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# Psycho-social performance towards understanding local adaptation of coastal flood in Cilincing Community, North Jakarta, Indonesia

G A Yoga Putra<sup>1\*</sup>, R H Koestoer<sup>1</sup>, and I Lestari<sup>2</sup>

<sup>1</sup>School of Environmental Science, Indonesia University, Salemba, Indonesia

<sup>2</sup>Department of Social Welfare, Faculty of Social and Political Science, Indonesia University, Depok, Indonesia

\*e-mail: gdaswin.balinese@gmail.com

**Abstract.** The rising of coastal flood due to the climate change that occurred in Cilincing area, North Jakarta, has forced the community to take some adaptation strategies. However, the current adaptation strategy only emphasizes on the economic and physical, while ignoring the psychology and the social aspects also play a vital role in deciding a proper strategy towards the problem. The purpose of this study was to identify the relationship of each variable that forms psycho-social adaptation to coastal flooding. Quantitative approach was used by using Spearman correlation analysis between 3 variables namely psychological adaptation, sociological adaptation, and anthropological adaptation. The data obtained questionnaires in the Cilincing area using random sampling. Based on the results, it can be inferred that psychological adaptation determines society's sociological and anthropological adaptation. Psychological adaptation has a negative relationship to sociological adaptation with a correlation coefficient ( $R$ ) = -0,298 with significant value 0,00. Indicating the higher the psychological adaptation, the lower the sociological adaptation of society. Sociological adaptation has a positive relationship to anthropological adaptation with correlation coefficient ( $R$ ) = 0,474 with significant value 0,00. Indicating the higher the sociological adaptation, the higher the anthropological adaptation.

## 1. Introduction

Climate change is one of the actual environmental issues that currently become a worldwide problem [1] [2]. Climate change phenomenon is predicted as the perpetrator of sea level rising between 20 and 1000 cm by 2100, due to the ocean warming and faster rate of ice melting in the last 100 years [3]. It was estimated that the average sea level rise was 0.4 to 0.63 cm by the end of the century, affecting almost 70% of the coastlines across the world. Average sea level will be able to increase by more than 95% of the total sea area at a much higher level than in 1971-2010[4]. Rising sea levels, storms, and extreme weather caused by climate change have a significant impact particularly on coastal areas. One of the impacts is an intrusion of seawater into the land, causing a flood disaster. Furthermore, extreme weather and storms are also a potential flood in coastal zones. This condition has both direct and indirect impacts to the cities or settlement that surrounds the coastal area, potentially pose a hazard to the human and the environment that lives within the area [5] [6]. This potential threat aspect must be considered by all countries that have coastal zones, especially archipelago country[7].

As an archipelago country, Indonesia has many coastal regions that have developed into coastal cities that have overgrown in the past 100 years [8]. However, this development has to neglect the environmental aspect, causing an area that vulnerable to the disaster that caused by climate change[7]. according to BNPB, 95% of disaster events in Indonesia are closely related to the climate. While the rest are geological disasters and human consequences. Floods occupy the highest position in Indonesia at 34% of all disasters that occurred during 2001-2011. Most of the disasters occurred in Indonesia's coastal cities[9]. DKI Jakarta as an example, is very vulnerable to climate change events, especially sea level rise. In each year the North Jakarta area is damaged due to coastal flooding. There are three

<sup>1</sup> gdaswin.balinese@gmail.com



causes of coastal flooding in Jakarta, i.e., moon gravitation, land subsidence due to skyscraper and overexploitation of groundwater, and sea level rising [10]. Cilincing is one of four districts in North Jakarta that are included in the flood-prone areas. In general, Cilincing District said to be the most vulnerable area with a high level of flood disaster risk based on the data stated that only one of the seven sub-district in Cilincing that is not included in the category of flood-prone areas [11]. The area experiences a 0.5-meter sea level rise and land subsidence due to excessive groundwater extraction; if this condition continues, it will cause the area to be submerged permanently [9].

Previous researcher, conducted flood adaptation study on the community's strategy in adapting to physical and non-physical adaptations such as raising houses levels, building small dikes, and moving household appliances, all of them are three main adaptation forms taken by the community [12]. In addition another researcher has also examined more specifically the adaptation of coastal flood communities with a social approach in which communities have local knowledge that comes from people's experience in facing repeated floods so that they can adapt to the threat of flooding and adaptive actions [13]. Both studies only look at the physical and social side, while many factors influence the community in adapting. In this research, community adaptation will focus on psychosocial factors, given the psychosocial conditions of the community that greatly influence the adaptive actions of the community in the face of disasters. There are three adaptations that are influenced by community psychosocial factors, namely psychological adaptation, sociological adaptation, and anthropological adaptation.

Coastal floods will cause negative impacts and losses if the Cilincing communities who experience the disaster are in a vulnerable condition. According to BPBD data, infrastructure damage and the emergence of health problems are the biggest impacts caused by floods in seven sub-districts of Cilincing district. The emerging vulnerabilities also potentially change to environmental systems in coastal areas [14] [15]. However, this changes could be minimized with the efforts of the community to be accustomed towards the situation [3]. Such customization could be in the form of psycho-social adaptation and physical adaptation. Some of the self-adjustment done by the communities need to be considered as stages in disaster risk reduction and the sustainability of local communities. So far, physical adaptation that expressed by the community is only a short-term option in handling the impacts of coastal flooding [16] [17] [18] [19]. Therefore, psycho-social aspects in community adaptation in order to build a more resilient society towards the disaster is highly encourage [20]. This study explores the variables of psycho-social adaptation of the Cilincing community in facing the coastal flood disaster. In this study, the behavior of the people living in the coastal district was identified to see the relationship of each variable that works on community adaptation to coastal flooding due to local climate change. Based on psychological, social and environmental perspectives on community behavior, three types of Cilincing community adaptations in dealing with coastal flood disasters, i.e., psychological adaptation, sociological adaptation, and anthropological adaptation.

In psychological adaptation process, there are cognitive, affective, and behavioral responses to climate change. The community is encouraged to be more attentive to the arising problems, accept reality and impacts, adopt a problem-solving attitude, move towards a more pro-environment behavior, and act on psychological adjustments to the environment. [20]. Sociological adaptation includes the community ability to adapt both individually and collectively with the surrounding community. The relationship between 'individual' and 'collective' ideas is the key to reduce disaster risk by increasing resilience based on community collaboration and social links. Collective forces can also maintain and revitalize the culture that exists in society through growing social networks and values, as well as locally formulated resources. Thus, individuals will increase despite being under pressure [21]. The anthropological adaptation process involves humans in interpreting, facilitating, translating, communicating, advocating, and acting in response to the cultural implications from the unprecedented changes. Culture frames the way humans perceive, understand, experience, and respond to key elements of the environment they live. Anthropological focus on climate change and in developing culture, which arising the dynamics of unprecedented contemporary climate change. Some anthropologists also reveal human and cultural important roles in understanding climate change. This is seen based on conducted studies on the important role of society and culture in understanding land use and the changes within, while also predicting sea and climate change [22].

## 2. Method

This research was carried out using a quantitative approach with the aim of obtaining data in the form of values from each measured psycho-social variable. This approach was used because it is considered as an adequate measurement to the psycho-social variables of community adaptation towards coastal flooding. The number of samples determined at 213 by using random sampling by taking one respondent from each family card (KK) who live in the flood-prone areas. Criteria for respondents are one family head who has been at least 25 years old and has lived in a research location for more than 10 - 20 years. Determination of this sample is based on the assumption that the head of the family has a large influence on the behavior of family members, so it is considered capable of responding to the ability of adaptation.

For this study, questionnaires were sent to 250 households in several settlements affected by coastal flooding in the District of Cilincing. The questionnaire was designed to be completed without researchers. In total, 213 completed surveys were received, which represented a response rate of 85.2%. The questionnaire was developed concerning methodological guidance on survey design and formulation of questions. A combination of multiple scale choice questions and five Likert points was included in the survey. Besides, about the cost of losses, respondents were asked to enter the appropriate figures to indicate the amount of money spent on dealing with coastal flooding.

We recognize that behavior and habits concerning psycho-social adaptation differ from each other, and variables measured through questionnaires are mapped to represent psychological, sociological and anthropological aspects. In general, aspects of psycho-social adaptation can be described as habits carried out by residents in disaster risk reduction efforts. Individual habits refer to psychological tendencies expressed by evaluating certain entities with several levels of experience dealing with disasters. In general, the habits involving repetitive actions towards achieving satisfactory results. Habitual behavior is mediated by mental processes that involve the recognition of certain situations that lead to the formation and enforcement of customary actions in the disaster adaptation effort [20] [19].

After understanding each variable's characteristics, further analysis is performed with non-parametric statistical tests to determine the correlation between variables using SPSS (Statistical Package for the Social Sciences) version 22 for Windows. Data analysis of each community psycho-social adaptation variable on coastal flood disaster will be carried out using Spearman correlation technique ( $R_s$ ). Spearman correlation analysis ( $R_s$ ) serves to determine the magnitude of the relationship of three ordinal-scale variables. Interpretation of the relationship on Spearman correlation analysis can be seen in table 1.

**Table 1.**Correlation Value and Relationship Level

No	Correlation Value	Relationship Level
1	0,00-0,199	Very Weak
2	0,20-0,399	Weak
3	0,40-0,599	Medium
4	0,60-0,799	Strong
5	0,80-1,00	Very Strong

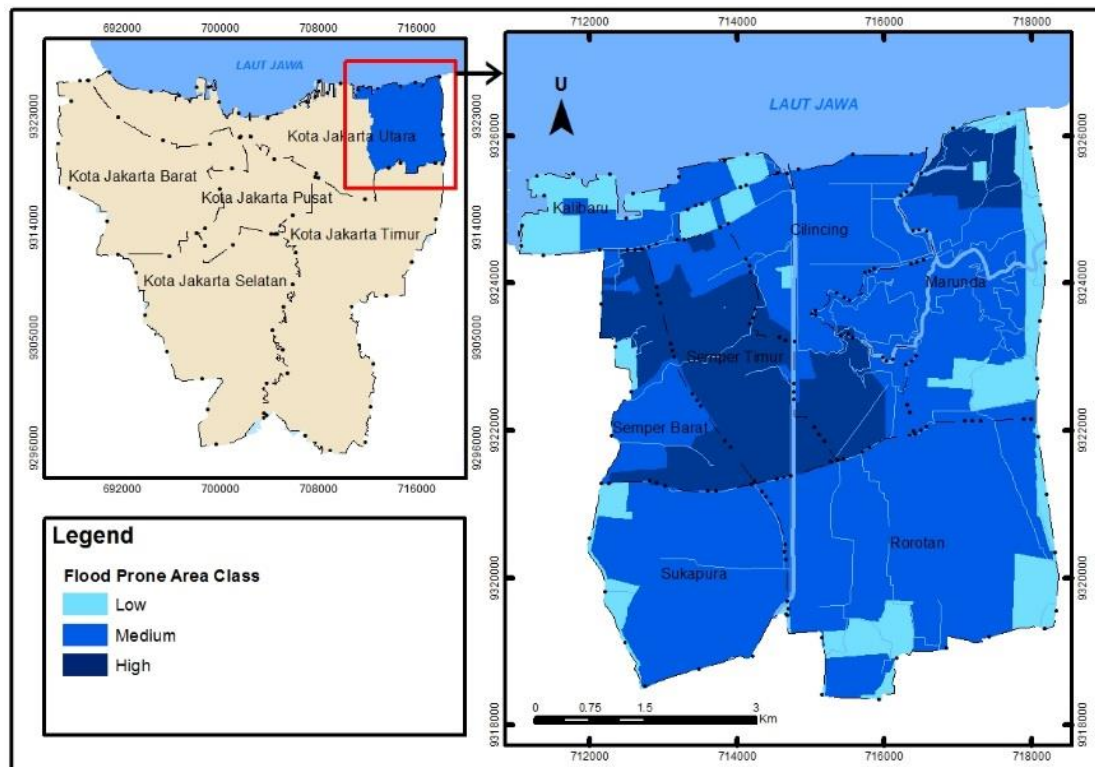
Source: Siregar (2014)

## 3. Results and Discussion

### 3.1 Cilincing District

Cilincing is one of six districts within the administrative area of North Jakarta City. Based on Governor Decree Number 171 of 2007, Cilincing has an area of 41.36 km<sup>2</sup>. The District of Cilincing is divided into seven villages, namely, Sukapura District 5.74 km<sup>2</sup>, Marunda Village 7.87 km<sup>2</sup>, Rorotan Village 10.69 km<sup>2</sup>, Cilincing Village 6.90 km<sup>2</sup>, Semper Timur Village 4.39 km<sup>2</sup>, Semper Barat 3 Village, 35 km<sup>2</sup>, Kalibaru Village 2.45 km<sup>2</sup>.Based on data from the Central Statistics Agency of

Cilincing District in 2017, demographic conditions in the Marunda region are 203,125 male population and 197,771 female population, with a population density of 9,693.69 people/km<sup>2</sup>.



**Figure 1.** Distribution of flood prone in Cilincing sub-district 2017.

Based on the results of the Jakarta BPBD data analysis, flood-prone areas are presented in Table 2. Flood-prone areas are scattered throughout Cilincing District with different levels of vulnerability according to the number of flood events. The flood-prone area is divided into three classes, namely low, medium, and high. Coastal flood distribution for low class covers an area of 5.35 km<sup>2</sup> with a percentage of 12.94%, medium class covering an area of 27.79 km<sup>2</sup> with a percentage of 67.19%, and a high-class area of 8.22 km<sup>2</sup> with a percentage of 19.87%. Semper Timur village is the widest area with high flood vulnerability. Maps of flood-prone areas can be seen in Figure 1.

**Table 2.** Flood Prone Class in Cilincing District 2017

No	Sub-District	Flood Prone Area (km <sup>2</sup> )		
		Low	Medium	High
1	Kalibaru	1,23	1,21	0,01
2	Marunda	1,62	5,04	1,22
3	Cilincing	0,39	4,93	1,57
4	Semper Timur	0	0,78	3,61
5	Semper Barat	0,15	1,41	1,80
6	Rorotan	1,48	9,17	0,01
7	Sukapura	0,48	5,25	0,01

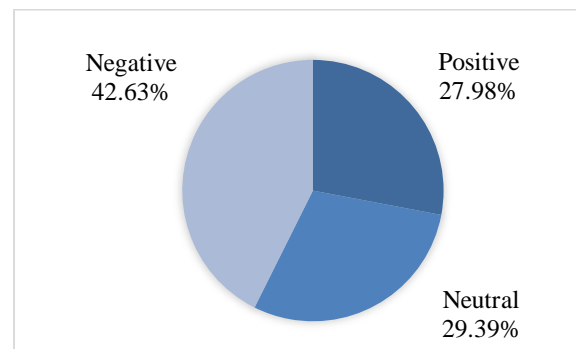
Source: BPBD DKI Jakarta

The number of questionnaires distributed in this study is 250 sheets. A total of 220 questionnaires returned and 30 questionnaires did not return. A small portion of the 220 returned questionnaires, namely 7 sheets of questionnaires, cannot be processed further. The total number of sample

questionnaires that were successfully collected and further processed in this research were 213 questionnaires. Based on gender, respondents from this study amounted to 67% of respondents in the male gender group and 33% of the female sex group. Based on the level of education, respondents from this study can be divided into five groups. The most groups based on education level have a junior high school / equivalent education level of 32%. Based on length of stay, respondents from this study can be divided into three groups. The most groups are represented by respondents who have lived more than 20 years by 59%. Based on age, respondents from this research can be grouped into 4 groups. The age group most represented by respondents is aged 50-60 years, by 34%. The least age group is over 61 years of age.

### 3.2 Psychological Adaptation

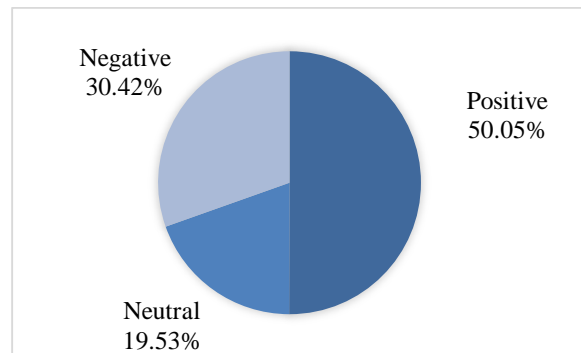
Psychological adaptation in this study refers to the ability of each community to control psychological stress when a coastal flood disaster occurs. Behavioral adaptation towards coastal flooding distinguished based on the process of occurrence, i.e. knowing the signs before the flood occurred, when the flood occurred, and the impact when the flood was completed. The three adaptation processes had risen some psychological aspects of society in the form of comfort, fear, panic, and anxiety. Before the coastal flooding including comfort and anxiety for the community to settle and have a place to live in a flood-prone location. When coastal flooding occurs including the arising fear and panic in facing the flood. Post-coastal flooding includes community anxiety in the face of adverse impacts. The findings of this study indicate that there is still a low psychological adaptation to the phenomenon of coastal flooding in the Cilincing community. Lack of preparation for changes in attitudes and behaviors needed to survive the danger of flooding is the cause of the low psychological adaptation of society. The measurement results show that only 27.98% of community respondents have a positive psychological adaptation.



**Figure 2.** Measurement Results of Psychological Adaptation

### 3.3 Sociological Adaptation

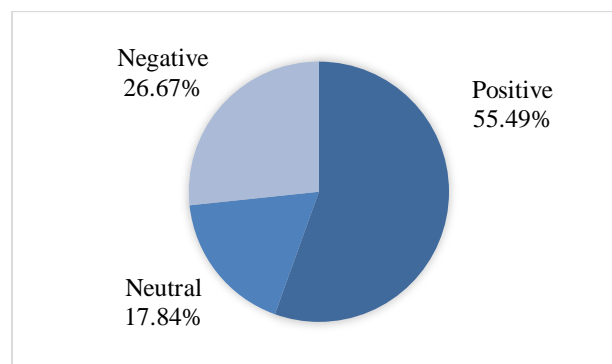
Sociological adaptation in this study refers to the response and behavior of the community in building relationships between individuals and groups when coastal flooding occurs. The question of sociological adaptation states about how the response and behavior in building relationships in the community in the face of flooding consisting of five points. Prior to coastal flooding including the community relations with RT and RW administrators. When a coastal flood occurs, it includes the ability to provide direction and cooperate with families in emergency situations during floods, and also participate in disaster relief. Post-coastal flooding includes the desire to help between neighbors who have more losses. The findings of this study indicate that the high sociological adaptation towards coastal flooding phenomenon in the Cilincing community. Community efforts in building relationships between individuals and groups are a good adaptation process, so that the community has a high sociological adaptation. The measurement results show that only 30.42% of the community respondents have a sociological adaptation in the negative direction.



**Figure 3.** Measurement Results of Sociological Adaptation

### 3.4 Anthropological Adaptation

Anthropological adaptation in this study refers to the response and behavior of the community to the local culture in the event of a coastal flood disaster. The better process of community anthropological adaptation is a form of conformity of responses and behavior with local culture. Most of the answers are directed to do something that is appropriate to the local culture, so at that time it can also be seen that the community has good adapting behavior. The question of anthropological adaptation states about the community response and behavior in the face of flooding consisting of five points. Before coastal flooding, participation in environmental protection and preparation for disaster emergency activities took place. When a coastal flood occurs, it includes the ability to continue working and participation in sharing disaster information. Post-coastal flooding includes involvement in mutual cooperation activities. The findings of this study indicate that there is a high level of anthropological adaptation towards the coastal flooding phenomenon in the Cilincing. Community efforts to participate in maintaining local culture is a good adaptation process, so that the community has a high anthropological adaptation. The measurement results show that only 26.67% of community respondents have anthropological adaptations in the negative direction.



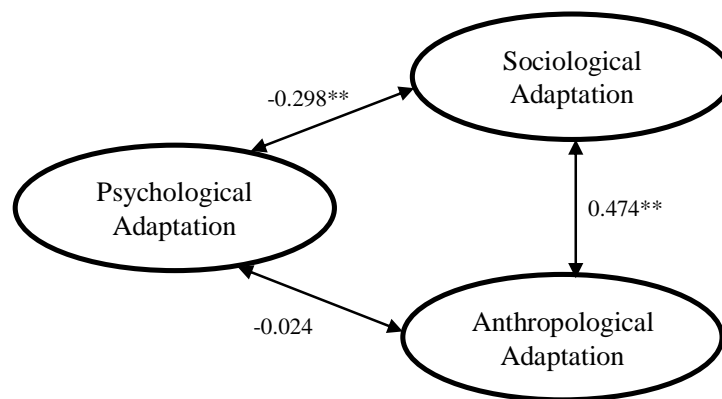
**Figure 4.** Measurement Results of Anthropological Adaptation

### 3.5 Correlations Psycho-social Variables

Psychological adaptation has an opposite and significant relationship to sociological adaptation which has a correlation coefficient (R) that is -0.298 with a significant value of 0.00. It implies that there is an opposite relationship between psychological adaptation and sociological adaptation of society in the face of coastal flooding. This means that the higher the psychological adaptation Cilincing community has, the lower community's sociological adaptation in the face of coastal flooding. Psychological Adaptation has no significant relationship to anthropological adaptation because significant values are greater than  $\alpha$  values. This can be implied that both psychological adaptation and sociological adaptation are running individually. Sociological adaptation has a direct and significant relationship to anthropological adaptation, which has a correlation coefficient (R) equals to 0.474 with a significant



value of 0.00. This means that the higher sociological adaptation Cilincing community has, the higher community's anthropological adaptation will be in the face of coastal flooding.



**Figure 5.** Correlation between the psycho-social adaptation variables.

\*\* Correlation is significant at the 0.01 level (2-tailed).

Identified links between all psycho-social variables will help to understand the mechanism of local community adaptation towards the climate change and coastal flood[17]. The importance of non-physical aspects from climate change and coastal flood disasters that focus on adaptation efforts will create resilience within the community itself[20]. Psychological, sociological and anthropological factors that develop in the adaptation process needs to be the considered factors in disaster studies, especially climate change. Thus, psycho-social adaptation can be used as the focus of how social boundaries are applied in the efforts of local community adaptation to achieve the community's sustainability in coastal flooding prone areas [21].

#### 4. Conclusion

The concept of adaptation is a comprehensive part of the biological and social disciplines. In this study, we argue that psycho-social adaptation must be broadly conceptualized to build local adaptations of the Cilincing community in the face of climate change impacts, namely coastal flooding. There are two correlations between the psycho-social adaptation variables formed in the cilincing community. First, psychological adaptation with sociological adaptation with a weak and opposite level of relationship. Second, sociological adaptation with anthropological adaptation with a medium and direct relationship. This supports social psychological changes and changes in people's behavior, especially changing the way someone faces a problem. This is a good and durable way to deal with environmental changes due to coastal flooding. Furthermore, to analyze changes in the internal community, namely, changes in cognitive, affective, motivational, and self-regulation processes that enable the community to understand, adjust and continue to move together in various changes in the external environment.

The results of this study can be used as input for the preparation of contingency plans and disaster risk reduction action plans, taking into account aspects of the capacity and adaptation of the community. We analyze the psycho-social aspects of community adaptation, while in the resilience of a region the role of government is also needed. In the future, research on government adaptation efforts can be done to develop this research.

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