



## COMPARATIVE ANALYSIS WITH TOPIC MODEL ON NATIONAL DISASTER MANAGEMENT PLAN IN MYANMAR

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### Abstract

In general, disaster management plan describes duties and actions by each stakeholder both before and after disaster occurs. This plan, however, is often written only in text and difficult to grasp its perspective including relationship between actions and stakeholders. This inconvenience causes lack of understanding about whole disaster management and inefficient coordination between stakeholders on actual disaster response. In addition, without grasping perspective, it is difficult to find out whether there is oversight or omission on disaster management. Based on the background, the primary objective of this study is to structuralize disaster management plan and to compare different plans by analyzing its text with topic model, which is one of techniques on text mining. This paper focuses on two national disaster risk management plans in Myanmar: Standing Order and National Earthquake Preparedness and Response Plan (NEPRP). These plans describe what each ministry should do only by text, and therefore it is difficult to understand flow of these actions and check omission on disaster management. In addition, the relationship between two plans are not clarified.

In this study, all text on Standing Order and NEPRP were automatically tagged with hazard type (earthquake, flood, fire, and cyclone), disaster phase (Preparedness and Prevention, Alert and Warning Stage, Disasters Stage, and Relief and Rehabilitation), stakeholder in charge (Ministry of Home Affairs, Ministry of Health, and so on) by text preprocessing. Besides, total 686 actions about disaster response were extracted from both plans. Next, structure of every sentence in all actions were analyzed with linguistic dependencies in order to extract nominal subject, predicate verb, object word, and agent word, which mean Who (ministry) is supposed to do What with Who (ministry) respectively.

We categorized all actions by applying Latent Dirichlet Analysis on extracted object word. As a result, this study divided actions on emergency response phase into 36 disaster action categories. By comparing the number of actions by disaster action category, some inconsistency was identified: 1) Infrastructure management including water supply and electricity are not mentioned in NEDRP. 2) On the other hand, actions related to security issues and fund/budget are written more detailed in NEDRP. 3) Actions related to "Military / Police" are reduced in the newer NEDRP.

In conclusion, this study illustrates potential and effectiveness of structuration and visualization of disaster management plan. It is recommended to conduct comparison analysis on disaster management plan by using this methodology between national level and local level in Myanmar as well as Myanmar and other countries.

*Keywords: Myanmar, disaster management plan, visualization, text mining, Latent Dirichlet Allocation*



## 1. Introduction

In general, disaster management plan describes duties and actions by each stakeholder both before and after disaster occurs. This plan, however, is often written only in text and difficult to grasp its perspective including relationship between actions and stakeholders. This inconvenience causes lack of understanding about whole disaster management and inefficient coordination between stakeholders on actual disaster risk and crisis management. In addition, without grasping perspective, it is difficult to find out whether there is oversight or omission on disaster management. Based on the background, the primary objective of this study is to structuralize disaster management plan and to visualize how ministries coordinates each other by analyzing its text with text mining.

This paper focuses on two national disaster risk management plans in Myanmar: Standing Order and National Earthquake Preparedness and Response Plan[1,2]. This plan, however, describes what each ministry should do only by text, and therefore it is difficult to understand flow of these actions and check omission on disaster management.

Myanmar Government stated in the Capacity Development Strategy for Disaster Risk Management in Myanmar 2017-2030 that lack of capacities at various levels is one of the most critical factors and capacity building for disaster risk management is important. There have been some researches which summarized and discussed disaster risk management in Myanmar [3,4,5]. However, to the best of the authors' knowledge, nor research has yet been carried out to visualize disaster risk management plan and sector coordination using text information. Based on the background, the purpose of this paper is to structuralize and visualize disaster risk in order to contribute to deepen understandings on it, which leads to capacity building on disaster management in Myanmar.

## 2. Overview of disaster risk management in Myanmar

### 2.1 Disaster Risk in Myanmar

Myanmar is exposed to multiple natural hazards including earthquake, tsunami, cyclone, storm surge, floods, landslide, drought, and so on. As regards to earthquake, Myanmar lies in a major earthquake zone known as the Alpine Himalayan Belt, and there are some major seismotectonically important faults including the well-known Sagaing Fault.

The seismic records show that there have been at least 16 major earthquakes with Richter Scale (RS)  $\geq$  7.0 within the territory of Myanmar in the past 170 years[6]. In recent years, a 6.8 magnitude earthquake in northern Myanmar in 2012 killed at least 16 people and injured 52, with over 400 houses, 65 schools, and 100 religious building damaged[7]. In addition, strong earthquakes rocked Tarlay in 2011, Kalay and Chauk in 2016, which cost lives and destroyed temples and pagodas in ancient Bagan heritages[8]. Except for earthquake, about 10 tropical cyclones and depressions form in the Bay of Bengal and out of them almost five become severe cyclones. Especially, Cyclone Nargis and the accompanying storm surge in Myanmar in May 2008 caused the worst natural disaster in Myanmar's recorded history with 138,000 fatalities estimated.

### 2.2 Legal Framework on Disaster Risk Management

In 2013, the Myanmar government enacted the Natural Disaster Management Law, which is most fundamental legal framework on disaster risk management in Myanmar. In addition, supporting Disaster Management Rules were issued in 2015. Section 3 on the Rules stated that the Disaster Management Plan, the Standing Order and the other related programs at the national level shall be prepared by the Ministry of Social Welfare, Relief and Resettlement. Based on this sentence, two important disaster risk management plans were formulated: Standing Order on Disaster Management (Standing Order) enacted in 2009 and National Earthquake Preparedness and Response Plan (NEPRP) enacted in 2019. In addition to these plans, Myanmar Action Plan on Disaster Risk Reduction (MAPDRR), a framework for multi-stakeholder engagement on disaster risk reduction in Myanmar, was launched in 2012 and updated in 2017.



The difference between Standing Order and NEPRP can be summarized in the Table 1. Standing Order covers all disaster phase including prevention, mitigation, early warning, emergency response, rehabilitation and reconstruction, while NEPRP covers only emergency response phase. On the other hand, time unit are described more detail in NEDRP. Moreover, Standing Order is described by ministry and department while NEPRP is by Natural Disaster Management Work Committee as mentioned in the next section.

The relationship between Standing Order and NEPRP is not indicated in the newer NEPRP, though it mentions National Disaster Management Law and Rules. Based on the background, this paper targets on analyzing and identifying the difference between these two plans to check the consistency.

Table 1 – Diffence between Standing Order and National Earthquake Disaster Response Plan

	Standing Order	National Earthquake Preparedness and Response Plan(NEDRP)
<b>Target phase</b>	All (Prevention, Mitigation, Early Warning, Emergency Response, Rehabilitation and Reconstruction)	Emergency Response
<b>Target hazard</b>	Earthquake, Tsunami, Flood, Cyclone and Fire	Earthquake
<b>Stakeholder Unit</b>	National Committee, 22 Ministries, Departments, and City Development Committees, etc.	9 Disaster Management Work Committee
<b>Time unit</b>	Phase(Pre-disaster, during disaster, Post-Disaster etc.)	Within 24 hours after an earthquake / Within 24-48 hours / Within 48-72 hours / Within 72 hours-7 days
<b>Number of Action</b>	1475	336

## 2.2 Institutional Arrangement in Myanmar

Disaster Management Law specifies the formation of National Natural Disaster Management Committee (NDMC) and Section 5 in the Law states NDMC forms Natural Disaster Management Work Committee and other necessary Committees and determining duties and powers as its duties and powers. Based on this article, 12 Disaster Management Work Committees are described in the MAPDRR as indicated in Fig. 2.



Fig. 2 –Disaster Management Bodies in Myanmar



### 3. Methodology

Analysis on this study can be separated into 3 steps as following:

Step 1. Pretreatment of text information

Step 2. Morphological and Syntactic Analysis

Step 3. Text Clustering Analysis on disaster risk management actions

#### 3.1 Pretreatment of text information

All text in Standing Order on Disaster Management and NEDRP was automatically processed in order to utilize this text in the following analysis. For example, the Standing Order is written in hierarchical manner with Organization or Ministry in charge (Ministry of Home Affairs, Ministry of Health, and so on), Category(Formation, Function, and so on), hazard type (earthquake, flood, fire, and cyclone), disaster phase (Preparedness and Prevention, Alert and Warning Stage, Disasters Stage, and Relief and Rehabilitation), as illustrated in Fig.2.

Using this hierarchical characteristic, all actions are extracted and formatted with meta information such as Organization, Category, and Disaster Phase.



Fig. 2 – Standing Order(extracted) (highlight part is added by author)

#### 3.2 Morphological and Syntactic Analysis

Structure of every sentence in all actions in the previous section were analyzed with linguistic dependencies. Syntactic Analysis was applied to all sentences of all actions extracted in the previous subsection in order to extract important information such as following:

- 1) Who (Nominal Subject)
- 2) What to do (Predicate verb)
- 3) To what (Object words)



#### 4) From who / To whom / With who (Related organization words)

On the analysis, one of natural language software, Stanford CoreNLP, was applied. Stanford CoreNLP gives the base forms of words, their parts of speech, the structure of sentences in terms of phrases and syntactic dependencies[8].

Here is an example sentence:

*“Ministry of Social Welfare will coordinate with the Ministry of Home Affairs to issue instructions to the local administrative bodies for evacuation of people from disaster-prone areas to safe locations in consultation with the Department of Meteorology and Hydrology”*

By applying Syntactic analysis using, relationship and dependent type between two words are returned as shown in Table 2.

Table 2 – Sample result of syntactic analysis (extracted)

	governor	dependent	type	governor index	dependent index
<b>1</b>	ROOT	Ensure	root	0	9
<b>2</b>	ensure	Ministry	nsubj	9	1
<b>3</b>	Planning	Of	case	4	2
<b>4</b>	Planning	National	compound	4	3
<b>5</b>	Ministry	Planning	nmod:of	1	4
<b>6</b>	Planning	And	cc	4	5
<b>7</b>	Development	Economic	compound	7	6
<b>8</b>	Planning	Development	conj:and	4	7
<b>9</b>	ensure	Will	aux	9	8
<b>10</b>	prepared	That	mark	19	10

Here, “type” in Table 2 is also called “dependency type” which indicates grammatical relations between two words (governor and dependent word). For example, nsubj in Table 2 indicates noun phrase which is the syntactic subject of a clause. Therefore, the word “Ministry” can be judged as a nominal subject in the sample sentence. Using this information about grammatical relationship, 1) Who (Nominal Subject), 2) What to do (Predicate verb), 3) To what (Object words), and 4) From who / To whom / With who (Related organization words) can be separated and summarized as illustrated Fig. 3.

By focusing on this structuralized text information, relationship between ministries and perspectives of Standing Order and NEDRP were analyzed and visualized on the following analysis. Furthermore, it is noted that some mistakes of spelling or grammar in the original sentence were corrected by hand in advance.

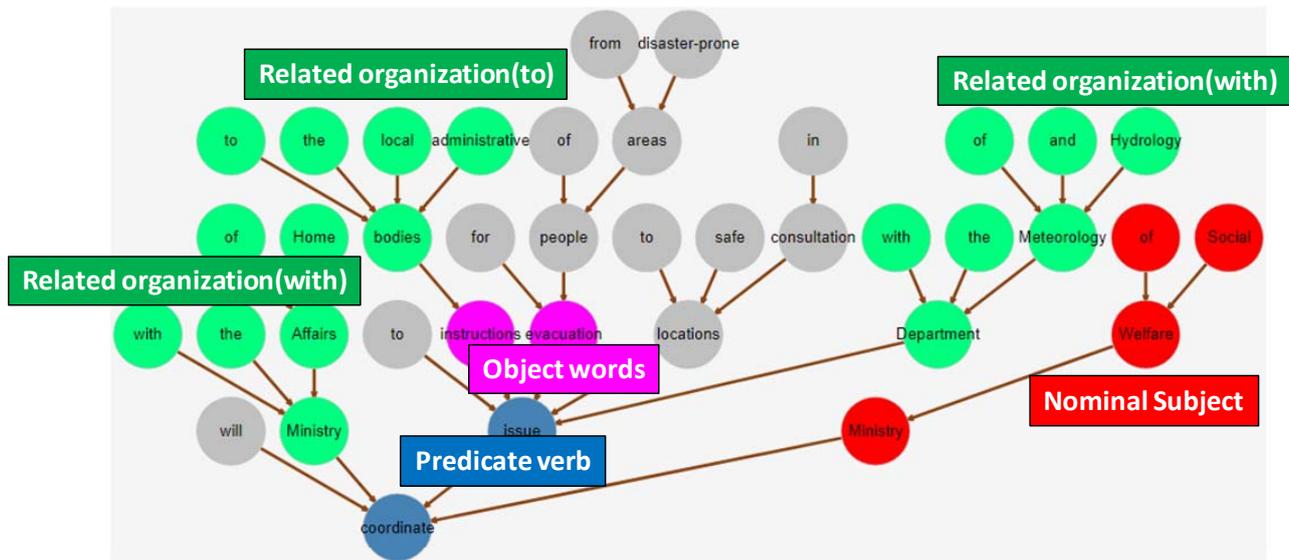


Fig. 3 – Dependency tree as result of syntactic analysis

### 3.3 Text Clustering Analysis on disaster risk management actions

Using structuralized text information in the previous subsection, text clustering analysis were conducted in order to categorize disaster risk management actions. Generally, on text clustering analysis, it is important to improve clustering accuracy by excluding unnecessary term. Therefore, text clustering on this paper only utilized the object words extracted in the previous subsection. All object words were formatted in Bag of Words as illustrated in Table. 3, which represents frequency of each term in each document and text clustering was conducted.

Table 4 – Bag of words (extracted)

Sentence No.	information	need	support	necessary	situation	emergency	international
NRP_19	1	1	0	0	0	0	0
NRP_20	1	0	0	1	0	0	0
NRP_21	1	0	0	1	1	0	0
NRP_22	1	0	0	0	0	0	0
NRP_23	1	0	0	0	0	0	0
NRP_24	2	0	0	0	0	0	0
NRP_25	1	0	0	0	0	0	0

On text clustering analysis, Latent Dirichlet Allocation (LDA) were applied which is one of machine learning techniques [9]. LDA assumes that each item of terms and documents is modeled as a finite mixture over an underlying set of topics and topic probability.



## 4. Result

### 4.1 Result of pretreatment of text information

For comparison between two plans, 332 actions from Standing Order and 354 actions from NEDRP, which are actions on emergency response phase, were extracted. In addition, based on the Morphological and Syntactic analysis, total 537 terms derived from object words of 686 actions were extracted after excluding stop words.

### 4.2 Clustering Analysis on disaster risk management actions

The result of clustering analysis on 686 actions with 537 terms by Latent Dirichlet Allocation were illustrated in Fig. 5. As a result of clustering, actions on emergency response were divided into 36 disaster action categories.

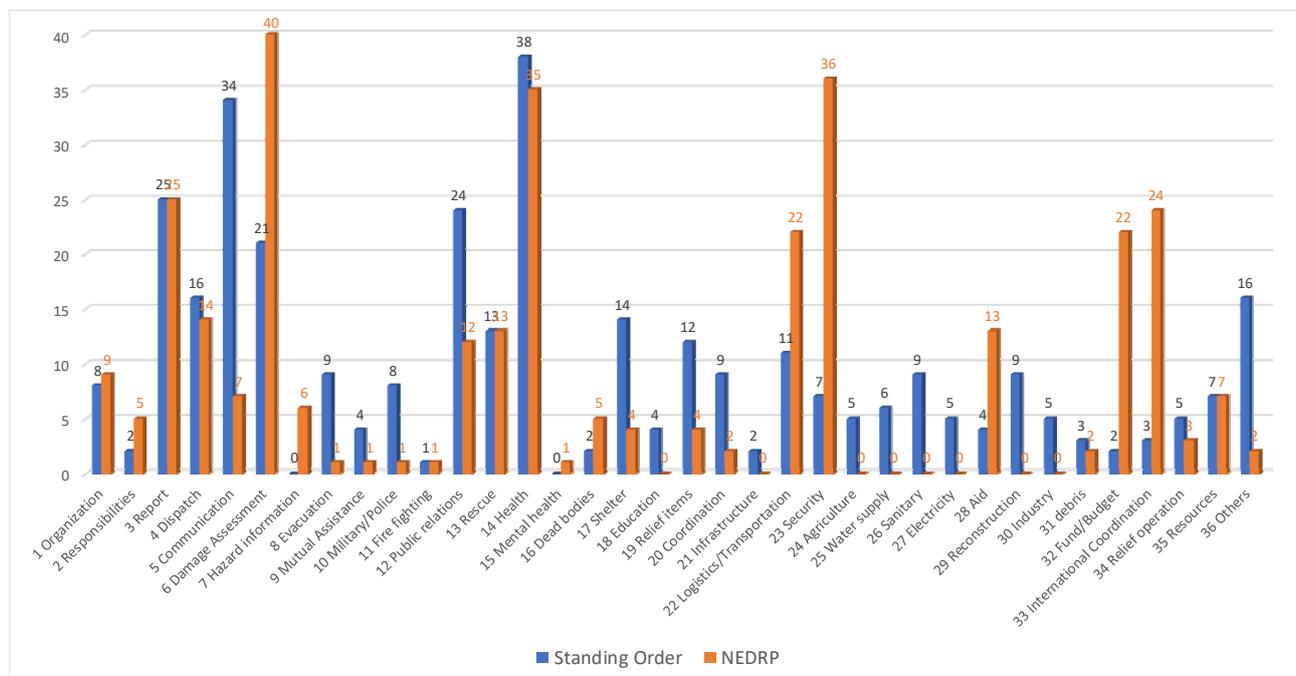


Fig. 5 – Number of actions on Standing Order and NEDRP by disaster action category

## 5. Discussion

By comparing two disaster risk management plans, the following discussion can be made:

- 1) Infrastructure management including “25 water supply”, “27 Electricity” are not mentioned in NEDRP.
- 2) On the other hand, actions related to “23 Security” issues and “32 Fund/Budget” are written more detailed in NEDRP.
- 3) Actions related to “10 Military / Police” are reduced in the newer NEDRP. This is considered to affection by political change in Myanmar Government.



These reveals inconsistency between two plans, which should be improved and incorporated in the future.

## 6. Conclusion

In conclusion, this study illustrates potential and effectiveness of structuration and visualization of disaster management plan. It is recommended to conduct comparison analysis on disaster management plan by using this methodology between national level and local level in Myanmar as well as Myanmar and other countries.

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## 8. References

- [1] The Republic of the Union of Myanmar (2011): Standing Order on Natural Disaster Management in Myanmar
- [2] Kikuchi R, Numada M, May MM, Tun N, Khin TY, Meguro K (): A Comparison of Disaster Management Plans for Both Japan and Myanmar. *Journal of Disaster Research*, **13** (1), 62-69.
- [3] May MM, Tun N, Numada M, Khin TY, Meguro K, Kyaw ZL (2018): Analysis of Disaster Response During Landslide Disaster in Hakha, Chin State of Myanmar, *Journal of Disaster Research*, **13** (1), 99-115.
- [4] Srikandini, A. G., Hilhorst, D., van Voorst, R. (2018): Disaster Risk Governance in Indonesia and Myanmar: The Practice of Co-Governance, *Politics and Governance*, **6** (3), 180-189.
- [5] Soe TT, Tint LS (2009): Earthquake and Tsunami Hazard in Myanmar, *Journal of Earthquake and Tsunami*, **3** (2), 43-57
- [6] Union of Myanmar, Myanmar Engineering Society, Myanmar Geosciences Society, Myanmar Information Management Unit, Asian Disaster Preparedness Center (2009): Hazard Profile of Myanmar
- [7] The Republic of the Union of Myanmar (2019): Myanmar launches National Earthquake Preparedness and Response Plan, <https://www.president-office.gov.mm/en/?q=briefing-room/news/2019/08/07/id-9486>
- [8] Manning, Christopher D., Surdeanu, Mihai, Bauer, John, Finkel, Jenny, Bethard, Steven J., and McClosky, David. (2014) : The Stanford CoreNLP Natural Language Processing Toolkit, *Proceedings of 52nd Annual Meeting of the Association for Computational Linguistics: System Demonstrations*, pp. 55-60.
- [9] David M. Blei, Andrew Y. Ng, and Michael I. Jordan. (2003): Latent dirichlet allocation, *J. Mach. Learn. Res.* **3**, pp. 993–1022.