as an approach in monitoring and evaluation of development disaster risk reduction projects as they are the recipients of the project with whom the project managers are accountable for, and whose insights must be sought in order to achieve the goals [5][25][29]. Seeking the inputs of the community, local partners and external monitors can also solve the challenge of lack of M&E personnel, especially in high conflict areas [28].

- *Local context*

Creation of M&E systems should consider the local context and intricacies individuals, communities, and councils [24]. Spatial element of resilience measurements [3]. Each community has its own cultures and characteristics which must be considered in planning for disaster resilience projects.

- *Technology*

As mentioned, the utilization of technology in monitoring and evaluation of implementation efficiently gather data for M&E for proper tracking, consolidation and analysis [2][25]. This can also prevent issues in M&E such as incompleteness and inaccessibility of data and delay of reports.

- *Institutional and Political Commitment*

It has been stated also that institutional & political commitment to monitoring and evaluation is important for a successful MEAL system [9][14][15][28]. Having institutional and political commitment of stakeholders, especially local or federal governments, may result in MEAL-enhancing activities such as capacity-building of personnel in terms of conducting M&E, providing funding and equipment resources, and incorporation of early warning system in the local DRR plans, laws, and proactive actions towards early warning systems.

C. MEAL Framework for community-based early warning systems (CBEWS-L) for landslides

The developed MEAL framework for community-based early warning systems for landslides can be seen in Figure 3. This is the framework of MEAL. The core of the framework is the project's goal, which is to contribute to the empowerment and resilience of communities by using science and technology in the development of a community-based early warning system for landslides (CBEWS-L). The objectives are to: 1) improve early warning system for landslides; 2) promote enabling institutional environment by developing capacities of partner communities or sustainability; and 3) strengthen research and development practice in landslide risk reduction. It is hoped that the MEAL system for CBEWS-L shall concentrate on the guiding principles.

V. DISCUSSION

It was identified in the systematic review that it is integral to focus on the people for an effective MEAL system for landslide early warning system projects. MEAL frameworks, plans and tools and analysis should concentrate on what benefits the people and their unique situations, cultures and characteristics. It was apparent that implementation of MEAL without focusing on the outcomes has been a major issue. The support of effective and committed institutions is also necessary in the proper implementation of MEAL.

The limited number of academic articles specifically explaining the theory and paradigm for MEAL system for early warning system for landslide projects also implies the insufficient efforts to thoroughly understand the appropriate systems to monitor activities, evaluate the achievement of goals for disaster-related projects, and how to utilize the suggestions of the stakeholders for improvement. The available literature were mostly through handbooks, manuals and reports produced by funding and non-government organizations. These resources do not explicitly state how these manuals were formulated and what their bases were.

Landslide events may increase due to the effects of climate change, and changes in topography due to anthropogenic causes. Increase in landslide events may increase the likelihood of landslide-related disasters. It is important for funding institutions to create projects that will help communities reduce landslide risks. Thus, the framework presented in this paper can be a generic guide and impetus for scientific and collaborative discussion on monitoring and evaluating disaster risk reduction-related initiatives.

VI. CONCLUSION

The study reviewed the prevailing issues and challenges, and recommendations in MEAL systems for early warning system for landslides (EWS-L). The findings were utilized to formulate a framework for a MEAL system that can be applied for early warning system for landslides. It was found that focusing on the outcomes which will benefit the people is the key in formulating and implementing a MEAL system for EWS-L. Commitment of institutions and utilization of technology will also support the achievement of outcomes.

Literature on rigorous testing and evaluation of the appropriate MEAL for early warning system is sparse. As initiatives on disaster risk reduction and climate change have been increasing, it is integral to put effort in MEAL research by assessing and formulating the appropriate tools and analysis in order to achieve the disaster risk reduction outcomes.

Fig 3:- MEAL Framework for EWS-L

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