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8 Designing Cognitive Intervention to Improve the Awareness Index of the Residents in the Landslide Area

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Abstract. Considering Semarang as a city with a high potential of landslides occurrences in its almost area, human as the part of the system should be played as a centre of the disaster management system to reduce the natural disaster risk. The study area is located in Manyaran district (the west of Semarang) which is categorised as a vulnerable of landslide area. This study aims at establishing a cognitive intervention based on a cause analysis (Fault Tree Analysis/FTA) to find the cause of low value and improve the awareness index of residents as the implementation of human-based disaster management model. The FTA result was then combined with the demographical data to generate the design of the cognitive intervention. The FTA result conducted that the preparedness of emergency planning had the lowest value (18.2%) which was caused by the lack individual preparation including lack of residents knowledge, and the absence of observation facilities as well as the lack of evacuation planning. Analysis of demographical data resulted in a situation of lack socialisation and knowledge of the residents regarding the landslide occurrence. The model of cognitive intervention then utilised some tools such as video, module and discussion to improve the awareness index.

1. Introduction

Semarang city has a quite rapid development characterised by the implementation of development in all fields. This development must be balanced with a more specific handling of the disaster control to protect the assets and development outcomes that have been achieved and to provide a sense of security from disasters (before/pre or during disaster/emergency response) as well as post-disaster.

Semarang city has the potential landslides were quite high in almost all regions [1]. Recently, the studies focused only on the technical aspects of disaster management. The studies of disaster management largely focused on supply chain management of the logistics system [2] [3] [4] [5] and the technical problems of disaster from the point of view of geology, especially in the city of Semarang [6] [7]. Public awareness of landslides should be increased through people's behaviour toward disaster prevention, an understanding of the equipment factors as well as the establishment of the community's commitment to the security plan prepared by the Government of Semarang together with the community. The policies and programs undertaken by the Government of Semarang for this matter are still focused on the institutions whose responsible for the emergency response and post-disaster when residents in disaster-prone areas need an adequate training and education regarding the condition of the area. Human factors should be considered because humans are the most disadvantaged side in the event of disasters



even they are also suspected as one cause of the disaster. Human empowerment as individuals and community part is a critical point for the success of disaster management program.

Based on the previous research [8], analysis of awareness of Semarang residents to landslides has been conducted by calculating the index on the awareness of residents in 19 areas. From this study, it was known that Manyaran district (33.36) had the lowest level of individual and family awareness index and classified as “not ready” (0-39) on a scale of 0-100. Based on administrative data on 2016, the population in Manyaran includes 4899 households and a total population is 15,020 people with an area of 150 ha, consisting of dry ground (grounds/building/emplacement and orchards) amounted to 145.25 ha and ground purposes of public facilities (sports fields, recreational parks and cemeteries) of 4.75 ha.

Manyaran district is a densely populated area and it requires empowering people to improve the success of disaster management and to prevent material losses and casualties in the event of landslides. Analysis of the causes of low index of residents’ awareness needs to be done as a community empowerment approach using Fault Tree Analysis.

The human factor in empowering the community is needed, especially regarding the cognitive and physical readiness and awareness of residents on preventing and overcoming disasters. An ergonomics of cognitive interventions in disaster management should be highly considered as the key to successful mental aspects of disaster management. With these cognitive factors, human cognition during the critical phase was not bothered by stress or emotional aspect of decision makers and agents collaborated [9]. Recent studies of human factors in disaster management can be further analysed based on the research result of [10] about improving human awareness index in children. Lachland et al. [11] investigated elderly people in disaster management. Other studies analysed the role of government [12], strategy to overcome the trauma of the disaster [13] and disaster risk management [14] [15].

A new novel model of intervention is purposed in this study. This model utilises a cognitive aspect of human being in disaster management. Cognitive intervention is a form of psychological interventions, techniques and exercise therapy in counselling [16]. Cognitive interventions can be used for the conceptual design of cognitive interventions to reduce the depressive level of breast cancer patients after mastectomy [17]. The function of cognitive interventions in addition to reducing depressive also to change individual behaviour to fit the purpose of the intervention. Cognitive interventions in disaster management should be highly considered as the key to successful mental aspects of disaster management is applied. The results of the Fault Tree Analysis approach used as the basis for the design of cognitive interventions on the human condition combined with typography and vulnerabilities that exist in the area. Thus, this study aims at analysing the cause of the low index of awareness of residents to landslides using Fault Tree Analysis as well as designing the cognitive interventions for the communities in landslide areas.

2. Research Methods

2.1. Research Area and Sample

This research was conducted in Manyaran district of Semarang city from March to June 2016. The sample in this study were 40 people aged ≥ 17 years, illiteracy and the board of neighbourhood (RT) or Hamlet (RW), and Family Welfare Programmed (PKK) cadres thereby contributing to disseminate information to the other resident. The sampling technique in this research is purposive sampling or judgmental sampling.

2.2. Research Variables

This study has four independent variables; they were Knowledge and Attitude (KA), Emergency Planning (EP), Warning System (WS), and Resources Mobilization (MR) from LIPI-UNESCO/ISDR [18]. The dependent variable in this study is the index of awareness of residents to landslides. Measurements were made using a Likert scale questionnaire which is then weighted for each parameter

with the weight of each parameter of 25%. After weighting, calculation of Awareness Index can be taken into account using following formula:

$$\text{Preparedness Index} = \frac{\text{Total Riil Score of Parameter}}{\text{Maximum Score of Parameter}} \times 10 \quad (1)$$

From the calculation of the index, it will be obtained awareness index which then can be categorised based on the detail in Table 1.

Table 1. Category of awareness index (Sopaheluwakan, 2006)

Nr.	Index score	Category
1	80-100	Very ready
2	65-79	Ready
3	55-64	Almost ready
4	40-54	Less ready
5	0-39	Not ready

The determination of cognitive intervention was varied according to the characteristic of the residents in the each of district that obtained from the result of the survey.

2.3. Research Procedure

The study was begun with a preliminary study through field surveys by spreading the questionnaire according to the specified parameters. From the results of the questionnaire Likert scale in the form of resident awareness index, a parameter with the lowest value can also be identified. 5 point Likert scale was selected considering the diversity of the respondents' education level and to reduce charging errors generated by respondents caused by too many options. From the lowest parameter, a Fault Tree Analysis was conducted to find the cause of low index.

Along with the spread of the questionnaire, characteristics of the population in the study area was obtained, as well. The design of cognitive interventions carried out based on the combination of the Fault Tree Analysis and data characteristics of the population.

3. Result and Discussion

3.1. Population Characteristic

There were in total 40 people in Manyaran district from RW V, RW VI, and RW IX. The selection of RW and RT location was conducted based on data of landslide occurrences, the advice and recommendation of the Head of the Manyaran district as well as the result of survey research. District Disaster Awareness (KSB) of Manyaran district was less active and do not run well. In addition, most of the resident in the Manyaran district were not realised that their area is prone to landslides (based on a survey on April 2016).

Pretest phase was conducted to determine the awareness index of the residents in the Manyaran district before obtaining cognitive interventions. The result showed that the awareness index awareness residents to landslides was 32.20 and categorised as "Not Ready". Index for the parameters of knowledge and attitudes was 44.25%, parameter of self-preparedness plan amounted to 18.21%, the warning system parameter was 22.17%, and the parameters of resource mobilisation was 25.83%. The parameter of preparedness plans was a parameter with the lowest percentage. This parameter was served as the basis of Fault Tree Analysis.

3.2. Fault Tree Analysis

The information contained in the Fault Tree Analysis was obtained through interviews with residents, the district government and the KSB (District Disaster Awareness). Figure 1 showed the Fault Tree Analysis of the awareness parameter in the Manyaran district.

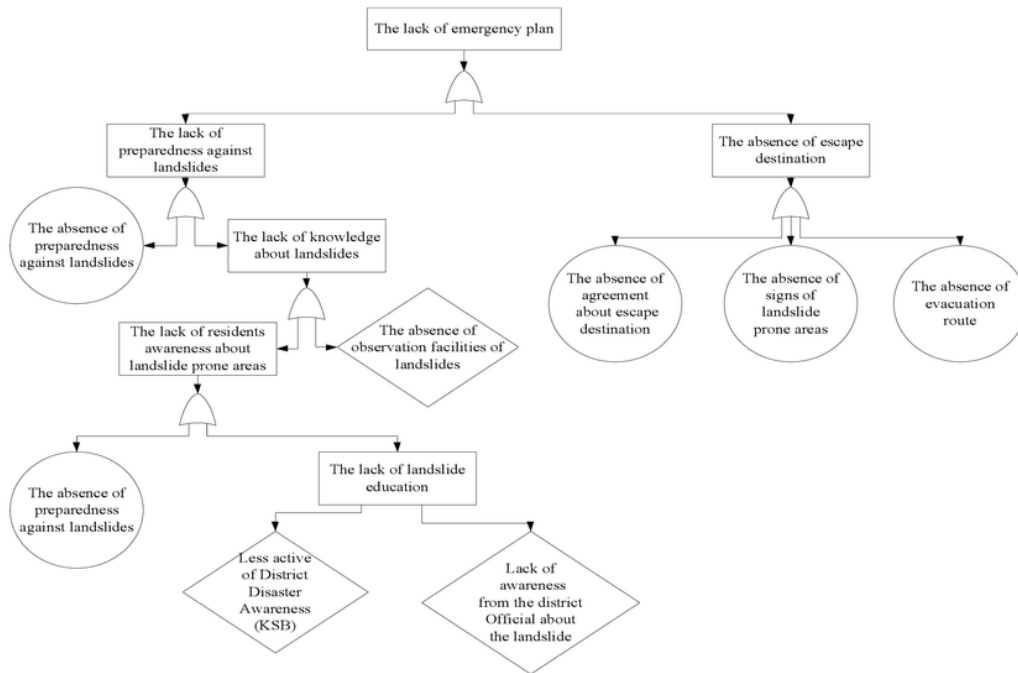


Figure 1. Fault Tree Analysis of awareness parameter in Manyaran district

Based on Figure 1, it can be explained that the basic event of awareness parameter was the lack individual preparation, the absence of landslide hazard map, the absence of agreement about escape destination, the absence landslide signs as well as the absence of evacuation route. That basic event was then used as the basis for cognitive interventions while did not ignore the other three parameters that expected to improve the awareness index in Manyaran district. In addition to a basic event, there was undevelopment event including the absence of observation facilities of landslides and less active District Disaster Awareness (KSB). The undevelopment event were not considered as the basis of the design of cognitive interventions because these undevelopment events were certain failure event that was not sufficiently related to the research conducted. By doing so, further cause analysis was not taken into account.

To analyse FTA qualitatively, it was found firstly the minimal cut set using Boolean algebra. The next step was to analyze the failure that led directly to the occurrence of a top event and the quantitative analysis using probability theory to get the top probability event occurred. A cut set is the set of the basic event which happens when all the basic event are occurred, and then there will be a top event. The Minimal cut set is the set of the smallest combination of basic event where if the event occurs, it will cause the top event occurs [19]. For example:

T = Top event

P = Primary Event (Basic event)

G = intermediate event

S = conditioning event

So, the study can be translated into:

T = Lack of plan for emergencies in the Manyaran district (Top event)

G1 = Lack of the preparedness against landslides

G2 = The absence of escape destination

G3 = Lack of the knowledge about landslide

G4 = Residents are not aware of the area prone to landslides

G5 = Lack of education about landslides

S1 = The absence of observation facilities for landslides

S2 = Less active of District Disaster Awareness (KSB)

S3 = Lack of awareness from the district official about the landslide

P1 = Lack of preparation against landslides

P2 = The absence of agreement about the escape destination

P3 = The absence of the signs of landslides prone pins

P4 = The absence of evacuation route

P5 = The absence of a landslide hazard map

So the Fault Tree Analysis can be drawn as seen in Figure 2.

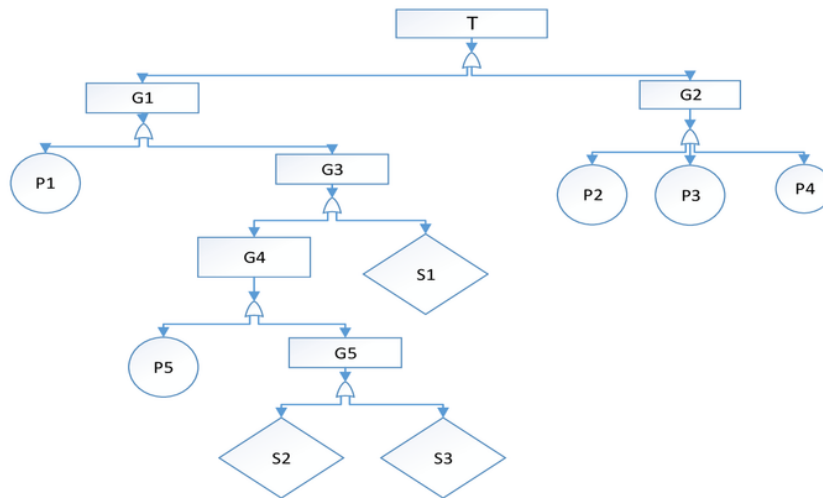


Figure 2. Fault Tree Analysis for Manyaran district with code

The Boolean equation was:

$$T = G1 + G2$$

$$G1 = G3 + P1$$

$$G2 = P1 + P2 + P3$$

$$G3 = G4 + S1$$

$$G4 = G5 + P5$$

$$G5 = S2 + S3$$

Using a top-down approach, it can be found:

$$T = G1 + G2 \text{ (because } G1 = G3 + P1 \text{ and } G2 = P2 + P3 + P4)$$

$$= G3 + P1 + P2 + P3 + P4 \text{ (because } G3 = G4 + S1)$$

$$= G4 + S1 + P1 + P2 + P3 + P4 \text{ (because } G4 = G5 + P5)$$

$$= G5 + P5 + S1 + P1 + P2 + P3 + P4 \text{ (because } G5 = S2 + S3)$$

$$= S2 + S3 + P5 + S1 + P1 + P2 + P3 + P4$$

So the minimal cut set were {P1}, {P2}, {P3}, {P4}, {P5}, {S1}, {S2}, {S3}. As aforementioned, the top event was the low score of emergencies plan. The results of the qualitative analysis showed that the causes of low score of plan for emergencies in Manyaran district were under these events:

- Lack of the preparedness against landslides
- The absence of a landslide hazard map
- The absence of an agreement about the escape destination
- The absence of the signs of landslides prone pins
- The absence of evacuation route
- The absence of observation facilities for landslides
- Lack of awareness from the district official about the landslide
- Less active of District Disaster Awareness (KSB).

The design of cognitive interventions was emphasised the basic event because the development event was a specified failure that was indirectly related to the research conducted. For example, observation facilities of landslides and lack of awareness about the landslides by the district official were the responsibility of local government and the Regional Disaster Management Agency (BPBD) Semarang. They have a responsibility to undertake the procurement of equipment and increase the government awareness regarding the landslide. Less active of District Disaster Awareness (KSB) is the responsibility of BPBD Semarang.

3.3. Design of Cognitive Intervention

The establishment of cognitive interventions in this study carried out the modules and videos about landslides, as well as the discussion. These instruments were selected based on the result of the survey regarding the characteristics of the population in the study area. They were indicated have a diverse educational level and rarely get the socialisation of the government regarding the landslide disaster that may occur in their area. Based on the results of the survey in April 2016, it was found that residents in Manyaran district did not know that the area was prone of the landslide. The knowledge level was inadequacy, as well. There were also an insufficient preparedness plans against landslides and the warning system when landslides occurred, while the mobilisation of resources in the form of disaster preparedness activities carried level RT/RW/district was not well occupied.

These conditions affected the awareness index of the resident, and it prominently needed an effort to improve index. The cognitive intervention was utilised video, modules and discussion media. The media for delivering the information in the form of the module was used because the residents in Manyaran district insufficiently obtained the information on landslides and environmental conditions.

3.3.1. Video

The use of video in this study was based on research conducted by Gloria [20]. Selection of video as a medium of intervention given to the Manyaran district based on research that video is the most effective media of information and it expected can draw enthusiasm of the residents. The selection of cognitive intervention media by using video is also based on the recommendations of the Regional Disaster Management Agency (BPBD) Semarang. BPDP was suggested to make a video about landslides as media dissemination and delivery of information to the residents in landslide-prone area (Survey result on May 2016). The video was included some material which is established based on the basic events of Fault Tree Analysis and a parameter of awareness index for landslide areas.

3.3.2. Module

The module was included the basic information based on the result of the basic events in Fault Tree Analysis, materials about the parameter of awareness index as well as a short comics about the importance of residents' awareness to landslides. The resident characteristic in Manyaran district was identified as a population with insufficient knowledge and information of landslide area caused by due to the lack of information on landslides from the official and District Disaster Awareness (KSB). So,

the module was designed to detail to deliver understandable basic information and to improve the resident intention about landslide occurrences.

The video and module material used in the cognitive intervention consisted of four parameters as seen in Table 2.

Table 2. Material of video and module for cognitive intervention

PARAMETER	VARIABLE	INDICATOR	MATERIAL
Knowledge and attitudes	Natural events and disasters (type, source, quantity, location)	Explaining the condition of disaster-prone areas	Understanding of knowledge of regional situation
		Explaining the impact	The impact of landslides
		Explaining the signs	Signs of landslides
		Explaining the source of the landslide	The causes of landslides
Plan for emergencies	Physical vulnerability	Explains the vulnerability of communities to natural disasters	The rate of occurrence of landslides urban village
	Attitude when the landslide occurred	Describes the self-rescue measures in time of disaster	Attitude when the landslide occurred by Major Disaster Scenario
	Disaster preparedness	Preparedness against disasters	Individual Preparedness Plan (<i>Basic Event</i>)
Disaster warning system	Evacuation plans	The availability of escape destination	Meeting point in the landslide occurrence (<i>Basic Event</i>)
		Availability of hazard maps	Landslide hazard map of the district (<i>Basic Event</i>)
		Availability of evacuation maps, route / lane	Evacuation route map (<i>Basic Event</i>)
Resource Mobilization	Disaster warning systems that traditionally evolved/ heredity applied and/or local agreements	Availability of signs alarm	Signs prone to landslides (<i>Basic Event</i>)
		Resource Mobilization	Warning system agreed
		Warning system agreed and the level of understanding and the effectiveness of the warning system	
		Resource mobilization activities and effectiveness of conducted resource mobilization done	Explanation on resource mobilization

3.3.3. Discussion

The discussion was started with material transfer via the slide show (power point) medium. The utilisation of the slide show was considered with the aim to deliver a large scope of information and to optimise the intervention implementation. The material of the presentation was designed in the form of points, comprehensive and understandable statement. By doing so, it was expected the resident can achieve a higher knowledge about the presentation material. Besides. Animation and picture were used to attract the resident attention. The material was consisted of four parameters in awareness index; they were knowledge and attitude (KA), emergency planning (EP), warning system (WS), and resource

mobilisation (RM). After the presentation, the discussion session was conducted to check the resident comprehension and to explain further the unclear material presented in the first session.

4. Conclusion and Further Study

The result of the study conducted the causes of low awareness index toward landslides in Manyaran district (index score = 32.30) were the absence of preparedness to the landslide, the absence of landslide hazard map, the absence of the agreement about escape destination, the absence of landslide signs as well as the absence of evacuation route.

The design of cognitive intervention can be different for each area depends on the characteristic of the population and the result of root cause analysis. Manyaran district was identified as an area with insufficient knowledge and information of landslide occurrences and by doing so, module, video and discussion were utilised to improve the awareness index.

The further studies should be implemented the design of cognitive intervention as well as analysed the role of the other stakeholders in disaster management, such as government/local official and non-departmental institution (for example, BPBD). Besides, an advanced study regarding collaboration design between the stakeholders should be carried out to improve the total awareness index.

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