Journal of Civil Engineering, Planning, and Design Vol. 2, No. 1, 2023: page 34-40

The Influence of Non-Structural Mitigation Education on Understanding Community Preparedness for Flood Disaster in Sumberrejo District

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Abstract. Indonesia is a developing country that is prone to disasters, especially floods. Based on data from DIBI, recorded from 2013 to 2018, Bojonegoro Regency has experienced 299 disaster events out of 5 types of disasters with floods being the most frequent. One of the affected areas is the Sumberrejo District. Non-structural mitigation planning is an essential part of efforts to reduce disaster risk, therefore this research focuses on providing education on appropriate non-structural mitigation. The purpose of this study is to analyze and the influence of non-structural mitigation education on understanding community preparedness for flood disaster in Sumberrejo district. The activity was carried out in the form of giving closed questionnaires, and giving educational socialization using the oral explanation method and brochures, which contained educations regarding introduction to a sustainable environment, and flood non-structural mitigation. Afterward, a final questionnaire was given with the results obtained: the knowledge of respondents regarding the importance of environmental sustainability and non-structural flood disaster mitigation efforts has increased, where as many as 39 respondents (86.7% of respondents) out of a total of 45 respondents experienced an increase in post-test scores due to the education carried out in this study and 71.1% of respondents were able to answer more than 70% of the post-test questions correctly. The improvement of total value of the post-test average score (5.93) compared to the pre-test score (7.44) increased by 1.51, which showed that the respondents' understanding of non-structural mitigation for flood disasters increased through the holding of education that had been carried out by this study.

Keywords: Bojonegoro, Disaster Management, Flood Disaster, Non-Structural Mitigation, Sumberrejo District

1. Introduction

Disaster is an event or series of events that threatens and disrupts people's lives and livelihoods caused by human factors resulting in human casualties, environmental damage, loss of property, and psychological impacts [1]. Vulnerability to disasters can be caused by a lack of proper disaster management, environmental impact management, or human management itself. Indonesia is a developing country that is prone to disasters, especially floods. Floods are caused by 2 (two) categories, namely (1) floods caused by nature; influenced by rainfall, physiography, erosion, sedimentation, river capacity, drainage capacity, and the influence of tides; and also (2) floods caused by human activities that cause environmental changes such as changes in the condition of the watershed, residential areas around the banks, damage to land drainage, damage to flood control buildings, damage to forests (natural vegetation), as well as inadequate/inappropriate flood control system planning [2].

During the period from 1991 to 1995, floods in Indonesia caused losses of trillions of rupiah with 4,246 fatalities, 6,635 injuries and around 7 million suffered and 324,559 houses were damaged. During the period 2000 to 2011, 77% of the disasters that occurred were hydrometeorological disasters. The estimated losses do not take into account small-scale floods, immaterial losses, and indirect losses which are not insignificant [3]. According to data from the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) report, the Asian region is at the top of the list of victims of natural disasters, where almost half of the world's disasters occur in the Asian region. The report contains data from the National Disaster Management Agency (BNPB) showing that from 2015 to 2019, there were 12,478 disaster events in Indonesia. The types of disasters that occurred were dominated by hydrometeorological disasters by 75.35%, especially floods and droughts. In 2016 and 2017, Indonesia suffered economic losses of more than Rp. 7 trillion and Rp. 4.7 trillion due to the impact of geological and hydrometeorological disasters [4].

One of the areas in Indonesia that experienced flooding was Bojonegoro Regency, East Java. Based on data from the Indonesian Disaster Information Data (DIBI), recorded from 2013 to 2018, Bojonegoro Regency has experienced 299 disaster events out of 5 types of disasters with floods and extreme weather being the most frequent. According to the BNPB Disaster Risk and Study in 2017-2023 which is written in the Strategic Plan (RENSTRA) of Bojonegoro Regency in 2018-2023, 7 disasters frequently occur, with floods (overflow of the Bengawan Solo river) in the first place and flash floods in rank second [5]. Based on the results of the Bojonegoro Regency BPBD report, a total of 40 flash floods have occurred since 2018-2020. Bojonegoro Regency has a large potential for flash floods when compared to other districts in East Java [6]. 21 districts in the Bojonegoro Regency area are prone to flooding, overflowing the Bengawan Solo River, and flash floods arising several times in the local area during the rainy season. One of them is Sumberrejo District, where there is one village that is prone to flooding due to the overflow of the Bengawan Solo River and six other villages that are prone to flash floods [7].

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JCEPD-ISSN: 2830-3628
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The Sumberrejo District area is an area that has developed into a new growth center because it is relatively close to the city center in Bojonegoro Regency and is traversed by the main route that connects the Bojonegoro-Lamongan-Surabaya route. This indicates that the area is very vulnerable both socially, physically, economically, and environmentally when facing a flood disaster. The risk of flooding causing health problems, damage, and economic loss cannot be completely avoided so it must be managed properly. Flood disaster management is not trying to eliminate the danger of flooding but to overcome it. The success of flood risk management is obtained if structural and non-structural mitigation measures are implemented, such as flood prevention and mitigation including structural flood control measures such as the construction of dams or river embankments, and non-structural measures such as flood prediction and warning, flood risk management, community/society participation, and institutional arrangement [2].

Mitigation is a series of efforts to reduce the impact of disaster risk by increasing the ability to deal with disaster threats [8]. Well-planned disaster mitigation can create disaster resilience. Mitigation plans are efforts made to reduce disaster risk through the development/development of physical aspects and/or increasing community awareness and coping capacity against disasters [9]. This description can be described and carried out structurally and non-structurally [10]. Structural mitigation includes technical and physical development such as the construction of dams, artificial embankments, drainage channels, and storage ponds, while non-structural mitigation includes social, educational, community, afforestation, and reforestation aspects [11, 12].

Along with the increasing intensity and frequency of river overflow floods, structural mitigation alone is no longer sufficient to deal with flood disasters. Communities as victims who are most affected when a flood disaster strikes are important objects whose coping capacity must be increased as part of non-structural mitigation efforts in dealing with these disasters [13]. If the capacity of people living in areas prone to river overflow floods can be increased, then the vulnerability of these communities will decrease because they are ready to face the worst possibility of a flood disaster. With good and proper capacity, the community can carry out more mature preparations, can save their families, the people around them, and also their property when a flood hits [13]. Therefore, non-structural mitigation planning is a very important part of efforts to reduce disaster risk.

This research focuses on providing education on appropriate non-structural mitigation to residents in the Sumberrejo District area which is prone to flooding by taking into account the history of flood events and vulnerability (physical, social, economic, and environmental). From previous research conducted by Tiwow regarding school-based flood disaster mitigation that has been carried out by providing education to school children, it was found that providing education about flood disaster mitigation can increase the knowledge and awareness of school children in supporting flood disaster mitigation efforts [14]. From research conducted by Ulum, it was found that successful flood disaster management requires simultaneous multi-stakeholder involvement and community participation, the greater their involvement, the more capacity they will be able to minimize flood risk. Therefore, education must be given to every line of society so that all parties can be involved and understand better and have a shared role and responsibility in effective flood disaster management [2]. Based on research conducted by Herawati, flood risk management is quite effective in dealing with risks and minimizing the consequences of flooding [6]. The research conducted by Suarmika concluded that providing the community with correct knowledge about disasters and the importance of disaster mitigation is very important and will form Indonesian people who are resilient in dealing with natural disasters [8].

So in this study, education was given to the people in the Sumberrejo area in the form of effective education of non-structural mitigation. The purpose of this study is to analyze and the influence of non-structural mitigation education on understanding community preparedness for flood disaster in Sumberrejo district. It is hoped that with education as a non-structural mitigation effort, the people in the Sumberrejo District area, Bojonegoro Regency can grow into disaster-resilient communities and understand what steps should be taken in dealing with floods which often occur in their area.

2. Materials and Methods

2.1. Place and Time of the Study

This research activity was carried out in Sumberrejo District, Bojonegoro Regency, East Java which is a flood prone area. As for the time, the study was carried out on June 5th and 6th, 2023.

2.2. Method Used

The activity was carried out in the form of giving closed questionnaires in the form of multiple choices to several community representatives in the Sumberrejo District location, regarding the level of community understanding of environmental sustainability, floods, and mitigation, which is used as a reference for measuring the success of the activities carried out. The selected respondents were several residents of the Sumberrejo sub-district. After the questionnaires were procured, educational socialization was carried out using the oral explanation method, giving brochures to respondents, distributing brochures, and posting brochures at several strategic locations in the Sumberrejo sub-district which contained eductions regarding non-structural mitigation of flooding, which contained (1) explanation of material introduction to sustainability environment, (2) explanation of material about the factors that cause flooding, (3) explanation of material about the adverse effects of flooding, (4) explanation and information regarding non-structural mitigation of flood disasters. The purpose of the socialization and distribution of brochures is to equip participants with knowledge about environmental sustainability, the causes of floods and their impacts as well as flood disaster mitigation. After providing education in the form of oral explanations and brochures,

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another final questionnaire was given to find out the success of the material provided, with the target that the respondent answered correctly more than 70% of the questions given. Both before and after the distribution of materials and brochures, the same number of questions (a total of 10 questions) were given as well as questions related to the meaning of floods, the meaning of flood mitigation, and non-structural flood mitigation measures that can be taken. This stage is intended to see and analyze how the knowledge of respondents and socialization participants increases before and after the socialization activities are carried out.

3. Result and Discussion

The initial questionnaire distribution activity in the Sumberrejo sub-district, Bojonegoro district was carried out on June 5th and 6th, 2023. It was agreed that the material provided in both oral explanations and brochures was about environmental sustainability, the causes of floods and their impacts, and non-structural mitigation of flood disasters. Outline the results of the implementation of activities can be seen from the assessment of the following components.

3.1. Planned Material and Education Targets

The target number of respondent participants and educational socialization is 30 people from the Sumberrejo District community. The success of the target number of respondents was considered very good because the total number of respondents obtained was 45 people which fulfilled the initial target of initial respondents. The material planned is an initial introduction to the importance of environmental sustainability, the causes of flood disasters, the impact of flood disasters, as well as knowledge of non-structural flood disaster mitigation that can be done on a family basis. All material was conveyed to respondents through educational brochures which were packaged in an informative and attractive manner and additional explanations were given verbally so that respondents could better understand the material provided, but due to time constraints and personal interests of some respondents, not all material was delivered in details for each respondent.

The time for the socialization was relatively short (± 5 - 10 minutes per respondent), so it was assumed that the short socialization time would allow the respondents to not fully understand the material given orally, however, with the educational brochures it was hoped that the public could learn more about the complete detailed information provided with more free time after the respondent returned to their respective activities. In the oral explanation session, several respondents showed more interest by asking further questions about the material presented related to floods and non-structural mitigation. It can be interpreted that there is a willingness on the part of respondents to explore further floods and their impacts as well as non-structural mitigations that can be carried out by respondents when their area or house is one day flooded.

3.2. Achievement of Socialization Objectives

The purpose of the socialization (distribution of questionnaires, oral explanations, and distribution of educational brochures) is to provide knowledge to the people of Sumberrejo District, Bojonegoro Regency about environmental sustainability and mitigation of non-structural flood disasters which often hit the residential areas of the respondent community. To increase the knowledge of the respondents, educational brochures were also provided regarding environmental sustainability, the causes and impacts of floods, as well as non-structural flood disaster mitigation which they could save and take home to their respective families so that it was hoped that the respondent's family would also receive education indirectly through educational brochures that given. Respondents were enthusiastic about filling out questionnaires and receiving explanations and educational brochures given because the brochures were packaged in an interesting and informative presentation. In carrying out the socialization, before and after giving oral explanations and brochures, the same 10 questions were given related to environmental sustainability, flood factors, and impacts, as well as non-structural flood mitigation efforts. This stage is intended to see how the knowledge of respondents before (pre-test) and after (post-test) activities.

The achievement of the socialization objectives can be assessed as good if there is an increase in the knowledge of the respondents from the results of the questionnaire after and the results of the questionnaire before the oral explanation and distribution of brochures. The results of the pretest and posttest values of all respondents can be seen in Table 1.

Table 1
Pre-Test and Post-Test Average Score Results

Number of Respondents	Questionnaire Average Score Results	
	Pre-Test	Post Test
45	5.93	7.44

From the data of the pretest and posttest average score results above, further data processing is carried out. The number of respondents who experienced an increase in the results of the posttest scores from the pretest values were as many as 39 respondents (post-test scores were better/> than pre-test scores), 5 respondents had fixed scores (post-test scores equals/= to pre-test scores), and 1 respondent had a decreased score (post-test scores less than/< pre-test value). This is possible because one of the respondents answered carelessly because he was in a hurry to continue other activities. As many as 39 out of 45 respondents experienced an increase in their results due to the education carried out in this study, or a total of 86.7% of respondents had an increase in results, 11.1% of respondents had a decrease in results, and 2.2% of respondents had constant results, both before and after the implementation education.

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Calculations were made of how many respondents have a post-test score greater than or equal to 7, (post-test score ≥ 7 / pass the post-test), to see how many respondents have mastered the material more than 70%. From the calculation results, it was found that as many as 32 respondents had post-test scores ≥7 (passed), and 13 respondents had post-test scores <7. This means that as much as 71.1% of respondents can answer more than 70% of the questions correctly. From the data analysis performed, it can be concluded that from the procurement of this socialization education, as many as 86.7% of respondents had an increase in results/understanding of the material provided, and as many as 71.1% of respondents met the target of understanding the material by 70%. The improvement of total value of the post-test average score compared to the pre-test score increased by 1.51, which showed that the respondents' understanding of non-structural mitigation for flood disasters increased through the holding of education that had been carried out by this study.

3.3. Data Processing

The data processing carried out is the implementation of the Validity Test, Reliability Test, Normality Test, and Paired Sample T-Test. This test is done manually using Excel, and also using the additional IBM SPSS program to ensure the calculation is correct.

3.3.1. *Validity Test*

The data that has been obtained from distributing the questionnaires is recapitulated first, which is then tested for validity to measure whether the data that has been obtained after the research is valid data or not by using the measuring instrument that has been used (questionnaire). Testing the Validity Test is carried out by testing the t value and testing the r value by calculating the calculated r value which is then compared with the r table, and calculating the calculated t value which is then compared with the t table value. From the results of the R-test and T-test validity, the questions in the questionnaire can be said to be valid because the calculated R-value is greater than the R table value (shown by Table 2), and the calculated T value is greater than the T table value (shown by Table 3).

Table 2
Data Validity R Test Results

Data Validity R Test			
Question Items	**R Count**	**R Table**	**Information**
P1	0.359	0.248	Valid
P2	0.419	0.248	Valid
P3	0.283	0.248	Valid
P4	0.439	0.248	Valid
P5	0.553	0.248	Valid
P6	0.268	0.248	Valid
P7	0.662	0.248	Valid
P8	0.564	0.248	Valid
P9	0.549	0.248	Valid
P10	0.281	0.248	Valid

Table 3
Data Validity T Test Results

Data Validity T Test			
Question Items	**T Count**	**T Table**	**Information**
P1	2.519	1.681	Valid
P2	3.029	1.681	Valid
P3	1.935	1.681	Valid
P4	3.206	1.681	Valid
P5	4.350	1.681	Valid
P6	1.826	1.681	Valid
P7	5.787	1.681	Valid
P8	4.473	1.681	Valid
P9	4.303	1.681	Valid
P10	1.919	1.681	Valid

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The results of the validity test calculations for both the R test and T-test using manual calculations with Excel, and the results of calculations using the IBM SPSS auxiliary program are the same. From the results of the above calculations, it can be concluded that all the questions used in the questionnaire as an assessment instrument in this study can be said to be valid because the value of r count and t count is greater than the r table or t table.

3.3.2. *Reliability Test*

The research instrument is said to be reliable if the Cronbach's Alpha value is > 0.6 and it is said to be unreliable if the Cronbach's Alpha value is <0.6. The Cronbach alpha value obtained from the results of calculations with the IBM SPSS auxiliary program (shown by Table 4) is 0.680, where the value is greater than 0.6. So, the research instrument can be said to be reliable (0.680 > 0.6).

Table 4
Reliability Test Results

Cronbach's Alpha	N of Items
.680	11

3.3.3. *Normality Test*

This test aims to determine whether the data is normally distributed or not. This test was carried out as a condition for conducting the Paired Sample T-Test which has the condition that the data under review must be normally distributed. The basis for this decision is (1) If the significance value is > 0.05 then the residual value is normally distributed; (2) If the significance value is <0.05, the residual value is not normally distributed. From the test results with the IBM SPSS auxiliary program, the normality test results obtained with the Kolmogorov Smirnov are in Table 5 below.

Table 5
Normality Test Results

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		45
Normal Parameters[a,b]	Mean	0E-7
	Std. Deviation	1.01249050
Most Extreme Differences	Absolute	.132
	Positive	.132
	Negative	-.111
Kolmogorov-Smirnov Z		.889
Asymp. Sig. (2-tailed)		.409

a. Test distribution is Normal.

b. Calculated from data.

Based on the results of the normality test above, it is known that the significance value (Asymp, Sig. 2-Tailed) is 0.409 where its value is greater than/> 0.05, it can be concluded that the residual values are normally distributed and the Paired Sample T-Test can be carried out.

3.3.4. *Paired Sample T-Test*

This test was conducted to see if there is an average difference between two paired or related samples. The two samples are the same sample but have two data (before and after). One of the conditions for conducting this test is that the paired sample data group must be normally distributed because the paired sample T-test is part of parametric statistics, therefore a normality test is performed first before.

Table 6
Paired Sample T-Test Results

Paired Differences					t	df	Sig. (2-tailed)
Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
			Lower	Upper			
-1.51111	1.03621	.15447	-1.82242	-1.19980	-9.783	44	.000

In Table 6 above, this output is the 3rd output from the results of the Paired Sample T-Test with the IBM SPSS auxiliary program. The basis for decision-making in this test is: (1) If the Sig. (2-tailed) < 0.05, so there is a significant difference between the results

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of the questionnaire on the pre-test and post-test data; (2) If the Sig. (2-tailed) > 0.05, so there is no significant difference between the results of the questionnaire on the pre-test and post-test data. It is known that the Sig. (2-tailed) in Table 6 is 0.000 where the value is less than/< 0.05, it can be concluded that there is a real difference between the results of the pre-test and post-test questionnaires. So from these results, it can be concluded that the activities carried out in the form of providing education with brochures and oral explanations, can increase respondents' understanding of the importance of environmental sustainability, factors and impacts that cause flooding, and non-structural flood mitigation, which can be seen from the results of the respondents test scores to the questionnaire.

3.3.4. N-Gain Score Test

This test was conducted to measure the increase in respondents' understanding between before and after educational activities. Score criteria can be interpreted as follows:
(1) G ≥ 0.7; high increase ; (2) 0.3 ≤ G < 0.7; moderate increase ; and (3) G < 0.3; low increase.

Table 7
N-Gain Score Test Results

	N	Minimum	Maximum	Mean	Std. Deviation
NGain	45	-.33	1.00	.4130	.30686
Valid N (listwise)	45				

From the results of the N-Gain test obtained from SPSS and manual calculations in Excel, the average (Mean) of N-Gain value is 0.413 (Table 7), which means that the increase in respondents understanding between before and after educational activities is a moderate increase since 0.413 value is more than 0.3 but less than 0.7.

Based on the assessment above, the implementation of this socialization activity can be said to be successful and considered good. The successful implementation of the socialization activities above can be seen from the results of the respondents' post-test scores and the results of data processing that has been carried out on respondents who received socialization activities. Several respondents were satisfied with the educational activities and brochures provided because they provide benefits for those who are frequently affected by floods but do not yet know the best steps to take in non-structural mitigation. With the various benefits that can be obtained from providing education and brochures, it is hoped that the people of the Sumberrejo sub-district, Bojonegoro district can become a channel of information for their respective families, friends, and other communities in the respondent's area so that they are always alert, ready at any time, and know what to do if there is a flood disaster in the area.

4. Conclusion

The results of the implementation of socialization activities can be concluded: (1) The knowledge, awareness, and understanding of respondents from the Sumberrejo sub-district community, Bojonegoro Regency regarding the importance of environmental sustainability, the causes of flood disasters, the impact of flood disasters, as well as family/community-based non-structural flood disaster mitigation efforts after socialization activities have increased, where as many as 39 respondents out of a total of 45 Respondents experienced an increase in posttest scores due to the education carried out in this study, a total of 86.7% of respondents had increased results, 11.1% of respondents had decreased results, and 2.2% of respondents had fixed results on posttest scores compared to pretest scores. (2) The objective of research socialization was achieved where as many as 71.1% of respondents were able to answer more than 70% of the posttest questions that were given correctly after being given education, which shows that the material given to respondents was well received. (3) The improvement of total value of the post-test average score (5.93) compared to the pre-test score (7.44) increased by 1.51, which showed that the respondents' understanding of non-structural mitigation for flood disasters increased through the holding of education that had been carried out by this study. (4) Providing education with brochures and oral explanations, can increase respondents' understanding of the importance of environmental sustainability, factors and impacts causing floods, and non-structural flood mitigation, as indicated by the Sig (2-tailed) value in the results of the Paired Sample T-Test that is equal to 0.000 (<0.05). (5) The increase in respondents' understanding between before and after the educational activity was a moderate increase (N-Gain = 0.4130), which was shown by the results of the N-Gain Score Test conducted.

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