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Urban Flood Risk Management: A Study of Adaptation Based on Knowledge of Ethnic Communities on the Banks of the Musi River in Palembang

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ABSTRACT

Areas lowland topographic in Palembang City have a high risk of flood vulnerability so they need to be able to occupy the area. The study aims to provide insight into the perception of knowledge of multi-ethnic communities regarding adaptive behavior in dealing with flood risks. There are five ethnic communities that have the highest risk of flooding events selected based on the location of settlements located on the riverbank. The research sample was selected based on a population consisting of 119 ethnic households living in houses on the riverbank. The flood knowledge perception index and flood risk response behavior were constructed based on relevant research questionnaire indicators and classified into high and low value scales. The analysis technique for each indicator uses regression to find the influence between respondent knowledge and flood risk adaptation behavior. The results of the study show that Arab ethnic knowledge has a significant influence on anticipatory behavior before a flood occurs. There is a significant influence of knowledge of flood height on the behavior of moving goods to higher places when flooding occurs among the Malay and Chinese ethnic groups. Research conclusion multi-ethnic knowledge of flood areas has a significant influence on adaptive attitudes during floods.

1. INTRODUCTION

The area of Palembang City is a lowland and swamp with almost 70% of the area located at an altitude of 4 to 20 meters above sea level [1]. Areas with topographic conditions in the form of lowlands have resulted in Palembang City becoming an area prone to flooding, both inundation floods and floods from river overflows [2]. In addition, rainfall of more than 150 mm/hour, land use, tides of seawater entering the Musi River, household domestic waste and other waste increase the risk of flooding that occurs in this area. The flood problem in this area comes from the drainage network system that is almost broken so that when it rains, water does not flow into the river properly [3].

Areas with high flood risk are estimated to be mainly in urban areas with less supportive terrain conditions and dense settlements [4, 5]. The density of buildings adversely affects the drainage system in its ability to drain water. The complexity of flood management is a consequence of the causes of flooding, including runoff, urban inundation, and drainage system failure [6]. Changes in urban development and consideration of efficient land use strategies are carried out with an emphasis on insight into community adaptation strategies in dealing with floods by minimizing the risks posed [7].

The high growth of the city's population every year adds to the pressure of environmental problems in the economic field and housing density, especially for urban people [8, 9]. The growth of the population and the cultural shift in urban communities led to the lack of stilt houses and raft houses and the dominance of permanent houses made the river narrower [10]. The area around the river is usually a residential area [11]. The culture of living on the banks of the river makes the settlements face the road and have their backs to the river, causing poor drainage, water pollution, and domestic garbage dumped into the river.

Climate change triggers a wider increase in flood incidence [12-14]. Therefore, every individual must take adaptation measures to prevent and minimize the risk caused by floods [15-17]. Trends in flood risk management and environmental management strategies are changing globally from expert-based decisions to a top-down approach involving local communities [18]. Flooding is caused by high rainfall coupled with dense settlements located on the banks of the river [19]. Flood risk does not only occur due to climate change but occurs due to people's lack of concern for their environment [20, 21]. Perception plays a very important role in the way individuals and societies respond to disaster risk and provides a link between emotions, perception of risk and behaviour [22, 23].

Threat assessment involves evaluating the perceived benefits of an action that is detrimental to the environment, and the magnitude of the perceived risk caused by the action, and the perceived vulnerability of a person to that risk Threat

assessment involves evaluating the perceived benefits of an action that is detrimental to the environment, and the magnitude of the perceived risk caused by the action, and the perceived vulnerability of a person to that risk [24]. The assessment of countermeasures reflects the extent to which communities think they can engage in pro-environmental action [25].

Understanding floods is very important for the community to understand, meaning that every individual must understand the possibility of flooding in their environment [26]. Community adaptation can be described from the shape of house buildings, the shape of support poles, house materials, residential roads, and habits during floods [27]. Community empowerment regarding flood risk reduction requires a large community involvement and collaboration between stakeholders to improve community knowledge and capacity [20]. The capacity of individuals to cope with the environment can be defined as adaptation, and also the capacity of the group to survive and change can be defined as adaptation [28, 29].

Adaptation refers to spontaneous actions driven by local knowledge to reduce the risk of environmental change and increase opportunities to improve well-being [30]. Community adaptation measures targeting flood hazards become more relevant in line with global climate change [31]. The adaptation process is a mutually beneficial relationship between humans and the environment, both the physical environment and the social environment. Meanwhile, in a social perspective, adaptation is carried out to improve individual responses in each symptom at risk due to flood events by improving technical skills and social abilities [32].

Ethnic knowledge can help in understanding the cultural values, history of community structures, and the environment of a particular building. Knowledge can also assist in setting priorities to ensure that important components of cultural heritage are in balance with the environment [33]. In addition, the involvement of local communities and cultural stakeholders can provide valuable insights that may not be visible in technical data alone, but can create ethnic resilience to environmental disaster risks [34].

Based on the background description of the risk of flood-prone areas in the ethnic communities on the banks of the Musi River, Palembang City, it is necessary to conduct more in-depth research. The goal to be achieved in this study is to provide insight into the perception of ethnic community knowledge on adaptive behavior in facing flood risk on the banks of the Musi River, Palembang City.

2. RESEARCH METHODOLOGY

2.1 Study area

The research was conducted in Palembang City, South Sumatra Province, Indonesia in the period of September 10 – December 20, 2023. The object of the research is the settlement of ethnic communities that occupy houses on the banks of the Musi River, Palembang City. Ethnic community settlements on the banks of the Musi River are adapted to the livelihood and the local transportation system uses the river route as the main route since ancient times and is maintained until now. For the people of ethnic communities who inhabit the riverbanks, rivers are a vital part of the activities of the community as a whole, where economic, transportation and social activities mostly use river facilities.

The Malay ethnic community is the original ethnic group of Palembang City which still maintains the location of settlements in all parts of the riverbank. The Arab ethnic community is located on the banks of the Musi River, the Ilir and Ulu areas, occupying flood-prone areas while still maintaining settlements grouped with the type of stilt houses. Meanwhile, mixed ethnic communities are immigrant communities from areas around Palembang City such as the Komering Tribe, Meranjat Tribe and Ogan Tribe. Mixed ethnic communities that inhabit the riverbanks in Palembang City are people who have a similar culture living in their home area. The Chinese ethnic community is an ethnic group located in the Seberang Ulu area, precisely in Ulu 6 and 7 Villages, with most of the settlements located on the banks of the river with the risk of flooding. In the Javanese ethnic community that inhabits the riverbank area, it is an ethnic immigrant who comes from Java Island and lives in the city of Palembang.

2.2 Sampling and data collection

Study analyzed 5 ethnic community settlements on the banks of the Musi River. The population in this study consists of all the people living along the riverbanks, and the sampling technique used in this method is a non-probability technique, specifically total sampling or census. The total sampling technique is a technique for determining samples when all members of the population are sampled [35]. The research sample was taken based on the similarity of the level of problems of people on the riverbank to flood risk. We collected information on perceptions, knowledge, and adaptation behaviors of 5 ethnic communities living in houses on the banks of the Musi River with a total of 119 respondents. The distribution of the number of research samples consisted of 25 respondents of Palembang Malay ethnicity, 28 respondents of Arab ethnicity, 24 respondents of mixed ethnicity, 20 respondents of Chinese ethnicity and 22 respondents of Javanese ethnicity.

Research indicators related to multi-ethnic community knowledge about flood victims, flood area, and settlement culture as well as adaptation behavior of ethnic communities when facing flood events. The independent variable in the research outlines research indicators related to the multi-ethnic community's knowledge about the causes of floods, the extent of floods, and the settlement culture as well as the adaptation behavior of ethnic communities when facing flood events. The knowledge of the multi-ethnic community is closely related to the understanding of the flood phenomenon in the residential environment. The independent variable of ethnic community behavior explains the preparedness of the ethnic community when facing floods. The research variables are presented in Table 1.

2.3 Data analysis

The research method uses the survey method, which is a method used to obtain data from certain natural places, but the research treats the data collection process using questionnaires. The research questionnaire was used to search for data based on knowledge perception indicators and behavioral indicators in dealing with floods. Each indicator is classified using a Guttman scale for perception of high knowledge using a scale of 1 and 0 for low knowledge.

Table 1. Research variables

No.	Perception	Empirical Studies
	Knowledge	
1	Perception of flood knowledge	[26, 36, 37]
2	Perception of flood-causing factors	[19, 38, 39]
3	Perception of flood impacts	[21, 30]
4	Perception of flood extent	[40-42]
5	Perception of flood location	[43-45]
6	Perception of flood height level	[37, 46, 47]
7	Physical structure of the house	[48-50]
8	Perception of distance of house from river	[51, 52]
9	Residence with kinship system	[53, 54]
	Behaviour	
10	Anticipation before flooding	[55-57]
11	Flood-adaptive houses	[58-61]
12	Protecting the environment	[62, 63]
13	Attitude during flooding	[32, 64]
14	Paying attention to flood fluctuations	[65, 66]
15	Moving goods	[67, 68]
16	Post-flood activities	[6]
17	Evaluation of flood events	[69, 70]
18	Cooperation with institutions	[20, 71]

2.4 Guttman scale

The Guttman scale is a self-report scale used to elicit definitive responses regarding attitudes and behaviors on issues and problems that have an order and hierarchy. The weighting of the respondents' answer scores was added to obtain the combined index (CI) value, the index value that was above the average was categorized as high of knowledge and behavioral actions (1) and the bottom was categorized at the low index level (0). Multiple linear regression analysis was used to determine the correlation and influence between respondents' knowledge of flood risk on adaptation behavior during floods. Regression analysis is an analysis that aims to predict how much influence independent variables and dependent variables [72]. Regression analysis was used to confirm the influence of independent variables (flood knowledge) to identify adaptive behaviors during floods.

2.4.1 Data validity

Data validity is defined as a scale that can be described as a wide difference in scale scores that reflects the actual differences between the objects to be measured with systematic or random error. This research uses factor analysis validity. The interview guideline questionnaire used to explore the knowledge and adaptation behavior of ethnic communities has a Measures of Sampling Adequacy > 0.5, which means that all the variables used are valid and reliable.

2.4.2 Data reliability

Reliability is a scale that produces consistent results when measurements are repeated. The research uses internal consistency reliability with the coefficient alpha or Cronbach's alpha, where the calculation results obtained a value > 0.6, thus it can be concluded that the collected data is reliable.

2.4.3 Multicollinearity test

The test is used to determine whether there is a perfect or nearly perfect linear relationship between independent variables in the regression model. Symptoms of multicollinearity include looking at the Value of Variance Inflation Factor (VIF) and its Tolerance. If the VIF value < 10 and Tolerance > 0.1, it is stated that multicollinearity does not occur.

2.5 Research data validity test

The validity of data uses types of validity, reliability, and data triangulation to avoid bias in research. Data triangulation refers to the use of multiple methods or data sources in research to develop a comprehensive understanding of a phenomenon. The research only uses triangulation in the study, specifically triangulation of data sources and triangulation of data collection techniques to obtain valid data.

Triangulation of data sources is used to test the credibility of the data by checking the data obtained through multiple sources. The testing of data regarding the ethnic community's knowledge of floods was conducted not only with the heads of families but also with family members such as wives and children. The data obtained were then described and categorized based on similar and different information, as well as the specifications of the three types of information available. The data from the analysis is then concluded to obtain valid and unbiased information. Triangulation the technique is carried out by checking data from the same source using different methods. The verification of the ethnic community's attitude towards flood events was obtained using a questionnaire technique, followed by verification through in-depth interviews and documentation techniques. The data obtained is considered credible if it contains the same information.

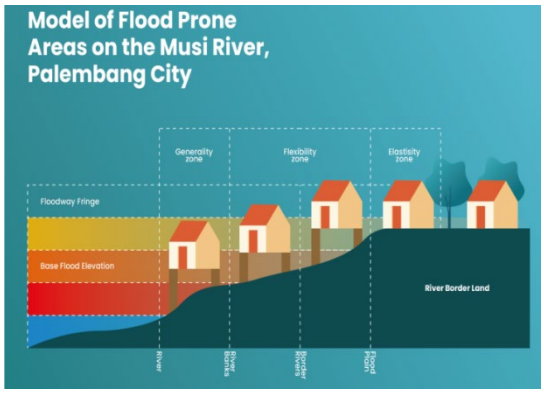
3. RESULTS AND DISCUSSIONS

3.1 Conditions of the research area

The city of Palembang is an area that is often hit by floods due to rainfall. The study examines the relationship between floods and ethnic communities on the banks of the Musi River. This is an analytical description of the relationship of urban ethnic community knowledge to flood-prone areas and the behavior of facing flood events that are considered a major problem in urban environmental management. The process of adaptation of the Musi River to flood risk has been carried out since ancient times, this can be seen from the development of the city of Palembang which started from the culture of living on the water. Ethnic settlements on the banks of the Musi River were built on the banks of the river. The distance that is too close to the main river, the density of settlements, river tides, accessibility, and inadequate drainage conditions make the area more vulnerable to flooding. However, most of the multi-ethnic communities still continue to maintain

settlements on the banks of flood-prone rivers. The behavior of ethnic communities in responding to flood events is influenced by the condition of settlements on the banks of rivers. The condition of the settlement of the ethnic community can be seen in the settlement model in Figure 1.

(a) Types of Houses of the People Living on the Banks of the Musi River



(b) Flood-Prone Area Settlement Model on the Musi River

Figure 1. Model flood prone areas on the Musi River Palembang City

3.2 Perception of flood risk knowledge of ethnic communities

The results of the study showed that the value of each indicator of flood risk knowledge perception varied greatly between ethnicities in the study area (Table 2). The difference in the perception of ethnic communities regarding flood risk knowledge is almost found in several indicators, except for the indicators of flood causing factors and the extent of flood points in ethnic community areas. Regarding flood knowledge, ethnic Javanese have (average 3.6) meaning less understanding of where flood sources and flood periods come from compared to Arab and mixed ethnic groups (average 3.9). There is no significant difference in knowledge (F_{hitung} 1,6399, P_{Value} 0,16905) caused by all ethnic communities having knowledge about floods. For knowledge about the impact of floods, ethnic Arabs (average 3.0) are less confident about the impact of floods caused by settlements that use wooden stilt house structures with large buildings, and there are significant differences (F_{hitung} 5,4911, P_{Value} 0,0004) can be caused by the Malay ethnicity in district 14 Ilir and the ethnic Chinese in the 7 Ulu sub-district often experiencing floods. Statistics Malay Arab Mixed Chinese Javanese.

In the indicator of knowledge about the level of flood height of the Malay ethnic group (average 3.8), they understood that settlements closer to the river have a higher risk of flooding, besides that there is a significant difference (F_{hitung} 16,148, P_{Value} 0,0000) caused by fewer ethnic Arabs experiencing flooding as a result of the influence of the river. For the perception of knowledge about the physical building of the house, there is a significant difference (F_{hitung} 57,529, P_{Value} 0,0000) caused by the Javanese ethnicity (average 1.64) who use stone footprint building types that are not adaptive to flood-prone areas. The perception of the Javanese ethnic group regarding house construction in relation to flood risk is influenced by their low level of knowledge and education, where most Javanese living along the riverbanks work as street vendors with an elementary school education. Meanwhile, ethnic Arabs and mixed ethnicities (average 3.75 and 3.85) have types of stilt houses made of hardwood resistant to water that are adaptive to flood-prone areas.

In terms of the distance of the house from the river, ethnic Arabs and ethnic Malays (average 2.86 and 2.84) know that living near the river is not safe, but they are used to it, while ethnic Javanese (average 1.36) feel uncomfortable living near the river. In the indicator of living with the kinship system, there is a significant difference (F_{hitung} 65,863, P_{Value} 0,0000) where the Javanese ethnicity and the mixed ethnicity who live are not based on the kinship system because they are immigrants and settle while other ethnicities are still influenced by the kinship system in settlement. The average value of knowledge about flooding in ethnic communities is presented in Figure 2.

3.3 Flood behavior adaptation in ethnic communities

This study describes the behavior of the community in responding to the risk of flood-prone areas on the banks of the Musi River in Palembang City. Perception of flood risk affects the behavior of each community to carry out the adaptation process with the aim of being ready to face danger and how the community responds to every flood information and warning. The results of the study on the behavior of ethnic communities towards flood events are known that there are differences in the variation in significance of various existing indicators. Overall, the adaptation behavior of flood events is presented in Table 3.

In terms of anticipation before the flood, there were significant differences from the five ethnicities (Fhitung 33,783, PValue 0.0000). The highest anticipatory behavior in the Malay ethnicity (mean 3.88) is due to the condition of settlements that have a high risk of flooding and the lowest anticipatory behavior is found in mixed ethnicities and Arab ethnicities (average 1.88 and 189), the difference in these conditions is related to settlements that are relatively safe from flood risk even though they are located on the riverbank. In the behavior of raising the house there is a significant difference (Fhitung 3.9511, PValue 0.0049) it is known that the Javanese ethnicity (average 2.86) raises the house such as the door as a barrier so that water does not enter the house during floods, followed by the Malay ethnicity (average 2.75) raising the house with the aim of minimizing the risk when flooding occurs. In terms of protecting the environment before floods, there are significant differences in ethnic communities (Fhitung 31,826, PValue 0.0000) the lowest environmental protection behavior is found in ethnic Arabs, followed by mixed ethnicities and Javanese ethnicities, this is worrisome because the three communities are in flood-prone areas.

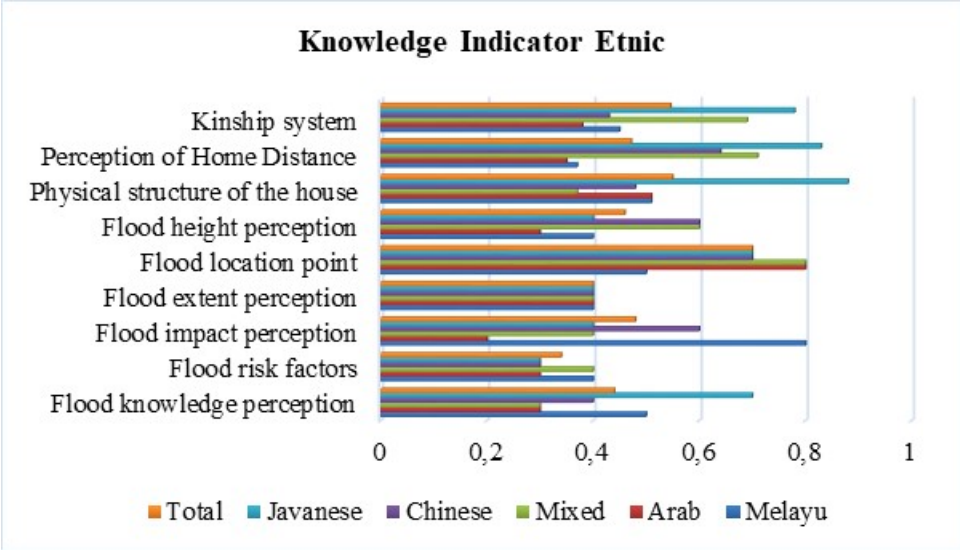


Figure 2. Average value of flood knowledge

Table 2. Knowledge perception flood risk

Indicator	Statistics	Ethnic Group					Anova (Uji F)		Total Ethnicity
		Melayu	Arab	Mixed	Chinese	Javanese	F_{hitung}	P_{value}	
Indicators Knowledge of floods	Mean	3.7	3.9	3.9	3.8	3.6	1.6399	0.16905	3.78
	Std. Dev	0.5	0.3	0.3	0.4	0.7			0.44
Factors causing floods	Mean	2.7	2.9	2.8	2.9	2.9	1.8074	0.1322	2.84
	Std. Dev	0.4	0.3	0.4	0.3	0.3			0.34
Impacts of floods	Mean	2.3	3.0	2.8	2.7	2.8	5.4911	0.00044	2.72
	Std. Dev	0.8	0.2	0.4	0.6	0.4			0.48
Knowledge of flood extent	Mean	2.8	2.8	2.8	2.6	2.7	0.2795	0.8907	2.74
	Std. Dev	0.4	0.4	0.4	0.4	0.4			0.4
Knowledge of flood locations	Mean	2.7	2.4	2.6	2.5	2.4	0.9344	0.44671	2.52
	Std. Dev	0.5	0.8	0.8	0.7	0.7			0.7
Flood height level	Mean	3.8	2.9	3.7	3.6	3.7	16.148	0.000	3.54
	Std. Dev	0.4	0.3	0.6	0.6	0.4			0.46
Physical structure of the house	Mean	3.56	3.75	3.83	3.65	1.64	57.529	0.000	3.286
	Std. Dev	0.51	0.51	0.37	0.48	0.88			0.55
Distance of the house from the river	Mean	2.84	2.86	2.54	2.7	1.36	24.199	0.000	2.46
	Std. Dev	0.37	0.35	0.71	0.64	0.83			0.58
Kinship system	Mean	2.72	2.82	2.33	2.75	0.5	65.863	0.000	2.224
	Std. Dev	0.45	0.38	0.69	0.43	0.78			0.546

Source: 2024 Research Data Analysis

Table 3. Adaptation behavior to floods

Indicator	Statistics	Ethnic Group					Anova Uji F		Total Ethnicity
		Melayu	Arab	Mixed	Chinese	Javanese	F_{hitung}	P_{value}	
Anticipation before flooding	Mean	3.88	1.89	1.88	2.65	2.91	33.783	0.0000	2.642
	Std. Dev	0.46	0.96	0.74	0.49	0.43			0.616
Raise the house part	Mean	2.75	2.29	2.25	2.35	2.86	3.9511	0.0049	2.5
	Std. Dev	0.56	0.76	0.79	0.59	0.35			0.61
Protect the environment	Mean	3.04	1.54	2.71	2.85	2.86	31.826	0.0000	2.6
	Std. Dev	0.28	0.88	0.46	0.37	0.35			0.468
Attitude during floods	Mean	1.96	1.79	1.17	2.2	2.77	16.814	0.0000	1.978
	Std. Dev	0.67	0.99	0.56	0.41	0.35			0.596
Pay attention to flood fluctuation	Mean	3.79	2.5	3.42	3.55	3.41	12.149	0.0000	3.334
	Std. Dev	0.57	0.84	0.78	0.51	0.59			0.658
Moving goods	Mean	1.88	1.71	2.04	2.3	1.86	4.1356	0.0036	1.958
	Std. Dev	0.65	0.46	0.55	0.57	0.46			0.538
Activities after floods	Mean	3.88	2.86	2.71	3.7	3.59	14.170	0.0000	3.348
	Std. Dev	0.46	0.85	0.69	0.47	0.59			0.612
Evaluation of flood events	Mean	1.56	2.14	1.96	2.0	2.64	11.832	0.0000	2.06
	Std. Dev	0.65	0.59	0.62	0.65	0.48			0.598
Cooperation with institutions	Mean	2.91	2.75	2.54	2.6	2.81	1.2981	0.2750	2.722
	Std. Dev	0.4	0.44	0.65	0.68	0.39			0.512

Source: Analysis of the Results of the 2024

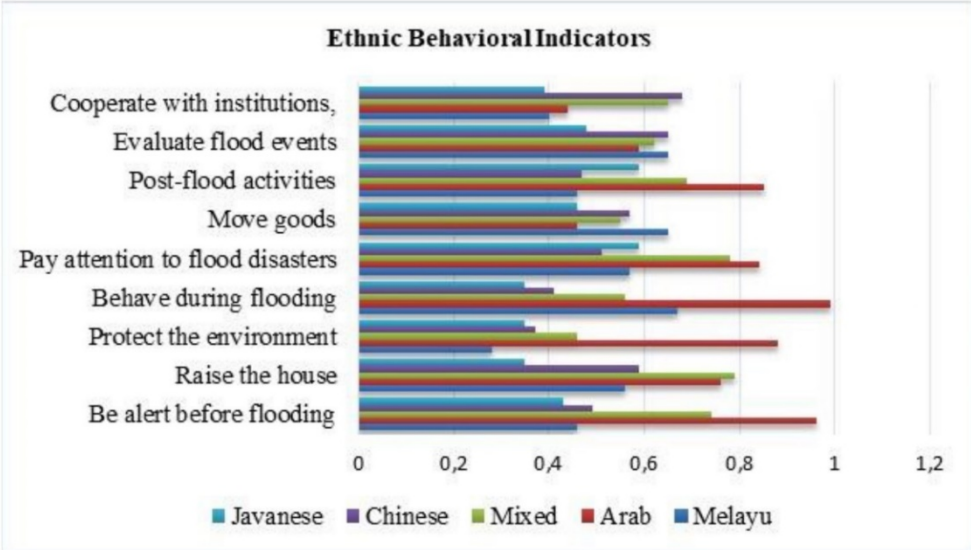


Figure 3. Average value of flood adaptation behavior

For overall flood behavior. there is significant variation (F_{hitung} 16.814. P_{Value} 0.0000). In general. this shows that all ethnic communities feel unaccustomed to floods entering houses and cleaning flood-affected furniture. In the behavior of ethnic Malays (average 3.79) and ethnic Chinese (average 3.55) on flood fluctuations. they made periodic observations and checks on the increase in river water discharge. while the lowest score was in the Arab ethnicity (average 2.5) where checking for fluctuations in river discharge increase was not a problem due to the use of stilt type houses and being in higher areas in Arab ethnic settlements. There is a significant difference in the behavior of moving goods to a safe place during floods (F_{hitung} 4.1356. P_{Value} 0.0036) It is known that ethnic Chinese (average 2.3) move valuables such as electronics to higher places during floods while other ethnicities have low behavioral scores with the possibility that they have placed valuables in a high position to avoid risk during floods. The level of adaptation of the Chinese ethnic community in terms of goods transfer is influenced by the economic status of the community. which has a high income and ownership of other valuable properties.

Study Regarding behavioral indicators after floods. there are significant differences (F_{hitung} 14.170. P_{Value} 0.0036) the Malay ethnicity (average 3.88) the reason that may occur is due to the location of settlements that are in low-lying areas and the risk of flooding in Ilir Village 14 makes ethnic Malays carry out activities to clean furniture and waterways after flooding. while Mixed ethnic groups (average 2.71) carry out the least activities after floods. probably supported by the type of houses and neighborhoods that are higher settlements so that the area of flooded houses is more little. In addition. in the evaluation after the flood there was a significant difference (F_{hitung} 11.832. P_{Value} 0.0036) Javanese ethnicity (average 2.64) has a high flood evaluation rate compared to other communities due to the type of houses that are prone to flooding. while ethnic Malays (average 1.56) are likely to consider flooding as a common occurrence that can occur at any time so that it does not require evaluation. In the aspect of cooperation with institutions. there is no significant contribution from all these ethnic communities. It is possible that all ethnic communities cooperate with relevant institutions regarding the risk of settlement flood [20]. The average value of adaptation behavior to flooding in ethnic communities is shown in Figure 3.

3.4 Results of knowledge and behavior regression in ethnic communities

Personal knowledge and experience of flood events increases the competence of individuals and community groups. The flood knowledge of ethnic communities living on the banks of the Musi River increases their motivation to have skills and resilience in responding to flood-prone environments with adaptive behaviors. Behavior can be seen from the knowledge of multi-ethnic people such as building houses that are suitable for the flood environment. anticipating environmental cleaning before a flood occurs. moving items that are at risk of being affected by floods to a higher place and cleaning and maintaining the house periodically after a flood occurs. The regression model (Table 4) was developed to explain the knowledge factor of adaptive behavior in responding to flood events. Regression analysis was used to relate aspects of knowledge about flooding in ethnic communities with behaviors carried out before. during. and post-flood behaviors.

The regression results in ethnic Arabs had a positive influence between knowledge and anticipatory behavior before the flood. These findings can illustrate that the Arab ethnic community has a high knowledge of floods and has a positive effect on the aspect of anticipation before floods occur by increasing environmental awareness. This is in accordance with the process of adapting people's behavior to the environment which is carried out due to the causal relationship between humans and the environmental conditions they occupy [55, 73]. Meanwhile. knowledge of the main flood risk factors did not have a significant effect on house types in all ethnic communities. These findings can conclude that the type of residential houses of ethnic communities is not influenced by other knowledge. but rather on the culture of living in Tang that has been carried out for generations. This can also be interpreted as building adaptation only focusing on the process of changing the capacity. function and performance of the type of house [58, 74]. Just like the community carries out strategies in dealing with environmental problems. including by building houses with strong construction [75].

Table 4. Knowledge regression with behavior in responding to floods

Indicator Regression	Malay		Arab		Mixed		Chinese		Javanese	
	Regr	Anova	Regr	Anova	Regr	Anova	Regr	Anova	Regr	Anova
Knowledge with anticipation	0.206	0.3222	0.531	0.0036	0.238	0.2610	0.060	0.7999	0.124	0.5811
Risk Factors with House Type	0.135	0.5186	0.079	0.6882	0.033	0.8783	0.087	0.7142	0.228	0.3073
Impact on maintaining the environment	0.307	0.1346	0.103	0.6010	0.329	0.1163	0.012	0.9592	0.215	0.3355
Flood Areas with attitude during flood	0.092	0.6619	0.380	0.0461	0.154	0.4705	0.210	0.3741	0.071	0.7505
Flood location with fluctuation checking	0.083	0.6927	0.158	0.4205	0.259	0.2216	0.458	0.0422	0.030	0.8936
Flood height with moving	6553	0.0000	0.193	0.3235	0.041	0.8478	0.554	0.0112	0.182	0.4155
House type with post-flood activities	0.014	0.9457	0.084	0.6699	0.303	0.1496	0.022	0.9237	0.113	0.6141
Distance from the river with flood evaluation	0.041	0.8454	0.075	0.7030	0.044	0.8372	0.246	0.2939	0.010	0.9635
Relationship with Institutional Cooperation	0.089	0.6719	0.053	0.7856	0.125	0.559	0.174	0.4629	0.150	0.504

Significance to 5%

There is a very low correlation and no significant influence on knowledge of flood impacts by protecting the environment in all ethnic communities. This finding can be interpreted that the ethnic community has taken good care of the surrounding environment. but the environmental conditions of the settlements on the banks of the river allow the risk of flooding to occur at any time. These findings support research on the role of communities in protecting the environment at risk of flooding [6, 15, 31, 76]. The results of the study show an increase in public awareness to protect the environment against socio-economic risks and losses and environmental impacts due to urban floods.

Meanwhile. knowledge about the extent of floods has a positive effect on attitudes when floods occur. However. this only applies to the results of ethnic Arab regression. this condition may be the reason why ethnic Arab settlements can survive well in flood-prone environmental conditions. This is in accordance with the factors of individual beliefs applying behaviors driven by behavioral beliefs and control over the environment to protect against floods. The main goal is to increase social resilience to the types of social and environmental threats [77]. In the factor of knowledge of the location of the flood by checking the fluctuation of the river discharge height. there is no significant influence between the two. this condition is believed by the ethnic community to have a good understanding of environmental conditions. Meanwhile. knowledge about flood height has a positive effect on the behavior of moving valuables when floods occur and has a very strong correlation level. The positive influence is found on ethnic Malays and ethnic Chinese. this usually happens because of the use of the ground floor of the stilt house which is used to place goods. this is in accordance with research [67].

The knowledge of house type did not have a significant influence on post-flood activities. This condition is usually caused by the frequent intensity of flooding in riverbank areas so that all ethnic groups do not clean the house environment after the flood takes place because the flood event will definitely recur. The regression results show a very weak correlation between house type and post-flood activities in the Malay ethnic group. This is because the type of Malay ethnic housing is a type of house with a stilt construction using the main material of hard wood such as ironwood and rain tree wood which are adaptive to wetland areas. The type of Malay ethnic stilt house does not require much maintenance and changes in shape when a flood occurs in the residential environment. The structure of the stilt house building can withstand water discharge during a flood with a height of 1 m and a speed of 3.5 m per second. As one of the local wisdoms that is often found in flood-prone areas. stilt houses are designed to adapt to local conditions [78]. Likewise. with the knowledge of the distance of the house from the river. there is no significant influence on the evaluation of flood events. The reason that this may happen is that all ethnic communities are more experienced that flooding due to river water fluctuations can occur at any time and last at any time. The youth of kinship culture in living in cooperation with institutions does not have a significant influence and the correlation level is very weak. This can be interpreted that the culture of settlement is not related to the institutional process in dealing with floods.

3.5 Multicollinearity test

The results of the multicollinearity test presented in Table 5 indicate that there is no multicollinearity problem. This can be seen from the VIF values for both independent variables < 10 and tolerance values > 0.100. Based on the test results. it can be concluded that the model does not exhibit multicollinearity symptoms.

Table 5. Multicollinearity test for knowledge and attitude

Multicollinearity Test of Knowledge and Attitude	Collinearity Statistics	
	Tolerance	VIF
Knowledge with Attitude During Floods	0.413725	2.417066
Knowledge through Collaboration with Institutions	0.17499	5.714605
Maintaining the Environment with Attitude During Floods	0.494662	2.021583
Knowledge of Flood Fluctuations with Flood Event Evaluation	0.183631	5.445706
Moving Items with Post-Flood Activities	0.298501	3.350076

Source: Analysis of the Results of the 2024

4. CONCLUSION

The perception of ethnic communities regarding knowledge of flood risk is almost found in several indicators. except for indicators of flood causing factors and the extent of flood points in ethnic community areas. Perception of flood risk affects the behavior of each community to carry out the adaptation process with the aim of being ready to face danger and how the community responds to every flood information and warning. There are significant differences in flood risk behavior from the five ethnic communities. the highest anticipation is in the Malay ethnicity. this is due to the condition of settlements that have a high flood risk. while the lowest anticipatory behavior is in the Arab ethnicity with the possibility of settlement locations and house types that are

adaptive to flooding. From the regression results. it is known that there is a significant influence between flood knowledge and anticipation before the flood occurs only in ethnic Arabs. For the knowledge of flood location and behavior when flooding occurs. there is a significant influence on the Arab ethnicity. And there was a significant influence between the knowledge of the flood height level and the behavior of moving items to a safe place during floods in the Malay and Chinese ethnic groups.

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