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ANALYSIS OF SCHOOL DISASTER PREPAREDNESS IN MOUNT MERAPI ERUPTION-PRONE AREAS: A CASE STUDY IN SLEMAN REGENCY, YOGYAKARTA

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ABSRACT: Indonesia, situated within the Pacific Ring of Fire, exhibits a unique combination of dynamic tectonic plates and active volcanoes, rendering it susceptible to various seismic activities, ranging from minor tremors to large-scale earthquakes (megathrust). Volcanic eruptions, a prevalent natural disaster in Indonesia, pose significant threats due to the presence of over 130 active volcanoes, with 129 concentrated on Java Island alone. Among these, Mount Merapi stands out as the most active and perilous, situated 30 kilometers north of Yogyakarta City, spanning the administrative boundaries of Yogyakarta Special Region and Central Java. Educational institutions, particularly schools, serve as vital hubs equipped with resources and infrastructure that demand meticulous preparation for potential disasters. This research endeavors to assess the level of school preparedness in the face of disasters, with a specific focus on volcanic eruptions. Through data processing and analysis, it is discerned that Y Primary School in Girikerto village exhibits the highest average preparedness score across five criteria: disaster management plan, community action plan, rehabilitation efforts, early warning system, and competency (89.66%). This is followed by X Primary School (82.39%) and Z Primary School (22.61%). In a broader context, the study reveals that 17.4% of respondents exhibit low preparedness, 4.35% fall within the medium preparedness category, while 34.8% and 43.5% demonstrate high and very high preparedness respectively.

Keywords: Volcanic Eruptions, Mount Merapi, School Preparedness

1. INTRODUCTION

Indonesia, situated within the Pacific Ring of Fire, embodies the complex interplay of dynamic tectonic plates and active volcanoes, capable of generating earthquakes ranging from minor tremors to large-scale seismic events (megathrust). Earthquakes of significant magnitude, particularly those with shallow epicenter depths, may induce tsunamis, particularly when frictional movement occurs along coastlines. Indonesia serves as the convergence point for four active tectonic plates—the Asian, Indo-Australian, and Pacific plates—boasting one of the world's lengthiest coastlines, exceeding 108,000 km. These tectonic dynamics render a substantial portion of Indonesia susceptible portion of Indonesia susceptible to seismic risks arising from plate movements [1].

Adding to the region's vulnerability, Indonesia is situated in a volcanic belt (volcanic arc) extending across the islands of Sumatra, Java, Nusa Tenggara, and Sulawesi. This belt is characterized by ancient volcanic mountains and lowlands, some of which are marked by expansive swamps. The National Disaster Management Agency (BNPB) issues a Disaster Vulnerability Index Map, indicating elevated vulnerability levels in nearly all coastal areas, including Sumatra, Java, Nusa Tenggara, and Sulawesi, highlighted in red. BNPB reports that 184 million Indonesians reside in disaster-prone regions, with 3.8 million exposed to tsunami threats (www.cnn.com). The volcanic disaster-prone areas in Indonesia cover approximately 17,000 km2, housing around 5.5 million people, with 585,000 individuals facing the threat of volcanic eruptions annually [2].

Based on 2022 disaster data, 6,144,324 people were affected, resulting in 861 fatalities, 46 missing individuals, and 8,727 injuries. The impact on infrastructure was profound, with 95,403 housing units damaged (comprising 20,205 heavily damaged, 23,213 moderately damaged, and 51,985 slightly damaged units), 1,983 damaged facilities (including 1,241 educational facilities, 95 health facilities, and 647 worship facilities), along with 163 damaged offices and 342 damaged bridges.

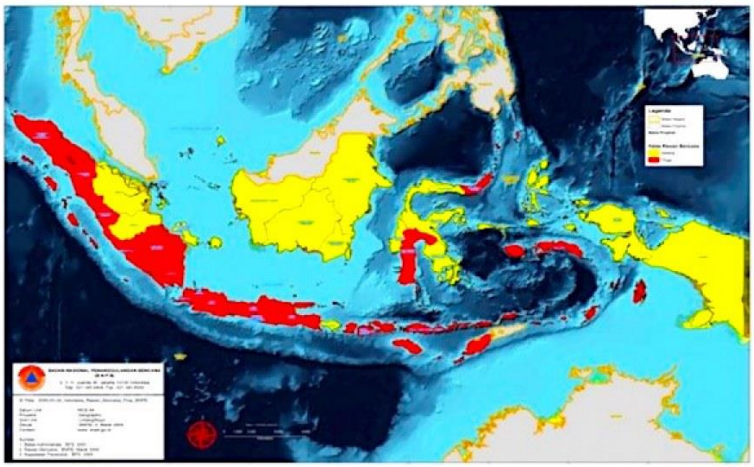

Fig 1. Disaster Vulnerability Index Map in Indonesia (source: www.bnpb.go.id)

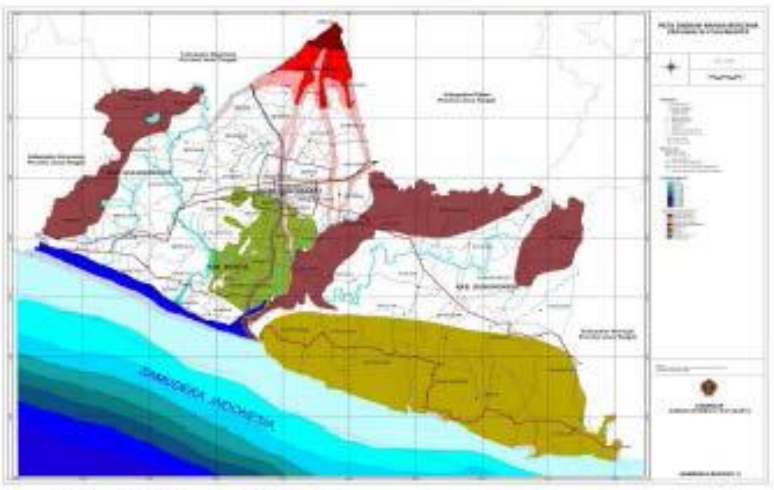

Fig 2. Disaster Vulnerability Map (source: www.bpbdiy.com)

The Disaster Proneness map, released by the Yogyakarta Special Region (DIY) Regional Disaster Management Agency (BPBD), highlights various types of natural disasters with a medium to high probability of occurrence in each region. These include floods, landslides, volcanic eruptions, droughts, earthquakes, tsunamis, and typhoons/tornadoes. Notably, volcanic eruptions, particularly from Mount Merapi, are classified under the high-risk category index, indicated by the color red. The disaster vulnerability map of DIY is depicted in Fig 2.

Volcanic eruption is one of deadly natural disasters that often happen in Indonesia because this country contains over 130 active volcanoes. One hundred twenty-nine volcanoes stated in Java Island with Mount Merapi as the most active and dangerous one. Merapi is located about 30 kilometers north of Yogyakarta City and administratively in two provinces, Yogyakarta Special Region, and Central Java. More than 1 million people live on the flanks of this volcano, which erupts effusively (non-explosive) almost continuously and explosively every 8-15 years, and violently every 26-54 years. Historical records

showed that Merapi volcano has already experienced at least thirteen major eruptions with death tolls since 1006. The deadliest eruption in historical times happened in 1672, leaving a reported of 3,000 people dead while in 1930, Merapi volcanic eruption killed at least 1,300 people. Then, in 1994 eruption, it was reported that 64 people were dead and over 2,000 were made homeless. The recent major eruptions of Merapi volcano were in October and November 2010 that killed 339 people and destroyed at least 217 schools. [4] [5] [6].

The definition of disaster based on the United Nation International Strategy for Disaster Reduction (UN-ISDR) is “a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exhaust the ability of the affected community/society to cope using its own resources “. Meanwhile, the definition of disaster according to the Disaster Management Law number 24 of 2007 (UU No. 24, 2007) is “an event or series of events that threatens and disrupts people's lives and livelihoods caused by both natural and/or non-natural factors and human factors so that resulting in human casualties, environmental damage, property loss, and psychological impacts” [7] [8].

The National Disaster Management Agency (BNPB) has the smallest chain spread across the regions, namely the Regional Disaster Management Agency (BPBD) which can be a strong forum for disaster issues in Indonesia. BNPB issues simplified rules in a pocketbook cover emergency procedure such as earthquakes, tsunamis, volcanoes, floods, landslides, tornadoes, tidal waves, land and forest fires, drought, transportation accidents, and others. These rules have completely explained the procedures for dealing with disasters for the community.

Schools as an educational institution have resources and infrastructure that must be prepared with disasters mitigation. Mitigation of emergency procedures in the event of disasters is needed to minimize disaster risk and increase capacity to respond the disasters. Analysis of the level of risk and school preparedness is needed as a basis for determining the part of preparedness that must be improved and the process of raising awareness of the school academic community. The risk level analysis will be determined based on the slope of the land where the school is located, the height of the school above sea level, the type of most buildings, the condition of the walls on the lowest floor, the condition of the school building, the school's use of concrete structures, the presence of retaining walls, the school's efforts to compact the land around the school.

Some research in school preparedness on the slope of Mount Merapi has been done. The research found out that among the 24 primary schools, in the slope of Merapi, 13 schools still needed to improve the preparedness level due to either their critical soft or hard components. Eleven schools under relatively middle risk level had shortage in soft components of preparedness, and only one school under this risk level had shortage in hard components. Besides that, 5 schools were categorized in the worst condition with both critical soft and hard components. The schools under such condition had major characteristics of having no or poor evacuation plan and no regular risk assessment, few supply emergency kits, and few or no emergency exits, little support from government, and the teachers were almost never trained about disaster prevention education. There were only 6 schools under well-preparedness level with both good soft and hard components. These schools had dominant characteristics, such as having a well-prepared special unit and evacuation plan, regular risk assessment, good coordination with local fire department and health center, sufficient support from government, and the teachers often got training related to disaster prevention education). In addition, 80% of teachers in the 24 primary schools still lacked knowledge on natural disaster prevention measures based on limits on the frequency of in-service teacher training [9] [10].

Another research found that learning in discussions and learning in lectures had significant changes or improvements regarding knowledge about appropriate actions indoors during a big earthquake (statement 1, with p values of 0.019 and 0.022). It was further found that students learning in the lectures also had significant changes in knowledge about the consequences of a big earthquake regarding a house fire (statement 5, $p = 0.000$), and in attitude regarding awareness of living in a disaster-prone area (statement 7, $p = 0.039$) [11].

The results of the school disaster preparedness research in elementary school in the slope of Merapi (SMP Negeri 2 Cangkringan) showed that the students' knowledge about disaster preparedness reaching 63.88 in the good category and teacher and employee knowledge about preparedness for the Merapi eruption disaster reaching 87% in the very good category. Schools’ policy in supporting disaster preparedness school programs should be designed to meet school policy indicators. School preparedness for disasters in contingency plan documents for dealing with disasters and mobilization of school resources is very good with safe building standards, cooperation with external parties and the formation of a school alert.

2. METHODS

In this research there are two stages such as: identification and analysis of school risk levels and measuring community preparedness as an academic community. In identifying and analyzing the understanding of the school (academic community) risk levels, surveys, observations, and interviews will be carried out using open questionnaires and closed questionnaires of stakeholders for staff, teachers, and principals. A descriptive analysis of the school's risk level and the school's preparedness were carried out.

The school's preparedness measurement based on five criteria such as: disaster management plan, community action plan, rehabilitation, early warning system and competence. Measurements are carried out on all criteria set by BNPB in the disaster mitigation pocketbook. Disaster management plan is an official document that contains data and information regarding disaster risks that exist in schools and school plans to reduce risks through physical and non-physical development programs and activities through strategies, policies to realize disaster preparedness, adequate response capacity and selective mitigation efforts. The community action plan is an action plan created by the community as an effort to reduce disaster risk by minimizing danger, vulnerability and increasing capacity as a detail of the school disaster management plan. Rehabilitation activities are efforts to repair and restore all aspects of public or community services to an adequate level in post-disaster areas with the main target being to normalize all aspects of education as soon as possible. An early warning system is a series of activities to provide warnings as soon as possible to all educational activities about possible disasters in schools. Emergency response is a series of activities carried out immediately at the time of a disaster to deal with the adverse impacts that arise which include rescue and evacuation activities for victims, property, fulfillment of basic needs, protection, evacuation management, rescue and restoration of facilities and infrastructure.

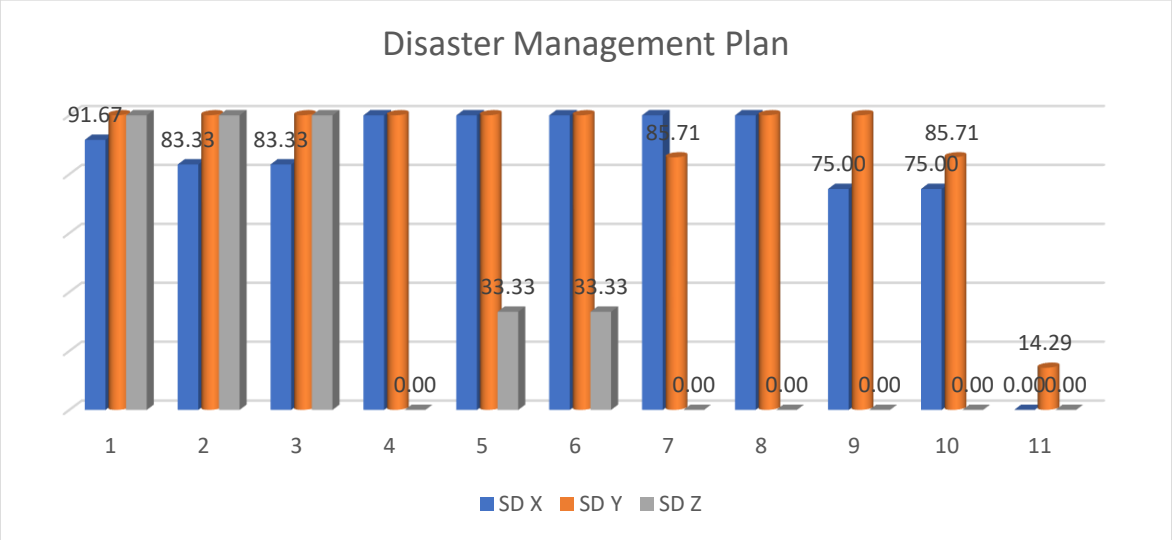

Fig 3. Disaster Management Plan

3. RESULTS AND DISCUSSION

Measuring the level school of risk and preparedness in facing disasters was carried out at three primary schools spread across the villages of Girikerto, Wonokerto and Merdikorejo and included in KRB I Merapi. distributing questionnaires in Turi District schools with 23 complete questionnaires. Primary School Y primary school is a state primary school located in Girikerto village with a total of 13 staff/teachers and 122 students. Z primary school is a private primary school located in Merdikorejo village with 40 staff/teachers and 360 students.

In the three primary schools, the risk category for the slope of the school site is more than 200 (high risk), the height is more than 700 above sea level, the building is bolted from brick bolts, not multi-story with a concrete structure, the position of the building is parallel to the road, has a retaining wall and has compacted the soil around the school.

The disaster management plan is a criterion that measures school readiness by providing official documents containing data and information regarding existing disaster risks, risk reduction through programs and other policies as a school

commitment. This criterion is measured in 14 sub criteria and an illustration knowledge of the disaster management plans in the three primary schools based on imperfect criteria can be seen in Fig 3.

Based on Figure 3, the knowledge of school leaders/teachers/staff regarding disaster management regulations of the Ministry of Education and Culture (SE.70a/MPN/2010) and regional regulations/regulations of the district Education Office are 91.67% and 83.33% at X primary school. The percentage values from the three primary schools are the availability of fixed evacuation procedures (83.33%; 100%; 0%); trial of evacuation procedures (100%;100%;0.00%), procedures for preparing, storing and maintaining disaster warning equipment (100%;100%;33.33%), availability of materials in relevant subjects (100%,100%,0.00 %), disaster preparedness group materials/equipment in: disaster warning (100%;100%;0.00%), first aid/emergency kit (100%;85.71%;0.00%), rescue evacuation (75%;100%,0.00%),logistics(75%,85,71%,0.00%), others supporting activities (0.00%,14.29%, 0.00%).

Table 1. Community Action Plan

No.	X	Y	Z
1	83.33%	100.00%	100.00%
2	75.00%	100.00%	0.00%
3	100.00%	100.00%	0.00%
4	100.00%	100.00%	0.00%
5	100.00%	100.00%	0.00%
6	100.00%	100.00%	0.00%
7	100.00%	100.00%	0.00%
8	100.00%	100.00%	0.00%
9	75.00%	85.71%	0.00%
10	100.00%	100.00%	0.00%
11	100.00%	100.00%	0.00%
12	100.00%	100.00%	0.00%
13	100.00%	100.00%	0.00%
14	75.00%	100.00%	0.00%
15	100.00%	85.71%	0.00%
16	100.00%	85.71%	0.00%
17	100.00%	85.71%	0.00%
18	100.00%	100.00%	0.00%
19	100.00%	100.00%	0.00%
20	75.00%	100.00%	0.00%
21	100.00%	100.00%	0.00%
22	100.00%	100.00%	0.00%
23	100.00%	100.00%	0.00%
24	100.00%	100.00%	0.00%
25	100.00%	100.00%	0.00%
26	100.00%	100.00%	0.00%
27	100.00%	100.00%	0.00%
28	100.00%	100.00%	0.00%
29	75.00%	100.00%	33.33%

Community action plan criteria is an action plan prepared by a community as an effort to minimize disaster risk. An overview of knowledge and availability of community action plans is expressed in 34 sub-criteria, sub-criteria which have a score of less than one hundred percent in the three primary schools can be seen in Table 1.

Based on Table 1, Z primary school has the lowest value of knowledge and availability of community action plans (0.00%) in twenty-nine sub-criteria except for the regional disaster regulation action plan sub-criteria (100%) and access to warnings about the dangers of the disaster (volcano eruptions, earthquakes, forest fires and so on) (33.33%). X and Y primary school have same pattern with unperfect community plan in some sub-criteria which are: suitability of other supporting group activities with their functions (85.71%), incorporating disaster knowledge at extracurricular activities (85.71%), integration of preparedness material into subjects (85.71%), increasing teacher knowledge and skills (85.71%) at Y primary school and regional disaster regulation action plans (83.33%), availability of other supporting disaster preparedness groups (75.00%), suitability of the function of the disaster preparedness group with its functions (75.00%).), School budget allocation for school preparedness (75.00%), suitability of the supporting alert group to carry out fixed procedures (75.00%) for X primary school.

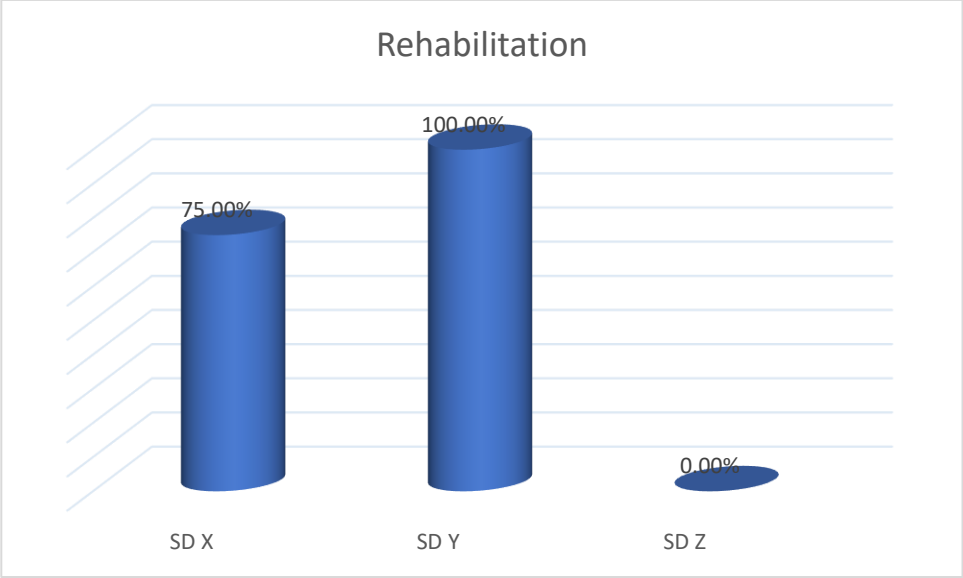

Fig 4. Rehabilitation

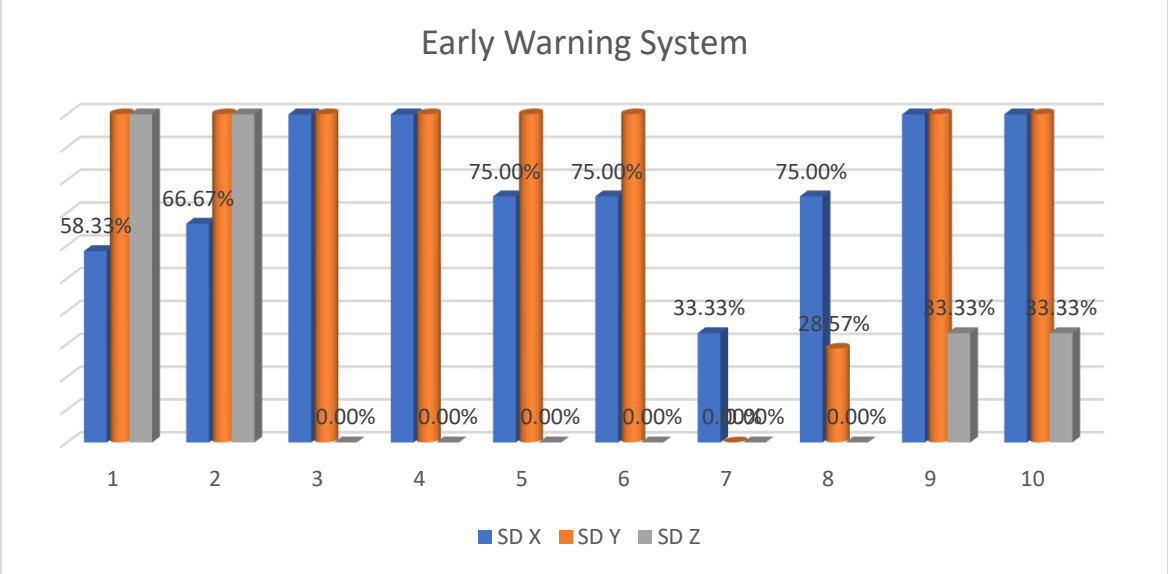

Fig 5. Early Warning System.

Rehabilitation efforts are efforts to repair and restore all aspects of public or community services to an adequate level in post-disaster areas with the main target being to normalize all aspects as soon as possible. An overview of the availability of rehabilitation efforts can be seen in Fig 4. In Fig 4 can be seen that Y primary school is the most prepared community with the value of the availability of back up or copies of important documents stored against the dangers of disaster (volcano eruptions, earthquakes, forest fires and so on) with 100%, followed by X primary school at 75%. On the other side, there is no backup or copy of any important documents against the dangers of disaster (volcano eruptions, earthquakes, forest fires and so on) available in Z primary school.

An early warning system is a series of activities to provide warnings as soon as possible to all educational activities about possible disasters in schools. The early warning system has twelve sub-criteria, the sub-criteria which are unperfect value in three schools can be seen in Fig 5. In Fig 5. Z primary school has the lowest value in the sub-criteria of disaster simulation/drills (0.00%), agreement on disaster warning signs/sounds (0.00%), differences in disaster warning signs (0.00%), socialization of disaster warning signs (0.00%), simulation disaster warning signs (0.00%), fixed procedures for disseminating warning signs and sounding warning signs (0.00%). Y primary school has the highest availability value of the sub-criteria except for the sub-criteria of socializing disaster warning sounds at 0.00% and warning sound simulation at 20.57%

The competency of the disaster preparedness group is the competency of disaster preparedness team members in carrying out a series of activities as quickly and effectively as possible during a disaster to minimize adverse effects through several activities. In this criterion there are twenty-one sub-criteria, an overview of the sub-criteria can be seen in Table 2.

Table 2. Team Competency

NO.	X	Y	Z
1	100.00%	100.00%	0.00%
2	100.00%	100.00%	0.00%
3	100.00%	100.00%	0.00%
4	100.00%	100.00%	0.00%
5	100.00%	100.00%	0.00%
6	66.67%	85.71%	0.00%
7	8.33%	0.00%	33.33%
8	0.00%	14.28%	0.00%
9	100.00%	85.71%	0.00%
10	91.67%	85.71%	66.67%
11	83.33%	100.00%	66.67%
12	33.33%	14.29%	0.00%
13	91.67%	100.00%	66.67%
14	83.33%	100.00%	100.00%
15	83.33%	71.43%	100.00%
16	8.33%	0.00%	33.33%
17	100.00%	85.71%	0.00%
18	100.00%	85.71%	0.00%
19	100.00%	100.00%	0.00%
20	100.00%	100.00 %	0.00%
21	8.33%	14.28%	0.00%

Based on Table 2, Z primary school has the lowest score in almost all sub-criteria except for the sub-criteria of availability of materials and preparedness materials in the form of VCDs for the earthquake/Merapi eruption (33.33%), assistance financial aid/guidance for schools (33.33%). Y primary school has the highest competency score from the sub-criteria except for the sub-criteria of preparedness assistance/guidance from the government (85.71%), preparedness assistance/guidance from NGOs (85.71%). preparedness assistance/guidance from companies/private parties (14.29%). assistance/guidance in the form of training and simulations (71.43%), assistance/guidance with funding assistance for schools (0.00%), increased knowledge and skills in disaster warning groups (85.71%), increased knowledge and skills in the first aid group (85.71%).

Preparedness is a series of activities carried out to anticipate disasters through organization and appropriate and effective steps. School preparedness in facing disasters can be seen in Figure 8.

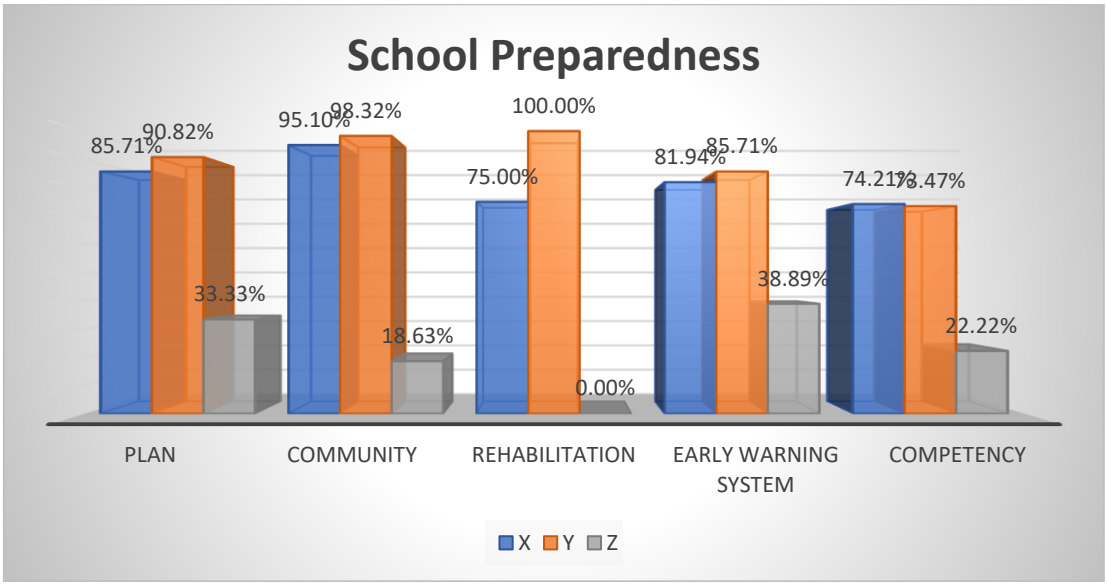

Fig 6. School Preparedness

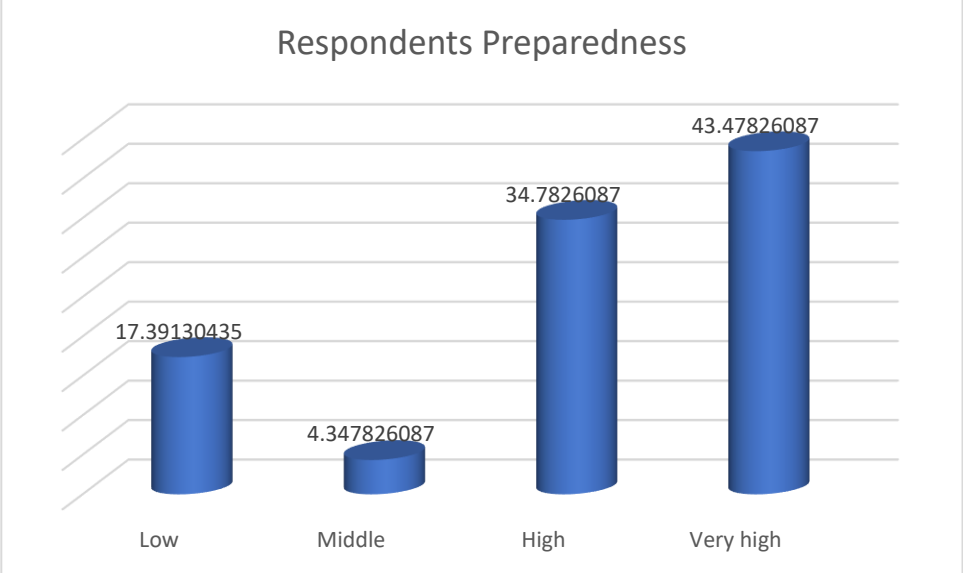

Fig 7. Respondent Preparedness

Based on Fig 6 can be seen that the pattern of all criteria is almost the same, Y primary school has the highest score, followed by X primary school and finally Z primary school. Y primary school has the highest score in all assessment categories: disaster management plan (90.82%), community action plan (98.32%), rehabilitation efforts (100.00%), early warning system (85.71%) and efforts to increase staff/teacher competency /alert group (74.47%). Z primary school has the lowest score in all assessment categories: disaster management plan (33.33%), community action plan (18.63%), rehabilitation efforts (0.00%), early warning system (38.89%) and efforts to increase staff/teacher competency /alert group (22.22%).

Analysis based on the overall preparedness of respondents' knowledge and skills can be seen in Fig 7. Based on Fig 7 in respondents' preparedness, 17.4% of respondents had low preparedness, 4.35% had medium preparedness. For the high preparedness category, 34.8% of respondents were at this stage, while in the very high category it was 43.5% or the category with the highest number of respondents.

4. CONCLUSION

Based on the data processing and analysis that has been carried out, a conclusion can be drawn that SD Y in Girikerto village has the highest average preparedness score on the five criteria, namely: disaster management plan, community action plan, rehabilitation efforts, early warning system and competency (89.66%) followed by X primary school (82.39%) and Z primary school (22.61%). Meanwhile in general, 17.4% of respondents had low preparedness, 4.35% had medium preparedness. For the high preparedness category, 34.8% of respondents were at this stage, while in the very high category it was 43.5% or the category with the highest number of respondents.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

[1] Badan Informasi Geospasial., (2023)., Jelajah Pantai Indonesia, diakses online pada: https://big.go.id/uploads/ebook/EBookGeospasial/26/FAIsi_JelajahPantaiIndonesia.pdf acces at: 10 Desember 2024.

[2] Wijaya, I.P.K dan Utama, W., (2016)., Pemetaan Tingkat kerawanan bencana lahar hasil erupsi gunung api Kelud., Jurnal Dialog Penanggulangan Bencana, Vol. 7 No. 1 page 31-41

[3] Badan Penanggulangan Bencana Nasional., Data dan Informasi Bencana di Indonesia.,https://bnpb.go.id/storage/app/media/uploads/migration/pubs/446.pdf access at 20 September 2023.

[4] Dove MR., 2008, Perception of volcanic eruption as agent of change: on Merapi volcano, Central Java. J. Volcanol. Geotherm; Res. 172, p. 329-337.

[5] Thouret JC, Lavigne F, Kelfoun K, Bronto S. 2000., Toward a revised hazard assessment of Merapi volcano, Central Java. J. Volcanol. Geotherm.; Res.100, p. 479-502.

[6] Tuswadi and Hayashi,T. 2014, Disaster Prevention Education in Merapi Volcano Area Primary Schools: Focusing on Students' Perception and Teachers' Performance Procedia Environmental Sciences p 668 – 677.

[7] Nurjanah, A., & Apriliani, R. (2021). The role of community in disaster mitigation: the case of Umbulharjo Merapi Monitoring Community on Merapi Mount, Indonesia. Jurnal Hubungan Internasional, 10(1), 72-83.

[8] Rinaldi, I. R., & Permana, A. Y. (2019). Tingkat Kerentanan Bencana Pada Sekolah. Jurnal Arsitektur Zonasi, 2(1), 12-24.

[9] HAYASHI, T. (2013). Preparedness assessment toward volcano eruption: Case of primary schools in Merapi area, Indonesia. Journal of International Development and Cooperation, Vol.19, No.3, 2013, pp. 65-72

[10] Hayashi, T. (2014). Educational Merits of Lecturing and Discussion Methods in Teaching Disaster Prevention: Toward Improvement of Students' Knowledge, Attitude, and Behavior in Merapi Volcano Area Primary Schools. Journal of Disaster Research, 9(5), 870-878.

[11] Hayashi, T Fujikawa,Y, Kimiko. U (2018). Current Status of University Students' Awareness on Disaster Prevention and Environment—Cases of Islamic University of Ahmad Dahlan in Yogyakarta and Hijiyama University in Hiroshima—. Journal of Teacher Training Courses, Hijiyama University Junior College, 4, 208-217.

[12] Santoso, A. B., & Juhadi, J. (2017). Pelaksanaan Program Siaga Bencana Di Sekolah Menengah Pertama Pada Kawasan Rawan Bencana. Edu Geography, 5(3), 86-94