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The Resilient Community: Strengthening People-Centered Disaster Risk Reduction in the Merapi Volcano Community, Java, Indonesia

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Abstract: Local communities generally play a crucial role during a disaster, so their involvement in pre-disaster capacity development may prove beneficial in the face of a disaster threat. Thus, People-Centered Disaster Risk Reduction (PCDRR) programs could enable communities living in disaster-prone areas to become more resilient. This study examines how relationships among individual attributes of the community (and their pre-event Disaster Risk Reduction (DRR) context (risk knowledge, information access, and network and stakeholders) could give insight into how communities can be transformed to make them more resilient in the case of the Merapi Volcano community. Based on data collected through online survey platform by non-probability sampling, this study uses non-parametric goodness fit tests and parametric regression to assess the dependencies between various indicators and find the predictor variables. The findings indicate that the individual attributes of the Merapi Volcano community, as perceived through the pre-event DRR context has led to a better understanding of the function of people exposure to prepare more people-centered preparedness and disaster mitigation. However, since the sub-variables did not show any significance for being predictors, this implies that, even though there is a significant reliance between the pre-event DRR context and the individual attributes, the individual attribute could be regarded more as a modifier than a predictor.

Keywords: community resilient; disaster risk reduction; Merapi Volcano; people-centered approach; people exposure

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1. Introduction

Even though resilience theory is widely discussed in different disciplines, its use in the context of disasters, climate change, and development is still relatively new [1]. This paper uses the definition for resilience put forth by the United Nations International Strategy for Disaster Reduction (UNISDR) [2]: "The ability of a system, community, or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management". The concept of resilience is linked to community or social risk in a disaster-prone area. This focuses on ensuring the system's functioning after a shock [3] and understanding that resilience is a process, rather than an outcome, where the roles of community and society become an essential factor, and these can only be embedded in the society through a disaster risk reduction program. Furthermore, since preparedness is the key to reducing potential risk, it must be done beforehand and be well designed and tailored to the needs of people [1,4].

In recent years, disasters have proved to be enormous obstacles to sustained development and progress and a challenge to the well-being of communities worldwide [5]. In

2020 alone, aside from the COVID-19 pandemic, there were 389 recorded disasters, which resulted in 15,080 deaths, 98.4 million people affected, and an economic loss of at least 171.3 billion USD [6]. A disaster is a combination of technical faults and a failure of social systems made up of technical, social, organizational, and institutional factors [7], primarily induced by human activities [1,4,8].

There are 3 domains to understand risk analysis of disaster in society: the environmental changes and shocks, people's exposure, and prevention and responses systems. Exploring how people cope with the environmental changes and shocks, depending on their capacity and their vulnerability profile, can aid us in understanding about the human side of disaster research [9]. Such exploration could consider a communities' perception, socio-economic enablement, information, communication, expectation, risk culture, age, gender, and other forms of social differentiation [9]. These social differentiations can lead to a variable range of vulnerability levels, both at individual and community levels. For example, different gender and age groups will face different difficulties and need different emergency aid during an emergency.

As people's decisions and behaviors at pre-event, during, and post-event situations can dramatically affect the impacts, vulnerability, recovery time, and resilience of individuals and communities [10,11], it is essential for local community living near the hazard to be aware about their risks [12,13]. This belief aligns with the evolution of DRR thinking and policy that has begun to foster public engagement, social capacity, community participation, and individual responsibility [10]. These people-centered approaches are based on the assumption that involving people in risk decisions empowers them, encourages ownership, responsibility, and participation [12,14]. However, convincing individuals to embark on activities that would reduce their vulnerability to natural hazards is difficult, especially in communities that have not recently experienced the impact of natural hazards [13]. In addition to this, there are community who do not want participate in the preparedness activities because they think that they cannot influence the natural process impact, such as a natural hazard [15]. At this point, it is necessary to help the community understand that they could intervene this condition: they can reduce the risk, as well as recover faster and better even after disaster strikes.

Although realizing that an assessment of people's exposure in the context of disaster risk is essential for local community, assessments are often conducted in the post-disaster context. Considering that DRR is a continuous learning process [16–22], as well as the importance of reflective responses to deal with more complex and uncertain risks [23], it is essential to see the relationship between people's exposure and their social attributes in the pre-event context especially in communities which have experienced past disasters. This can facilitate the formulation of more people-centered DRR programs. For example, a program for families with children in primary and secondary school age, or for those with vulnerable family members (children, parents, vulnerable women, and people with disabilities). Consideration of such people-centered approaches to strengthen community disaster resilience can allow to understand how demographic factors can influence the necessary actions at every stage of disaster response at each of the respective levels of the individual, household, and community [3,24,25]. In this regard, several indicators are commonly used to measure the people's exposure to disaster in society, such as: (1) household structure (household headship, marital status, and type of family); (2) socio-economic status (income, wealth, political power, and education); (3) gender; (4) race and ethnicity; (5) age; (6) tenure; (7) urban or rural; (8) special needs population; (9) employment status; and (10) time spent living in the neighborhood [3,9,24].

The reports and studies on the experiences of the 2010 Merapi Volcano eruption a suggest that individuals' social profiles determine how they think about the Merapi Volcano [26]. This research tries to understand this point further and explores how the Merapi community understand risk, either through their own experiences with Merapi eruption in 2010, and/or due to the DRR programs held, and contribute towards providing a longitudinal and reflective study from the past. To recommend designing a more people-centered DRR program for the community, this study attempts to reflect the community's performance through individual attributes of the community (i.e., demographic profile) and pre-event DRR aspects (risk knowledge, information access, and network and stakeholders). This research hypothesizes that different individuals in the community, as indicated by their attributes, understand the disaster risk, access the risk information, and network and stakeholders, to prepare for the possibility of more complex and uncertain disaster risk in the future. This research attempted to investigate which community capability may be able to influence a shift in the approach to living with natural hazards.

2. Study Area

Merapi Volcano (Figure 1) is home to around 1.6 million people, located 25 km north of urban Yogyakarta, Indonesia, [27–31]. Merapi, one of the many stratovolcanoes in Indonesia, has an altitude of 2980 m and has erupted at least 80 times since 1768, the most significant of which (Volcanic Explosivity Index–VEI $\geq$ 3) were in 1768, 1822, 1849, 1872, 1930–1931, 2010, 2014, and 2018 [32,33]. The earlier eruptions had higher VEIs, but the 20th century eruptions were more frequent [32]. In 2010, there was a large scale explosion of this volcano which caused 367 fatalities, 277 injuries, displaced 410,388 people, 2300 destroyed houses [27], and caused losses of 256.4 million USD [34]. Prior to the 2010 eruption, the people of Merapi depended on nature for their livelihoods: land and rivers, namely the agricultural sector, mining, and community services. After the 2010 eruption, however, different economic sectors emerged, such as trade, restaurants, lodging, and tourism services sectors [26,35–37]. The Merapi community was involved in the tourism sector before the 2010 eruption, through concepts, such as the development of community-based tourism as an eco-tourism village, but other activities, such as a lava tour, have also emerged after the eruption 2010 [38].

The zoning system on volcanic risk in Indonesia is instrumental in influencing the level of vulnerability, especially in the case of evacuation during an emergency. There are two zoning on volcanic risk, (1) Spatial zoning which consists of three different levels on the disaster-prone area (DPA): (Disaster Prone Area Zone I (lowest risk), II, and III (highest risk)), as well as (2) time zoning which consist of 4 stages based on the volcano activities: normal active (base), attention (advisory), pre-alarm (watch), and alarm (warning) [26,36,39]. At the 2010 eruption, although this risk zoning system was implemented, the disaster-prone area zone had changed due to changes in the character of Merapi's activities suddenly. The public were not aware of the changes due to the limited information channels and lack of preparation for emergency conditions at the time, with the effect of which was compounded due to a larger scale of eruption compared to the past [26]. As a result, the pyroclastic flows of up to 13 km from the Merapi's crater on the 2010 eruption forced people living in a radius of 17–20 km to evacuate. Therefore, this study was conducted in an area within a 20 km radius of the Merapi Volcano (Figure 1). The south area of the volcano has shown rapid urban growth [40], which has influenced the emergence of secondary urban areas, such as Pakem and Tempel, located less than 20 km from Merapi (see A and B in Figure 1).

The DRR program at Merapi is undergoing development and consolidation. Each phase of the disaster management cycle has a corresponding program, as stated in the DRR strategy, such as risk assessment programs, spatial planning reviews, disaster preparedness schools (currently called School Safe Learning (SSL)–*Satuan Pendidikan Aman Bencana*), Disaster Preparedness Village (DPV), Disaster Resilient Villages (DRV), and River Schools, strengthening the infrastructure sector, strengthening the economic sector. These have been carried out at various levels from provinces to village, through Disaster Management Mandatory Training (DMMT) [39].

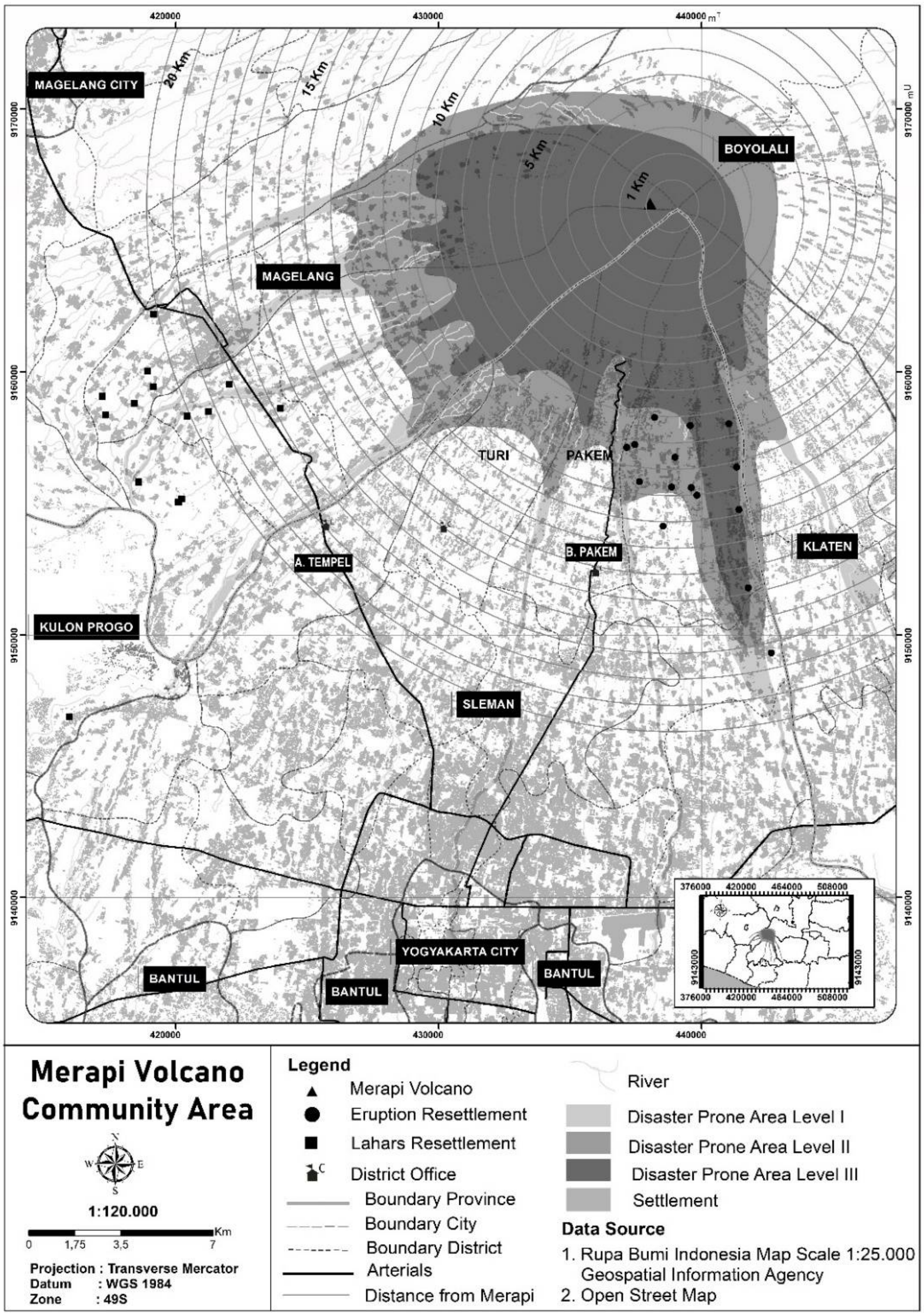

Figure 1. Merapi Volcano community area map.

Aside from this, several networks and community-based activities have been implemented through Merapi communities, such as the implementation of a sister village, sister school, community-based risk reduction forum (PASAG Merapi), and community-based communication network (JALIN Merapi) [26]. These programs and networks were developed before the 2010 eruption since the communities experienced several recurrent disaster events. For example, the risk reduction forum (PASAG Merapi), was founded after the 1994 eruption.

A decade after a catastrophic volcanic eruption in 2010, the Merapi Volcano community in Java, Indonesia, has been living with a high possibility of recurrent volcanic hazards. On 5 November 2020, the level of volcanic activities of the volcano was raised [41], and, since then, there have been 16 eruptions [42,43], where 836 people from vulnerable group have had to be evacuated [42]. With the geodynamics of volcano being uncertain [44], and the added complexity of the reliance of local communities on the volcanoes, strengthening disaster resilience governance would remain a challenge. Some community members have experienced permanent displacement from their previous neighborhoods because of the 2010 eruption, and some new members from the community have also moved voluntarily after the 2010 eruption due to the urbanization in the south part of Merapi.

Yet, despite the uncertainties surrounding the spatial nature of the next volcanic eruption, due to limited resources, the government has been implementing DMMT as DRR programs only for people living in disaster-prone areas. After the disaster training, the local community who filled the post-training-survey mentioned that they were confused about translating the concept of hazard map into reality [26,45–47]. During the 2010 eruption, people were confused when the government evacuation warning was issued based on the proximity (20 km distance) from Merapi, rather than the disaster-prone area identified by the existing hazard map based on the magmatic activity and the volcano morphology. This call had been made to be on the safer side and evacuate more people given that the scale of the 2010 eruption was higher than assumed by the hazard map. However, this resulted in confusion among people who were outside the disaster prone area and considered themselves safe from the risks. This implies that a wider area implementation of DRR programs is necessary to educate the wider community of the risks and prepare for an emergency.

Such awareness would also help the community utilize their networks and cooperate to evacuate themselves and their livestock to their sister villages (a sister village network is a network that connects the villages in Merapi disaster-prone area with buffer villages that are located in the Merapi safe zone [48,49]).

3. Data and Methods

This study used mixed method, using both quantitative research methods (non-parametric and parametric statistics), and the qualitative method

3.1. Survey and Sampling Design

Nonprobability purposive sampling was used in this research to understand Merapi communities' perspectives on several disaster issues (risk knowledge, information, and DRR program in pre-event). This sampling design helps to explore the phenomena that is happening in the area without generalizing the result for the community. Although this sampling method can lack clarity in the generalizing process and be biased to the population profile [50], it allowed the authors to reach the respondent population for data collection given the specific spatial distribution, time limitation, and several local community procedures for entering the community during the pandemic.

Assuming that Merapi community has a similar land tenure system [51–54], ethnicity, and race [55], and location in the rural area [26,36,56,57], only seven socio variables of people exposure [3,9,24] are used: gender, age, time spent living in the neighborhood, education, income, daily activity, and household profile (Appendix A Table A1). This survey was conducted among people who either (1) live within 20 km of Merapi, or (2) have experienced the Merapi eruption of 2010, or (3) have been either temporarily or permanently displaced by the 2010 eruption. In addition, the definition of 'Merapi community' is taken to be the community living in 20 km proximity from Merapi Volcano. As this research aims to understand the public perception of people's exposure around Merapi Volcano, this study did not specifically target residents who participated in DMMT who live in all levels of DPAs (see Section 2) since DMMT has been widely conducted in these areas since 2008 [45,46,58]

The survey was conducted using questionnaires through various streams, such as personal social media, public accounts, local influencers, and stakeholders' networks with whom the researcher previously worked. From a total population of 1.6 million near the Merapi Volcano, this online survey could obtain 215 usable responses through a reach of 476 people who completed an online survey between September and December 2020 on the online survey platform Survey Monkey (Appendix A Tables 1, 2 and A1). Since the online survey cannot ensure the adequate spatial distribution of respondents, nor control who fills the questionnaire, it is acknowledged that the population profile can be biased. However, to reduce the unfit criteria of respondents, we required address information to be filled on the survey. Considering the data saving and the voluntary participation in this research, privacy consent obtained in the online survey provides an explanation on how the data is to be used and saved in the system. With this, the respondents have the choice to fill the survey or not.

Table 1. Individual attributes of respondent profiles.

Description	Observed Frequencies	Percentage (%)
Sex		
Female	139	64.7
Male	74	34.4
Not stated	2	0.9
Age–A (years)		
$A \leq 24$	47	21.9
$25 < A \leq 54$	142	66.0
$54 < A$	21	9.8
No answer (N/A)	5	2.3
$D \leq 10$	55	25.6
$10 < D \leq 30$	95	44.2
$30 < 30$	63	29.3
No answer (N/A)	2	0.9
Education		
Primary	27	12.6
Secondary	82	38.1
Tertiary	101	47.0
No answer (N/A)	5	2.3
Monthly income–I (USD) [1]		
Do not have fixed monthly income	65	30.2
$I \leq 210.42$	67	31.2
$210.43 < I \leq 350.70$	35	16.3
$350.71 < I$	22	10.2
No answer (N/A)	26	12.1
Daily life activity		
Work and homemakers	163	75.8
Unemployed and retirement	18	8.4
Students	32	14.9
No answer (N/A)	2	0.9
Household profile		
Single person HH	18	8.4
Couple without child	8	3.7
Parent with one child or more	146	67.9
No answer (N/A)	43	20.0

[1] 1 USD = 14,257.199 IDR (1 March 2021).

Table 2. Descriptive statistics on disaster risk reduction variables.

Description	Observed Frequencies	Percentage (%)
The accessibility of disaster information		
Yes	137	63.7
No	20	9.3
Maybe	51	23.7
Do not know	7	3.3
Awareness of Community based Disaster Risk Management (CBDRM) Organization existence in the community		
Yes	76	35.3
No	80	37.2
Maybe	59	27.4
Experience with DRR program(s)		
Yes	38	17.7
No	41	19.1
Maybe	8	3.7
No answer (N/A)	128	59.5
Advantages of DRR program for preparing the community for a possible threat		
Yes	40	18.6
No	0	0
Maybe	6	2.8
No answer (N/A)	169	78.6
Prioritizing the vulnerable group during and after the emergency		
Yes	143	66.5
No	13	6.0
Maybe	59	27.4
The importance of women group on the decision making and DRR		
Yes	102	47.4
No	26	12.1
Maybe	87	40.5
Perception for collaborating with external stakeholders would give advantages for community preparedness		
Yes	176	81.9
No	3	1.4
Maybe	36	16.7

3.2. Data Analysis

In this study, the data analysis is conducted in two stages: a non-parametric test and a parametric test (see Figure 2). The non-parametric test was used to see whether the social attributes of the community have dependencies to the implementation and outcome of pre-event DRR context (risk knowledge, information access, and network and stakeholders) in their community. A parametric test was used to see if the individual sub-variables could become the predictor of implementation and outcome of DRR programs based on the significant result from the non-parametric test (the goodness-of-fit test)

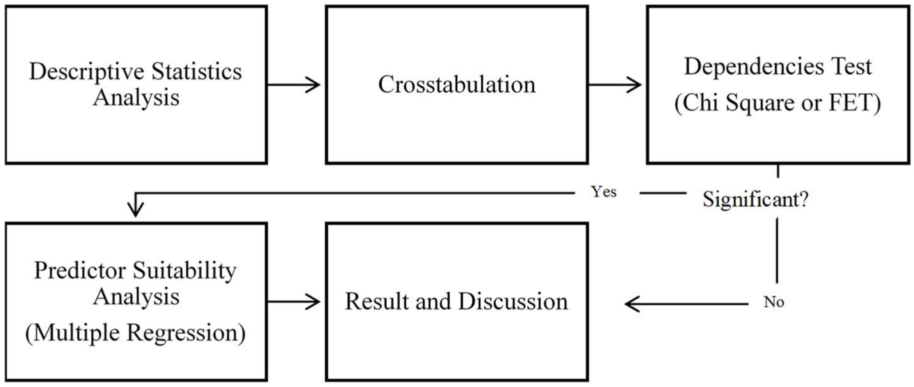

Figure 2. Data analysis flowchart.

3.2.1. Tools

IBM SPSS Statistics for Windows, version 27, was used in this study [59] to perform the descriptive analysis, calculate goodness-of-fit, and multiple regression. No answer (N/A) data has been omitted for the purpose of the statistical analysis.

3.2.2. Descriptive Analysis

The first analysis stage determined the respondents' attributes: gender, age group, activity, education, time living in their current neighborhood, and monthly income (Table 2). This portion of the survey was voluntary, and not all respondents completed this section; however, the analysis excluded blanks in these fields.

Observed frequencies were also determined from the answers regarding the perceptions in the Merapi Volcano community to several questions related to the implementation of DRR: risk knowledge, information access, and network and stakeholders: (1) where did the community get their information; (2) what information did they receive; (3) how was the information accessed; (4) what experiences did they have of DRR programs and of what type; (5) what advantages did the DRR program have for preparedness; (6) was there a CBDRM organization in their community; (7) did the DRR programs involve all community groups, including the vulnerable and women; (8) could they give an example of the role of women in the DRR programs in the community; (9) and what were their thoughts on collaborating with external stakeholders for disaster-related issues to provide advantages for preparedness? These variables were mainly processed in nominal data types and used to describe community perceptions for disaster-related issues.

Based on these variables, questions (excluding individual attributes) used for the next stage (goodness-of-fit test) require categorical data, such as yes, no, or maybe. These are question numbers 11,12, 14, 15, 16, 17, and 19, shown in Appendix A Table A1.

3.2.3. The Goodness-of-fit Test

The goodness of fit test assesses whether the observations or responses for one variable are associated with or independent of another [60–63]. This study used the Pearson chi-square test and the Fisher-Freeman-Halton exact test (FET) for analyzing goodness-of-fit. Chi-Square test is the first dependency test, for which some assumptions should be met [60,61,64]: (1) randomness of the sample, (2) independence between observations in each category; and (3) frequency of at least five for each category. If these assumptions cannot be fulfilled, another statistical model, such as FET, should be used for the goodness-of-fit [65]. Since, in this study, assumption (3) mentioned above could not be fulfilled, FET was conducted.

To conduct these tests, a null hypothesis (H_0) that there is no relationship between variables, and an alternative hypothesis (H_a) that there is a relationship between variables, was assumed. For example, in the case of representing the relationship between individual attributes (e.g., individual education level) of the community and information accessibility to Merapi Volcano disaster-related information: H_0 is that there is no relationship between the education level and access to the information, while H_a is that there is a relationship between education level and access to the information of Merapi Volcano.

The analysis involved a crosstabulation of the individual attribute and community responses to specific questions (DRR cases). IBM SPSS Statistics 27 crosstabulation and chi-square and FET were used to determine the degree of freedom between the community profile and the Merapi Volcano risk information on a 95% degree of confidence level.

To interpret the test results, *p*-values were calculated, and significant values asymptotically significant in chi-square or exactly significant in FET were compared with the set level of significance, here, 5%. The *p*-value can also be used to compare with the chi-square table as the standard [61,66].

3.2.4. Multiple Regression for Predictor-Suitability Analysis

Multiple regression is a statistical technique that can analyze the relationship between a dependent or criterion variable and a set of independent or predictor variables. It allows the prediction of one variable from information drawn from other variables [61,67]. In this study, multiple regression has been used to assess which sub-variables on the individual profile become significant predictors to the DRR program in the community, with a 95% degree of confidence level.

3.3. Survey Result

3.3.1. Individual Attributes Survey Result

The respondent attributes survey indicated that women dominated the group of respondents; most were under 54 years old, had been living in the current neighborhood for more than ten years, had high school or higher education, lived in families with one or more children, were either employed, homemakers, or students, and had income under 210.42 USD/month (see Table 1).

3.3.2. Descriptive Statistics Disaster Risk Reduction

Table 2 shows the descriptive summary results of the questions related to the pre-event activity (mitigation and preparedness) conditions related to risk knowledge, information access, and stakeholders and the network of Merapi Volcano communities. The community agrees that they can access the disaster information, prioritize the vulnerable group during and after the emergency, that women are an essential group in the decision making, and understand that collaboration with external stakeholders gives advantages to community preparedness. However, only a small number of the community (less than 20%) state that they have had the experience of the DRR program in recent times, with 59.5% not sure whether they have experienced it or not. Meanwhile, the community response on awareness of CBDRM organization's existence remains equally distributed among those who know, do not know, and are not sure (35.5%, 37.2%, and 27.4%, respectively).

4. Result and Analysis

4.1. Local Community: Risk Knowledge and Disaster Information Access

The Merapi Volcano community considers the volcano to be the most significant risk, followed by earthquakes, hydrometeorological hazards (climate change and floods), and pandemics, such as COVID-19 (Appendix B Table A2), which is similar to the result from DMMT post-survey that the local community understand Merapi as source of threat [46].

In regard to risk information, most respondents stated that they felt well supplied with information about the Merapi Volcano (63.7%), with 23.7% feeling somewhat unsure (Table 2). The primary sources of information were the mass media and online social media, chat apps, such as WhatsApp, and conservative media sources, such as TV, news portals (online and offline), and radio (Appendix B Table A3). In addition, around 50% of respondents indicated that the Disaster Management Agency (DMA) was their source of information, with the least accessed disaster information coming from schools and insurance companies. The local community in Merapi tended to access the information from trusted sources, such as the local DMA, research center, or local government.

The survey results show the types of information that respondents frequently accessed. The top two are focused on knowledge information regarding the Merapi Volcano status (see HI code on Table 3). The second most accessed type of information dealt with procedures associated with evacuations, and the least accessed knowledge was of folklore and traditional knowledge related to Merapi. Similar to this, a DMMT post-survey also mentioned that the early warning mechanisms are known to more than 70% of the community, while knowledge of the hazard map and risk understanding is only known to 45% [46].

Table 3. Disaster topics of information accessed by the community.

Group of Topics		Topics	Responses	
HI	Hazard information	Recent and updated information on Merapi Volcano	93.5%	275
HI	Hazard information	Knowledge about volcanic hazard	85.0%	250
E	Emergencies	Evacuation and emergencies procedure	73.8%	217
E	Emergencies	Evacuation shelter	72.1%	212
E	Emergencies	Evacuation route	71.4%	210
E	Emergencies	EWS—early warning system	69.7%	205
E	Emergencies	Time for evacuation	58.2%	171
M	Mitigation	CBDRM—community-based disaster risk management	51.7%	152
E	Emergencies	Contact and network communication during emergencies	48.0%	141
p	Preparedness	Disaster drill and simulation	44.6%	131
E	Emergencies	Live guidelines in the temporary shelters	42.9%	126
E	Emergencies	Organization of disaster emergency response	42.5%	125
HI	Hazard information	Folklore and traditional knowledge disaster-related	36.1%	106
		Total Respondent		294

At Merapi, people have experienced recurrent volcanic disasters because of which they acknowledge the risk information provided by the authorities, especially in the context of zoning risk (DPA) to some extent. However, since the perceived risk of the Merapi community is said to be influenced by the three factors of risk knowledge and information, socio-economic, and cultural setting, as explained in Lavigne et al. [37] and Saragih et al. [26], people sometimes ignore the recommendations from the government. People of Merapi understand that eruption is part of a culture, and they perceive eruption as a 'normal' event and do not fear it [26,36,37] but, rather, embrace the volcano activity as their part of daily life. This belief resulted in the large casualties of 2010 eruption, as there were people who continued to stay in their neighborhood and rejected the evacuation, even after the evacuation command had been given by the government [26].

The degree of freedom test (Table 4) revealed mixed results: H_0 asserted no relationship between individual attributes and access to disaster information, and Ha asserted a relationship between their attributes and access to disaster information. The only variable with a significant value was education; all others (sex, age group, duration of stay, monthly income, daily activity, and household type) showed no significant values. This means that there was no relationship between reliable access to disaster-related information and individuals' attributes in this community. Members of the community felt that they could easily access Merapi disaster information and performed this action collectively. In addition, following the 2010 eruption, the communities kept tabs on the information related to the Merapi Volcano themselves [68].

Table 4. Degree of freedom test between the individual attributes and information accessibility to Merapi Volcano disaster-related information.

Variables	*n*	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Test
Sex	207	0.742	2	0.690	0.685	Chi-square
Age group	205	2.500	4	0.645	0.657	Chi-square
Duration of staying in the neighborhood	207	2.035	4	0.729	0.737	Chi-square
Education	204	12.673	6	0.049	0.047	Chi-square
Monthly income	183	6.578	6	0.362	0.366	Chi-square
Activity	207	7.762			0.084	Fisher's exact test
Household types	168	5.450			0.187	Fisher's exact test

The significance of the education variable, indicating an association between education in the population and information accessibility, should be further considered, since there is difference in the percentage profile between the respondents who fill this survey based on their education (primary 12.6%, secondary: 38.1%, and tertiary: 47%) compared to population (never going to school/not graduated from primary: 27.87%, primary: 18.63%, secondary: 42.73%, tertiary: 10.77%) [69–76]. There is a possibility that people with different levels of education would understand the disaster-related information differently due to differences in their comprehension capacity. Thus, there is a possibility that a population with a given education level would require a specific type of communication design to assist their understanding of risk and disaster information.

4.2. Community DRR Program Experience

Respondents were asked whether they had ever participated in a DRR program and the type of programs they felt were most suitable. The results show (Table 5) that disaster-related simulations and training were frequently conducted, but participating in disaster social insurance had the least number of responses.

Table 5. Type of DRR programs in the Merapi Volcano community.

Categories of Topics		Programs	Responses	
AR	Awareness-raising	Disaster drill and simulation	67.90%	55
MP	Mitigation and preparedness	Disaster training and workshop	50.62%	41
MP	Mitigation and preparedness	Community meeting	40.74%	33
MP	Mitigation and preparedness	Disaster contingency plan-making	34.57%	28
MP	Mitigation and preparedness	Contributing to disaster evacuation route making and implementation	34.57%	28
MP	Mitigation and preparedness	Making community emergency SOP	33.33%	27
AR	Awareness-raising	Community disaster camp (school or volunteer)	32.10%	26
MP	Mitigation and preparedness	Building another structural mitigation	27.16%	22
AR	Awareness-raising	DRR campaign, fair, and feast	23.46%	19
LS	Livelihood securing	Livelihood based tourism on disaster-prone area training and capacity building	16.05%	13
LS	Livelihood securing	Livestock management during emergency	13.58%	11
LS	Livelihood securing	Participating in social insurance for disaster emergencies	11.11%	9
		Total Respondent		81

The crosstabulation of gender and involvement in DRR programs in their communities confirmed the existence of a strong gender bias in DRR participation. The survey results indicated that 75.6% of women had never participated in a DRR program, disaster drills, nor simulations in their community (Appendix C Table A4). However, a post-survey of DMMT participants shows that 42% of women participated in the DMMT program [46]. To some extent, though, both studies show that some women had also taken part in the DRR program in the pre-event context.

Similar to the previous results of the gender variable, among the variables tested, only the duration of stay in the neighborhood showed significant relation to experience with and participation in a DRR program (Table 6, Appendix D Tables A6 and A7). This relates to the differences in experience between those who had been in their neighborhood for more than 30 years and those who had lived there for less than ten years. These differences could relate to further differences in perception where people who experience recurring exposure may either be more prepared or normalize the threat completely, decreasing their preparedness level in exchange for easier access to livelihood sources [77]. Such a case is evident among the communities in Merapi, where people tend to live in their neighborhoods that ignore the risk zoning system for easier access to livelihood sources. No significant result was found among age, education, monthly income, household type, and DRR program experience, indicating that people from all backgrounds attended the programs (Table 6, Appendix D Tables A6 and A7).

Table 6. Degree of freedom test between the individual attributes, the experiences of DRR programs [2], and advantages of DRR program for preparedness [3].

Variables	Case	*n*	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Test
Sex	2	79	7.884	1	0.005	0.006	Chi-square
	3	46	3.067	1	0.080	0.187	Chi-square *
Age group	2	77	5.009			0.079	Fisher's exact test
	3	44	1.747			0.538	Fisher's exact test
Duration of staying in the neighborhood	2	78	9.983	2	0.007	0.007	Chi-square
	3	45	0.851			0.853	Fisher's exact test
Education	2	78	2.850			0.419	Fisher's exact test
	3	45	1.853			0.621	Fisher's exact test
Monthly income	2	71	6.039	3	0.110	0.112	Chi-square
	3	44	1.231			0.867	Fisher's exact test
Activity	2	78	1.923			0.448	Fisher's exact test
	3	46	8.711			0.014	Fisher's exact test
Household types	2	69	1.993			0.474	Fisher's exact test
	3	41	1.589			0.616	Fisher's exact test

* Count in 2 × 2 table. [2] Case 2: the experiences of DRR programs. [3] Case 3: advantages of DRR program for preparedness.

The survey results indicate that most respondents (84.1%) felt that the current DRR program helped them have better hazard preparedness (Table 2). Only the people activity variable was significant (Table 6, Appendix D Tables A6 and A7), indicating that the respondents' occupational status led to differing perceptions of the DRR programs. Since occupation can be related to the access to resources, such as financial and social networks, this could explain different perceived risk of the people as individuals or as a collective. However, no significant result to DRR program perceptions was found for gender, age, time living in the neighborhood, education, monthly income, nor household type.

4.3. Community-based Disaster Risk Management (CBDRM), Community Roles, Networks, and Collaboration

The local community's perceptions of the DRR program benefits were elicited with the use of several questions which considered their understanding of the current DRR programs, their impression of a community organization focused on disaster risk management, and the involvement of vulnerable groups and women in disaster-related issues (Table 7, Appendix D Tables A8–A11).

Table 7. Degree of freedom test between the individual attributes, the existence of community-based disaster risk management (CBDRM) organization [4], prioritizing vulnerable groups during disaster emergencies [5], women's involvement in disaster and risk management [6], and the impact of collaboration on disaster preparedness and community resilience [7].

Variables	Case	*n*	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Test
Sex	4	155	1.034	1	0.309	0.323	Chi-square
	5	200	0.110	1	0.741	0.747	Chi-square
	6	187	0.996	1	0.318	0.361	Chi-square *
	7	210	1.826	1	0.177	0.186	Chi-square
Age group	4	152	1.936	2	0.380	0.393	Chi-square
	5	195	1.939	2	0.379	0.414	Chi-square
	6	182	4.771	2	0.092	0.091	Chi-square
	7	205	0.210	2	0.900	0.924	Chi-square
Duration of staying in the neighborhood	4	153	0.052	2	0.974	0.979	Chi-square
	5	198	2.580	2	0.275	0.276	Chi-square
	6	185	3.882	2	0.144	0.140	Chi-square
	7	208	0.692	2	0.708	0.691	Chi-square
Education	4	153	4.439	3	0.218	0.222	Chi-square
	5	196	8.051	3	0.045	0.044	Chi-square
	6	182	6.261	3	0.100	0.101	Chi-square
	7	205	1.209	2	0.546	0.545	Chi-square
Monthly income	4	140	2.911	3	0.406	0.411	Chi-square
	5	175	6.727	3	0.081	0.081	Chi-square
	6	162	2.733	3	0.435	0.442	Chi-square
	7	184	1.580	3	0.664	0.678	Chi-square
Activity	4	154	7.780	2	0.020	0.018	Chi-square
	5	198	0.639	2	0.727	0.739	Chi-square
	6	186	2.179	2	0.336	0.352	Chi-square
	7	208	0.769	2	0.681	0.687	Chi-square
Household types	4	129	2.935			0.258	Fisher's exact test
	5	162	4.050			0.120	Fisher's exact test
	6	152	3.252			0.208	Fisher's exact test
	7	169	.099			1.000	Fisher's exact test

* Count in 2 x 2 table. [4] Case 4: the existence of community-based disaster risk management (CBDRM) organization. [5] Case 5: prioritizing vulnerable groups during disaster emergencies. [6] Case 6: women's involvement in disaster and risk management. [7] Case 7: the impact of collaboration on disaster preparedness and community resilience.

The responses regarding DRR specialist community organizations were as follows: 35.3% thought there was a particular DRR organization, 37.2% thought there was no such organization, and the remainder (27.4%) were unsure (Table 2), which indicated that the CBDRM organization was little known in the community. The only variable that showed the relationship between the existence of the CBDRM organization and the community profile was occupation type (Table 7, Appendix D Tables A8–A11). This is related to individuals' networks during their day-to-day activities. For example, the same understanding might circulate among a circle of students who share activities.

Around two-thirds of respondents said that their community prioritized vulnerable groups, such as the elderly, children, disabled persons, and pregnant women (Table 2), and there was a significant relationship found to education. Other variables, such as sex, age, duration of stay, monthly income, activity, and household type, were insignificant in prioritizing the vulnerable group during emergencies and post-disaster. This indicates that there was no relationship between the variables. However, the Merapi Volcano community prioritized this group after being exposed to the 2010 eruption [68]. When designing the contingency plan of Merapi Eruption, it is mandatory to assess the vulnerable group in the disaster-prone area and secure them during the emergency. In addition to this, the standard operation procedure (SOP) recommends the vulnerable group to be evacuated on the scale of volcanic activity level III, earlier than the other community members [78,79].

There were no significant relationships between the various individual attributes with the questions of the involvement of women's in DRR programs. This means that the community see that the women took part in DRR activities in the community equally compared to men and see that their role is important (Appendix C Table A4). Women at Merapi community have roles related family wellbeing, such as logistics supply management, children education, psychological, and community's wellbeing management (Appendix C Table A5). In addition, the community has been practically involved in social insurance managed by the community which only can be used during disaster emergency. This insurance is used when the disaster aid has not yet been received by the community. One women's group in Magelang, on the west side of Merapi (Nanggrung, Kamongan Village), conducted a Women Welfare Association activity to build awareness for emergencies called *nyapu dan nabung* (sweeping and saving). Every week, they hold a village clean-up movement, during which time they collect money from each member as social insurance for crisis conditions [80].

Then, to comprehensively understand risk communication and DRR program effects in the Merapi community, respondents were also asked about the local community's ability to collaborate with outsiders, such as NGOs/NPOs, universities, governments, and volunteers. The results (Appendix D Table A11) indicated that the community respondents agreed that collaboration could better prepare their communities to face risks.

4.4. Predictive Models of Sub-Variables of Individual Profile and DRR Programs

Multiple regression was carried out to investigate whether each sub-variables on the community's individual profile could predict certain dependent variables. This predictive uses the significant result from the goodness fit test (see Sections 4.1–4.3) and uses the sub-variables on the individual profile of the community to do the predictors test (Table 8, Appendix E Tables A12–A17). Using multiple regression analysis on SPSS from IBM, there are six models of this predictor test:

1. Model 1: education level: primary (*X1*), secondary (*X2*), and tertiary (*X3*) to predict the perception of disaster information accessibility scores.
2. Model 2: each gender (male (*X1*) and female (*X2*)) to predict the experience of DRR programs.
3. Model 3: duration of staying in the neighborhood ($\leq$10 (*X1*), 10–$\leq$30 (*X2*), >30 (*X3*) years) to predict the experience of DRR programs.
4. Model 4: people's type of occupation (worker and homemaker–activity type 1 (*X1*), unemployed and retired–activity type 2 (*X2*), and students–activity type 3 (*X3*)) to predict their perception of the advantages of DRR programs for disaster preparedness.
5. Model 5: whether a type of occupation (worker and homemaker–activity type 1 (*X1*), unemployed and retired–activity type 2 (*X2*), and students–activity type 3 (*X3*)) to predict the value of their awareness of CBDRM existence in their neighborhood.
6. Model 6: education level (primary (*X1*), secondary (*X2*), and tertiary (*X3*)) to predict perceptions of the inclusive process during the disaster.

Table 8. Predictive model of sub–variables of individual profile and DRR programs.

Description		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
R		0.112	0.170	0.068	0.422	0.286	0.196
R^2		0.013	0.029	0.005	0.178	0.082	0.038
F		F (3, 209) = 0.891	F (2, 131) = 1.943	F (3, 130) = 0.199	F (3, 85) = 6.139	F (3, 290) = 8.579	F (3, 289) = 3.835
p		0.447	0.147	0.897	0.001	0.001	0.010
Unstandardized B	*C*	1.800	1.745	1.695	1.930	1.988	1.780
	X_1	−0.133	0.005	−0.028	−0.744	−0.207	−0.521
	X_2	−0.276	−0.230	−0.195	1.070	0.346	−0.274
	X_3	−0.053	-	0.019	−0.310	0.140	−0.008
Coefficients SE	*C*	0.420	0.088	0.056	0.144	0.083	0.096
	X_1	0.457	0.121	0.358	0.203	0.101	0.193
	X_2	0.432	0.134	0.256	0.681	0.193	0.136
	X_3	0.430	-	0.238	0.317	0.052	0.130
Standardized Coefficients Beta (β)	*C*						
	X_1	−0.047	0.004	−0.007	−0.367	−0.134	−0.171
	X_2	−0.143	−0.168	−0.067	0.156	0.108	−0.140
	X_3	−0.028	-	0.007	−0.097	0.170	−0.004
t	*C*	4.290	19.878	30.108	13.448	24.023	18.490
	X1	−0.292	0.044	−0.079	−3.666	−2.051	−2.694
	X2	−0.638	−1.715	−0.762	1.571	1.791	−2.022
	X3	−0.122	-	0.081	−0.977	2.705	−0.063
p	*C*	0.000	0.000	0.000	0.000	0.000	0.000
	X1	0.771	0.965	0.937	0.000	0.041	0.007
	X2	0.524	0.089	0.448	0.120	0.074	0.044
	X3	0.903	-	0.935	0.331	0.007	0.950
Results		Predictors: (Constant), Tertiary, Primary, Secondary	Predictors: (Constant), Sex Female, Sex Male	Predictors: (Constant), duration of stay 3 (>30 years), duration of stay 1 (≤10 years), duration of stay 2(10–≤30 years)	Predictors: (Constant), Activity 3 (students), Activity 2 (unemployed and retired), Activity 1 (workers and homemakers)	Predictors: (Constant), Activity 3 (students), Activity 2 (unemployed and retired), Activity 1 (workers and homemakers)	Predictors: (Constant), Tertiary, Primary, Secondary
Interpretation		weak, not significantly contributed to predicting model	weak, not significantly contributed to predicting model	weak, not significantly contributed to predicting model	the medium could predict to model with X1 has a significant contribution to the model	weak, could predict to model with X1 and X3 have a significant contribution to the model	weak, could predict to model with X1 and X2 have a significant contribution to the model
Significant predictors		-	-	-	X1: workers and homemakers	X1: workers and homemakers. X3: students	X1: primary X2: secondary

According to model (1), (2), and (3), the predictive test could not show which individual sub-variables is the predictor (Table 8, Appendix E Tables A12–A17). Model (1) shows that every level in education could access disaster risk information at the same level of easiness. In regard to the DRR program experiences, the results indicate that people at Merapi Volcano could experience the program regardless of their attributes, including gender and the length of time living in a place.

On the other hand, models (4), (5), and (6) could show which sub-variables could be the predictors (Table 8, Appendix E Tables A12–A17). Model (4) indicates that the group of workers and homemakers significantly contributed as the predictors to perception to advantages of the DRR program to disaster preparedness. However, in model (5), aside from the worker and homemaker group, the student's group could predict the CBDRM awareness in the Merapi Volcano community. The results from models (4) and (5) could indicate that these groups could contribute to the DRR in the pre-event context because of their access to resources, such as livelihood, which livelihood sustainability is one of the critical aspects of people-centered DRR planning [4]. For the students, who were significant predictors for CB-DRM awareness, it may be that the youth organization and similar network systems could be beneficial for DRR programs due to their access to information and resources to prepare for possible disasters. Based on model (6), two sub-variables significantly contribute to the inclusive process of the DRR program: those with primary education and those with secondary education. These predictors could predict the perception of inclusive planning on disaster risk reduction model, both in negative and positive contribution. Furthermore, the education level represents the community's accessibility to knowledge and information that might assist in recognizing risk and improve network reach.

5. Discussion

This study found that the Merapi Volcano community had varied responses to several indicators related to the relationship between individual attributes of community members related to risk knowledge and information, capacity building activities, and awareness of community-based DRR organization, roles, and network. Regarding risk knowledge and information, accessibility shows that people with different education levels could access the disaster risk information equally, and that the community understands that Merapi has volcano risk. This result contradicts the findings of other research that have found a higher level of formal education to contribute towards a higher level of risk knowledge [81]. However, on the other hand, another research study stated that education does not significantly contribute to the different perceived risks of the community [82,83]. These contradictive statements could be due to several factors: (1) the current respondent group has not represented the population at large (another sample is needed), or (2) there is adequate risk communication within this community (which could be due to the variety in risk communication mediums and content design or due to the frequency of information accessed by the community).

This shows that there is a lack of clarity of the risk knowledge and a complex relationship between the individual attributes and the DRR indicators in this community. Even though, after the eruption of 2010, risk awareness of Merapi Volcano has increased significantly within the community [26,47,68], this study finds that further action is needed for designing people-centered DRR planning in order to strengthen community resilience. The findings indicate that the local community plays an essential role based on their attributes not as primary predictors, but as modifiers. Modifier here is defined as the variables that could change the size of the relationship of control variables, both as static and dynamic modifier [84]. In this research, the modifiers are the individual attributes, which could diversify how the local community perceives risk or could improve the extent of understanding of risk. For example, people who participate in different activities in Merapi have significant dependencies to the DRR activities. However, group based on sub-criteria of activities for their influence on DRR activities could not be measured, possibly because people in Merapi tend to act on collective action at the neighborhood scale, rather than on individual level. This result indicates that the individual attribute could influence the disaster risk reduction program on the community, both as a static and dynamic modifier. This finding supports a similar conclusion that individual attributes of the local community living in the disaster-prone area play a key role in comprehending the dynamic on disaster governance. [9,15,77,82,83].

The result that people in Merapi participated in the DRR program, and had changes in their risk perception after the 2010 eruption, implies that 2010 eruption became a catalyst of transformation for the community and the disaster governance. Aligned with this result, Thomalla et al. mentioned that understanding risk knowledge could help design better intervention to achieve more transformative DRR that is more proactive and agile to the changes [85]. In addition to this, the equal access to disaster risk information, equal participation of women, and equal consideration of vulnerable groups in guideline, policy, and practice, indicate that the disaster governance in Merapi tries to be inclusive in their approach. This approach could be taken a step further [15,85] to accommodate people's choice to engage in this process [86], rather than restricting it to established disaster-prone areas.

Volcanic eruption which is already difficult to predict because of its geodynamics, has become worse and frequent due to the combined effect of climate change and unplanned developments. This can cause multi-hazard situations and increase the complexity and uncertainty involved in disasters. This study indicates the need for tailor-made activities to support community resilience planning to ensure resiliency in such uncertain situations following a disaster [87]. For example, preparation of different content design and risk information for different age groups and revising the model of DMMT from a community-based disaster risk reduction organization to a more family or neighborhood level oriented organization could allow the program to reach the wider community members and ensure a more multisectoral approach.

6. Conclusions

This study considers the needs of people-centered DRR program design and indicates that understanding people's exposure could help to strengthen community disaster resilience so that the community has the ability to prepare, respond, and recover after a disaster. It indicates that the level of formal education and gender is not an issue in accessing risk information or for joining DRR program in the community, as shown by the analysis. However, in the context of DRR program, social learning for disaster risk awareness is a crucial factor when designing inclusive DRR programs for the community, which was indicated by the lack of people's awareness of DMMT and the existence of CBDRM. This learning process could be institutionally embedded as part of the curriculum in formal education (structured curriculum in school) and non-formal education (structured curriculum outside of school), as well as in the informal learning process (unstructured everywhere) [88] in the community (such as through CBDRM), on a smaller scale, such as family or neighborhood scale. Similarly, the study also indicates that people's daily activities (e.g., occupation) additionally drive the differences present in the perspectives on the organization and networks, the importance of disaster preparedness, and CBDRM organization. Thus, it can be concluded that understanding how the community sees the disaster risk could help to transform their way of living with a recurrent natural hazard.

Further study is needed to see how individual roles and contribution of the local community work in each DRR management cycle to understand which individual attributes work as static modifiers or dynamic modifiers to be able to design a more people centered DRR program for strengthening the community resilience.

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Institutional Review Board Statement: Ethical review and approval were waived for this study, due to the fact that this research design has discussed the perspective/opinion of the members of the community as applied research activity without any intervention to their individual action/behavior, and this research is not about the respondents themselves. This research focused on the policy or programs in their community.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Online Survey Question List

Table A1. Online survey question list.

	Questions	Programs
		A. Individual attributes as community members
1.	Sex (Gender)	(1) Female; (2) Male; (3) Not Stated
2.	Age (years)	(1) Less than 18; (2) 18–19; (3) 20–24; (4) 25–29; (5) 30–34; (6) 35–39; (7) 40–44; (8) 45–49; (9) 50–54, (10) 55–59; (11) 60–64; (12) 65–69; (13) More than 70
3.	Duration of stay in neighborhood (years)	(1) <1; (2) 1–3; (3) 3–5; (4) 5–10; (5) 10–15; (6) 15–20; (7) 20–25; (8) 25–30; (9) 30–35; (10) >35
4.	Education	(1) No education qualification; (2) Elementary School; (3) Junior HS; (4) Senior HS; (5) Professional Certificate/Diploma; (6) University Undergraduate; (7) University postgraduate (Master, Doctoral); (8) Others
5.	Monthly income (Million IDR)	(1) Do not have fixed monthly income; (2) <3; (3) 3–5; (4) 5–8; (5) 8–10; (6) 10–15; (7) 15–25; (8) 25–35; (9) 35–45; (10) >45
6.	Daily activity	(1) Employed; (2) Unemployed; (3) Retired; (4) Homemaker (including Housewife); (5) Student; (6) Entrepreneur
7.	Household profile	(1) Single person HH; (2) Couple without child; (3) Single parent with one child or more; (4) Parents with one child or more; (5) Others
		B. Risk knowledge and information
8.	What is the possibility that the following hazards could affect life: (1) Hydrometeorological hazard; (2) Earthquake; (3) Volcanic Eruption; (4) Flood; (5) Landslide; (6) Drought; (7) Climate change; (8) Work accident; (9) Household accident; (10) Pandemic; (11) Traffic accident; (12) Crime; (13) Infrastructure failure; (14) Recreational hazard	(1) Never; (2) Rarely; (3) Neutral; (4) Possible; (5) Highly Possible
9.	Source of information	(1) TV; (2) social media; (3) Friends and family; (4) Internet (website); (5) News portal; (6) Local DMA; (7) National DMA; (8) Radio; (9) Community meeting; (10) Local government (aside local DMA); (11) DRR community (12) Workplace; (13) Printed information (billboard, brochure, etc.); (14) Emergency service; (15) School; (16) Insurance company; (17) Others
10.	Type of disaster accessed information	(1) Recent and updated information of Merapi Volcano; (2) Knowledge about volcanic hazard; (3) Evacuation and emergencies procedure; (4) Evacuation shelter; (5) Evacuation route; (6) EWS—early warning system; (7) Time for evacuation; (8) CBDRM—community-based disaster risk management; (9) Contact and network communication during emergencies; (10) Disaster drill and simulation; (11) Live guidelines in the temporary shelters; (12) Organization of disaster emergency response; (13) Others
11.	The accessibility of disaster information	(1) Yes; (2) Maybe; (3) No; (4) Do not know
		C. Capacity building and future perspective
12.	Experience of DRR programs	(1) Yes; (2) No; (3) Do not know
13	DRR programs participated in	(1) Disaster contingency plan making; (2) Disaster training and workshop (3) Disaster drill and simulation; (4) Community disaster camp (school or volunteer); (5) Making community emergency SOP—standard operational procedures; (6) Contributing into disaster evacuation route making and implementation; (7) Building another structural mitigation; (8) DRR campaign, fair, and feast; (9) Community meeting; (10) Livelihood based tourism on disaster-prone area training and capacity building; (11) Livestock management during an emergency; (12) Participating into social insurance for disaster emergency

Table A1. *Cont.*

	Questions	Programs
14.	Advantages of DRR program for preparing the community for a possible threat	(1) Yes; (2) Maybe; (3) No; (4) Do not know
	D. Organization, roles, and network	
15.	Awareness of CBDRM organization in their neighborhood	(1) Yes; (2) No; (3) Do not know
16.	Prioritizing the vulnerable group during and after the emergency	(1) Yes; (2) No; (3) Do not know
17.	The importance of women group on the decision making and DRR	(1) Yes; (2) No; (3) Maybe
18.	Example of women roles in DRR program	(1) Evacuation shelter and routes planning; (2) Well-being management in the shelter (e.g., sanitation availability, cleanliness, health facilities, etc.); (3) The psychological condition of refugees; (4) Children education during the emergency; (5) Logistics and necessities (management) during emergencies; (6) Others
19.	Perception that collaborating with external stakeholders would give advantages for community preparedness	(1) Yes; (2) No; (3) Maybe

Appendix B

Local Community: Risk Knowledge and Disaster Information Access

Table A2. Respondents' perceptions of hazard occurrence possibilities.

Hazards	Never	Rarely	Neutral	Possible	Highly Possible	Total	Weighted Average
Volcanic Eruption	0.81%	5.66%	4.04%	30.19%	59.30%	371	4.42
Earthquake	1.35%	12.13%	1.08%	43.94%	41.51%	371	4.12
Hydrometeorological Hazard	2.70%	14.29%	3.50%	46.36%	33.15%	371	3.93
Pandemic	4.31%	11.32%	5.12%	48.52%	30.73%	371	3.90
Climate Change	0.81%	12.67%	12.67%	48.79%	25.07%	371	3.85
Traffic Accident	1.89%	16.44%	8.89%	48.25%	24.53%	371	3.77
Infrastructure failure	3.50%	19.68%	10.51%	45.55%	20.75%	371	3.60
Recreational hazard	5.66%	15.63%	13.21%	47.17%	18.33%	371	3.57
Crime	6.47%	19.68%	10.24%	42.59%	21.02%	371	3.52
Work Accident	5.12%	25.88%	9.16%	39.08%	20.75%	371	3.44
Household Accident	4.04%	28.03%	11.32%	40.43%	16.17%	371	3.37
Flood	16.71%	19.95%	9.43%	28.03%	25.88%	371	3.26
Drought	11.32%	23.45%	10.24%	43.67%	11.32%	371	3.20
Landslide	25.34%	28.30%	8.63%	24.80%	12.94%	371	2.72

Table A3. Source of disaster risk information.

Source of Information	Responses	
TV	91.16%	268
Social Media	87.76%	258
Friends or Family	78.91%	232
Internet (website)	73.81%	217
News Portal	66.33%	195
Local DMA	57.82%	170
National DMA	56.46%	166
Radio	56.12%	165
Community Meeting	51.02%	150
Local Government (aside Local DMA)	42.52%	125
DRR Community	40.82%	120
Workplace	38.78%	114
Printed Information (Billboard, Brochure, etc.)	37.07%	109
Emergency Service	37.07%	109
School	33.67%	99
Insurance Company	5.10%	15
Others		13
Total Respondents		294

Appendix C

Community-based Disaster Risk Management (CBDRM), Community Roles, Networks, and Collaboration

Table A4. Crosstabulation of gender and experience of participating in the Disaster Risk Reduction (DRR) program.

		Sex		Total
		Woman	Man	
Yes	Count	17_a	21_b	38
	Expected Count	23.1	14.9	38.0
	%	44.7%	55.3%	100.0%
No	Count	31_a	10_b	41
	Expected Count	24.9	16.1	41.0
	%	75.6%	24.4%	100.0%
Total	Count	48	31	79
	Expected Count	48.0	31.0	79.0
	%	60.8%	39.2%	100.0%

Each subscript letter denotes a subset of sex categories whose column proportions do not differ significantly from each other at the 0.05 level.

Table A5. Activities of women involvement in the Disaster Risk Reduction (DRR) Program.

Activities	Responses	
Logistics and necessities (management) during emergency situations	90.1%	136
Children education during the emergency	70.2%	106
The psychological condition of refugees	57.6%	87
Wellbeing management in shelter (e.g., sanitation availability, cleanliness, health facilities, etc.)	53.0%	80
Evacuation shelter and routes planning	27.8%	42
Others	11.9%	18
Total Respondents		151

Appendix D

The Goodness of Fit Test

Table A6. Degree of freedom test between the individual attributes and the experiences of DRR programs.

Variables	*n*	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Test
Sex	79	7.884	1	0.005	0.006	Chi-square
Age group	77	5.009			0.079	Fisher's exact test
Duration of staying in the neighborhood	78	9.983	2	0.007	0.007	Chi-square
Education	78	2.850			0.419	Fisher's exact test
Monthly income	71	6.039	3	0.110	0.112	Chi-square
Activity	78	1.923			0.448	Fisher's exact test
Household types	69	1.993			0.474	Fisher's exact test

Table A7. Degrees of freedom test between the individual attributes and advantages of the DRR program for preparedness.

Variables	*n*	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Test
Sex	46	3.067	1	0.080	0.187	Chi-square *
Age group	44	1.747			0.538	Fisher's exact test
Duration of staying in the neighborhood	45	0.851			0.853	Fisher's exact test
Education	45	1.853			0.621	Fisher's exact test
Monthly income	44	1.231			0.867	Fisher's exact test
Activity	46	8.711			0.014	Fisher's exact test
Household types	41	1.589			0.616	Fisher's exact test

* Count in 2 × 2 table.

Table A8. Degree of freedom test between the individual attributes and the existence of a community-based disaster risk management (CBDRM) organization.

Variables	*n*	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Test
Sex	155	1.034	1	0.309	0.323	Chi-square
Age group	152	1.936	2	0.380	0.393	Chi-square
Duration of staying in the neighborhood	153	0.052	2	0.974	0.979	Chi-square
Education	153	4.439	3	0.218	0.222	Chi-square
Monthly income	140	2.911	3	0.406	0.411	Chi-square
Activity	154	7.780	2	0.020	0.018	Chi-square
Household types	129	2.935			0.258	Fisher's exact test

Table A9. Degree of freedom test between the individual attributes and prioritizing vulnerable groups during disaster emergencies.

Variables	*n*	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Test
Sex	200	0.110	1	0.741	0.747	Chi-square
Age group	195	1.939	2	0.379	0.414	Chi-square
Duration of staying in the neighborhood	198	2.580	2	0.275	0.276	Chi-square
Education	196	8.051	3	0.045	0.044	Chi-square
Monthly income	175	6.727	3	0.081	0.081	Chi-square
Activity	198	0.639	2	0.727	0.739	Chi-square
Household types	162	4.050			0.120	Fisher's exact test

Table A10. Degree of freedom test between the individual attributes and women's involvement in disaster and risk management.

Variables	*n*	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Test
Sex	187	0.996	1	0.318	0.361	Chi-square *
Age group	182	4.771	2	0.092	0.091	Chi-square
Duration of staying in the neighborhood	185	3.882	2	0.144	0.140	Chi-square
Education	182	6.261	3	0.100	0.101	Chi-square
Monthly income	162	2.733	3	0.435	0.442	Chi-square
Activity	186	2.179	2	0.336	0.352	Chi-square
Household types	152	3.252			0.208	Fisher's exact test

* Count in 2 × 2 table.

Table A11. Degree of freedom test between the individual attributes and the impact of collaboration on disaster preparedness and community resilience.

Variables	*n*	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Test
Sex	210	1.826	1	0.177	0.186	Chi-square
Age group	205	0.210	2	0.900	0.924	Chi-square
Duration of staying in the neighborhood	208	0.692	2	0.708	0.691	Chi-square
Education	205	1.209	2	0.546	0.545	Chi-square
Monthly income	184	1.580	3	0.664	0.678	Chi-square
Activity	208	0.769	2	0.681	0.687	Chi-square
Household types	169	0.099			1.000	Fisher's exact test

Appendix E

Multiple Regression Analysis

Table A12. Multiple regression result for predictive analysis: education level: primary, secondary, and tertiary significantly predicted perception of disaster information accessibility.

Variables	Unstandardized B	Coefficients SE	Standardized Coefficients Beta (β)	t	*p*
(Constant)	1.800	0.420		4.290	0.000
Primary	−0.133	0.457	−0.047	−0.292	0.771
Secondary	−0.276	0.432	−0.143	−0.638	0.524
Tertiary	−0.053	0.430	−0.028	−0.122	0.903

Constant = 1.800, F(3, 209) = 0.891, $p = 0.447$, R = 0.112, $R^2 = 0.013$.

The final predictive model was:

$$\textit{Disaster information accessibility} = 1.800 + (-0.133 \times \textit{primary education}) + (-0.276 \times \textit{secondary education}) + (-0.053 \times \textit{tertiary education}) \quad \text{(A1)}$$

Table A13. Multiple regression result for predictive analysis: each gender (male and female) could significantly predict the experience of DRR programs.

Variables	Unstandardized B	Coefficients SE	Standardized Coefficients Beta (β)	t	*p*
(Constant)	1.745	0.088		19.878	0.000
Sex Male	0.005	0.121	0.004	0.044	0.965
Sex Female	−0.230	0.134	−0.168	−1.715	0.089

Constant = 1.745, F (2, 131) = 1.943, $p = 0.147$, R = 0.170, $R^2 = 0.029$.

The final predictive model was:

$$\textit{DRR program experience} = 1.745 + (0.005 \times \textit{male}) + (-0.230 \times \textit{female}). \quad \text{(A2)}$$

Table A14. Multiple regression result for predictive analysis: duration of staying in the neighborhood (≤10, 10–≤30, >30 years) could significantly predict the experience of DRR programs.

Variables	Unstandardized B	Coefficients SE	Standardized Coefficients Beta (β)	t	*p*
(Constant)	1.695	0.056		30.108	0.000
Duration of stay 1 (*≤10 years*)	−0.028	0.358	−0.007	−0.079	0.937
Duration of stay 2 (*10–≤30 years*)	−0.195	0.256	−0.067	−0.762	0.448
Duration of stay 3 (>30 years)	0.019	0.238	0.007	0.081	0.935

Constant = 1.695, F (3,130) = 0.199, $p = 0.897$, R = 0.068, $R^2 = 0.005$.

The final predictive model was:

$$\textit{DRR program experience} = 1.695 + (-0.028 \times \leq 10\ \textit{years}) + (-0.195 \times 10 - \leq 30\ \textit{years}) + (0.019 \times >30\ \textit{years}). \quad \text{(A3)}$$

Table A15. Multiple regression result for predictive analysis: people's type of occupation (worker, homemaker, unemployed, retired, and student) could significantly predict their perception of the advantages of DRR programs for disaster preparedness.

Variables	Unstandardized B	Coefficients SE	Standardized Coefficients Beta (β)	t	*p*
(Constant)	1.930	0.144		13.448	0.000
Activity 1 (*workers and homemakers*)	−0.744	0.203	−0.367	−3.666	0.000
Activity 2 (*unemployed and retired*)	1.070	0.681	0.156	1.571	0.120
Activity 3 (*students*)	−0.310	0.317	−0.097	−0.977	0.331

Constant = 1.930, $F(3, 85) = 6.139$, $p = 0.001$, $R = 0.422$, $R^2 = 0.178$.

The final predictive model was:

$$\textit{Impact of DRR programs on disaster preparedness} = 1.930 + (-0.744 \times \textit{workers and homemakers}) + (1.070 \times \textit{unemployed and retired}) + (-0.310 \times \textit{students}). \quad \text{(A4)}$$

Table A16. Multiple regression result for predictive analysis: people's type of occupation (worker, homemaker, unemployed, retired, and student) could significantly predict the value of their awareness of CBDRM existence in their neighborhood.

Variables	Unstandardized B	CoefficientsSE	Standardized Coefficients Beta (β)	t	*p*
(Constant)	1.988	0.083		24.023	0.000
Activity 1 (*workers and homemakers*)	−0.207	0.101	−0.134	−2.051	0.041
Activity 2 (*unemployed and retired*)	0.346	0.193	0.108	1.791	0.074
Activity 3 (*students*)	0.140	0.052	0.170	2.705	0.007

Constant = 1.978, $F(3, 290) = 8.579$, $p = 0.001$, $R = 0.286$, $R^2 = 0.082$.

The final predictive model was:

$$\textit{Impact of CBDRM awareness} = 1.988 + (-0.207 \times \textit{workers and homemakers}) + (0.346 \times \textit{unemployed and retired}) + (0.140 \times \textit{students}). \quad \text{(A5)}$$

Table A17. Multiple regression result for predictive analysis: level of education (primary, secondary, and tertiary) could significantly predict the perceptions of the inclusive process during disaster.

Variables	Unstandardized B	Coefficients SE	Standardized Coefficients Beta (β)	t	*p*
(Constant)	1.780	0.096		18.490	0.000
Primary	−0.521	0.193	−0.171	−2.694	0.007
Secondary	−0.274	0.136	−0.140	−2.022	0.044
Tertiary	−0.008	0.130	−0.004	−0.063	0.950

Constant = 1.780, $F(3, 289) = 3.835$, $p = 0.010$, $R = 0.196$, $R^2 = 0.038$.

The final predictive model was:

$$\textit{Inclusive process on disaster management} = 1.780 + (-0.521 \times \textit{primary education}) + (-0.274 \times \textit{secondary education}) + (-0.008 \times \textit{tertiary education}). \quad \text{(A6)}$$

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