The Resilience of The Coastal Communities of Semarang City in The Face of Floods and Tides Due to The Effects of Climate Change

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Abstract. The percentage of poor people in Semarang City was 21.52%. Spatially, the poor are many in the coastal areas of Semarang City. Climate change has caused a sea-level rise in the Coastal Area of Semarang City. There are three types of study approaches that underlie research, including qualitative approaches, quantitative approaches and triangulation approaches (mixed methods). The quantitative approach method is a measurable study approach and supports qualitative research. Respondent took from the selected households (poor household). The total number of respondents was 60 people in Bandarharjo and Tanjungmas Village. Based on the results of the analysis, it can be said that strategies undertaken by the community prior to the onset of the flood disaster by making flood barriers at the front door of the house and raising the building (the Coping Capacity aspect) combined with good social relations in the community and poverty alleviation program by the Semarang City government (the Adaptive Capacity aspect) and food and medicine aid to the community during the flood disaster which are carried out effectively and efficiently (the Response Capacity aspect); it can increase the economic and physical resilience of the community due to the effects of climate change (rob and flood).

1. Introduction

Based on data from the Semarang City Bappeda in 2015, the percentage of poor people in Semarang City was 21.52%. Spatially, the poor are mainly economically prone (many people whose income is unable to meet basic needs) are many in the coastal areas of Semarang City such as in North Semarang District, Tugu District and West Semarang District.

Silva [9] states that in the context of climate change, the direct impact of climate change is shocking such as storms, typhoons and heat waves, and pressures, sea-level rise, general temperature increases and changes in rainfall patterns. This impact is felt by some vulnerable communities, especially the poor, because of their limitations and low ability to respond because their asset base is also low. Westaby et al. in Akter and Mallick [1] states that households with high socio-economic resilience/resilience are better able to cope with the impact of disaster/climate change and conversely households with low socio-economic resilience are less able to cope with the impact of disaster/climate change.
Forgette and Boening [3] measure resilience by assessing household capacity in terms of recognition, resistance, redundancy and rapidity (4R). Recognition is the extent to which households recognize the risk of natural disasters. Resistance is the power of the system to withstand damage. Redundancy is the extent to which structural, environmental and socio-economic conditions are able to replace essential goods and services (e.g. food, water, medical supplies, credit). Rapidity is the amount of time needed for individuals/groups in society to access internal and external support (e.g. time to access assistance). The State and Transition Model Framework is a model developed by Westoby who sees the relationship between poverty with sensitivity, exposure, response capacity, adaptive capacity and resistance. First, higher exposure and sensitivity combined with a lack of adaptive capacity will cause more considerable damage. Second, households with high socio-economic resilience are better able to cope with the impact of the disaster. Finally, the inability to overcome the effects of the damage and lack of capacity to respond and adapt will cause a person to become poor [1].

Cutter et al. [2] and Gallopi’in [4] state that research on socio-economic resilience in relation to poverty is still relatively limited. This study will examine how the community resilience of the poor in the coastal areas of Semarang City is a result of the effects of climate change. The main question to be answered is "How is community resilience of the poor in the coastal areas of Semarang City due to climate change? Moreover, how aspects of coping, adaptive and response capacity of them affect community resilience?"

2. Community resilience and coping capacity from climate change

Join et al. [6] developed a community resilience framework starting from before the disaster, during the disaster and after the disaster into three scenarios; namely scenarios A, B and C.

![Community disaster resilience framework](image)

**Figure 1.** Community disaster resilience framework

Scenario A: the community's coping capacity is not sufficient to absorb a hazard. As a result, the community suffers from damages and losses, and its condition becomes weak—which is the evidence that the hazard could not be absorbed by the community and the consequence is a disaster. During the recovery phase, a community can get back to its pre-disaster condition (middle way), but also either not fully recover (bottom line) or learn and adapt (ideal) from the disaster (upper line), and enhance its resilience (capacity). Scenario B: the community's coping capacity is not sufficient to absorb a hazard. As a result, the community suffers from damages and losses (disaster), and its condition becomes weaker than before the hazard occurred. Unlike scenario A, the community cannot exercise recovery action and thus, remains vulnerable to future natural hazards. Scenario C: ideal scenario: the
community's coping capacity is sufficient enough to absorb a natural hazard (rainfall, storm, earthquake) and therefore, no damages or losses are recorded. Although the community may not have been affected by disaster impacts, it may still exercise a certain amount of adaptation (adaptive capacity) to strengthen its coping capacity for potentially more severe hazards expected to occur in the future; otherwise, the capacity remains the same as before the natural hazard took place.

Meanwhile, Jabeen [5] states that the term “coping capacity” is concerned with the means by which people or organizations use available resources and abilities to face adverse consequences that could lead to a disaster. Wisner et al. in Jabeen [5] state that there are a number of coping strategies undertaken by the community in dealing with the effects of climate change, such as floods and tidal. Description of coping strategies can be explained below: First, modifications to the physical and built environment: this may include modifications within the house or to the house structure so that it is not impacted. Also improvements outside the house or at the neighbourhood scale, such as retaining walls, drainage facilities or sandbags. Second, building up stores of food and saleable assets: storing food may be more common in rural areas, but urbanites living in cash-based economies may use similar strategies such as keeping items of value that can be sold if necessary. Third, diversifying income sources: in cities, this may mean illegal or quasi-legal work, such as street-hawking and waste-recycling. Having more than one, or sometimes several, income earners in the family also allows for diversification. This sometimes means taking children out of school to help generate extra income. If families have contributed to savings groups, this can offer a form of income during hard times. Fourth, the development of social support networks: this is the ability to call on the resources of others during difficult times. Networks can be within the household, between extended family members (living near or far), within neighbourhoods, and with more full groups that have a shared identity (religious, geographical, commercial).

3. Materials and methods

3.1. Case studies from two villages (tanjungmas and bandarharjo village)

Tanjung Mas Village is included in the administrative area of North Semarang District Semarang city. Tanjung Mas Village has an area of 323,782 Ha. Internally, the Tanjung Mas Village is seen through the interrelationships of the activities in it. Its location, which is part of the coastal city of Semarang, has caused many community activities related to coastal activities such as marine product management. Many people in Tanjung Mas Village work as small industrial entrepreneurs such as processing fish into fish meatballs. This activity is a little different if seen in every RW in Tanjung Mas Village. There are also people in Tanjung Mas Village working as hawkers both in the Tanjung Mas Village and outside the Tanjung Mas Village who peddle the processed products.

Bandarharjo Village is one of the villages in North Semarang Subdistrict which is directly adjacent to the Java Sea. Geographically, Bandarharjo Village is located in 110°3′10″ to 110°23′54″ BT and 6°55′57″ South Latitude. This village has an area of 370.65 Ha which is divided into 12 rows and 103 RTs. Bandarharjo Village is a village located in North Semarang District. In the Detail Plan of the Semarang City Spatial Planning, the kelurahan included in Semarang's BWK III according to the rules functioned as residential areas, warehousing areas, and industrial areas. Supported by a high level of accessibility, the strategic location close to the centre of activities, the city centre, and the central government makes this area has a role with quite high activity. The location of Bandarharjo Village, which is close to the two main transportation facilities in Semarang City, namely Tanjung Mas port and Tawang Station, makes this area develop as an urban area with high industrial activity, warehousing and trade. As a coastal area and a strategic area, Bandarharjo Village has extensive relations both inside and outside the Bandarharjo Village and even to the outside of Semarang City.
Figure 2. Map of Tanjung Mas Village, City of Semarang

Figure 3. Map of Bandarharjo Village, City of Semarang
3.2. Methods

Basically, there are three types of study approaches that underlie research, including qualitative approaches, quantitative approaches and triangulation approaches (mixed methods). The quantitative approach method is a measurable study approach and supports qualitative research. The qualitative approach method uses quantitative thinking patterns (pursuing measurable, observable, using mathematical logic, and generalizing on average); accommodate verbal descriptions replacing numbers, or combine processed statistics with verbal processing with quantitative fixed thinking patterns [7].

The study approach that will be used in this research is the mixed methods approach. The primary considerations used are because this method has the advantage of reducing the bias that might arise in a research method. Data sources will be neutralized if it uses a combination or combination of methods or a combination of investigators and other data sources. In addition, with the use of this method, research can be done in more detail but comprehensively because it uses a combination of several types of data. This method is developmental; namely, the first method used aims to help information obtained in the second method so that it can strengthen the arguments to be explained and finally be able to optimize the validity and reliability of research [8].

The sampling technique used is purposive sampling. Sampling is done by taking selected people according to the specific nature of the sample. This means that purposive sampling will not be carried out from a population that we do not know about its properties, or which must still be known first. The researcher also tried to make the selected sample represent representatives from all levels of the population and could fulfill the information needed by the researcher. In this case, the sample will be taken from the sparse population in the coastal area of Semarang City (covering North Semarang District, Tugu District and West Semarang District). Respondent took from the selected households (poor household).

The total number of respondents was 60 people. Each village was taken by 30 respondents, either Tanjungmas or Bandarharjo.

4. Results

4.1 Respondent characteristics

Based on the survey results, the age of respondents is mostly productive age (25-64 years) both in the village of Bandarharjo (63.3%) and in Tanjungmas (66.7%). The number of family members ranges from 4-5 people per household. Based on the aspect of population status, the majority are indigenous people both in the village of Bandarharjo (73.3%) and Tanjungmas (63.3%). The majority population is Muslim (100% and 90%). For the livelihoods of the population, the most massive percentage work in the informal sector (Bandarhajo 36.7% and Tanjungmas 50%). Meanwhile, for the level of education, most of the population only graduated from elementary school (Bandarharjo 50% and Tanjungmas 56.7%). A complete description of the characteristics of respondents can be seen in the following table.

| Table 1. Respondent characteristics |
|-------------------------------------|
| **Key characteristics** | **Bandarharjo Village** (N = 30) | **Tanjungmas Village** (N = 30) |
| Sex                      | Male 46.7% | 40.0% |
|                          | Female 53.3% | 60.0% |
| Age                      |             |      |
### Key characteristics

|                         | Bandarharjo Village (N = 30) | Tanjungmas Village (N = 30) |
|-------------------------|------------------------------|------------------------------|
| Household size          |                              |                              |
| Average (not in %)      | 4.6                          | 4.7                          |
| Population status       |                              |                              |
| Native inhabitants      | 73.3%                        | 63.3%                        |
| Comer                   | 26.7%                        | 36.7%                        |
| Religion                |                              |                              |
| Moeyslem                | 90.0%                        | 100.0%                       |
| Christian               | 10.0%                        | 0.0%                         |
| Occupation              |                              |                              |
| Fisherman               | 3.3%                         | 26.7%                        |
| Industrial worker       | 10.0%                        | 10.0%                        |
| Entrepreneur            | 26.7%                        | 3.3%                         |
| Trader                  | 23.3%                        | 10.0%                        |
| Informal sector         | 36.7%                        | 50.0%                        |
| Education               |                              |                              |
| No school               | 10.0%                        | 13.3%                        |
| Elementary school       | 50.0%                        | 56.7%                        |
| Primary school          | 16.7%                        | 16.7%                        |
| Secondary school        | 23.3%                        | 13.3%                        |
| Diploma/Bachelor        | 0.0%                         | 0.0%                         |

#### 4.2 Flood exposure

Most of the population experienced flood events since 1995 until now with flood intensity as much as 1-7 times a month. In fact, there are residents who experience flooding events for a full month, namely in Bandarharjo as much as 20% and in Tanjungmas as much as 23%. For the height of the flood, inundation reached more than 30 cm both in Bandarharjo and Tanjungmas with. While for the duration of the flood inundation most of less than 6 hours; however, there are areas in Bandarharjo that have been flooded for more than 12 hours.

| Exposure          | Key characteristics | Bandarharjo Village (N = 30) | Tanjungmas Village (N = 30) |
|-------------------|---------------------|------------------------------|------------------------------|
| The year 1995 -   | Yes                 | 97%                          | 97%                          |
| 2005               | No                  | 3%                           | 3%                           |
| The year 2005 -    | Yes                 | 100%                         | 97%                          |
| 2015               | No                  | 0%                           | 3%                           |
| Exposure                  | Key characteristics | Bandarharjo Village (\(N = 30\)) | Tanjungmas Village (\(N = 30\)) |
|--------------------------|---------------------|----------------------------------|----------------------------------|
|                          | Places affected by flooding | Yes                              | 100%                             | 97%                              |
|                          |                     | No                                | 0%                               | 3%                               |
| The intensity of being flooded |                     | The year 1995 - 2005              | 1 - 7 times per month            | 73%                             | 80%                              |
|                          |                     |                                   | 7 - 14 times per month           | 10%                             | 3%                               |
|                          |                     |                                   | 14 - 21 times per month          | 0%                               | 0%                               |
|                          |                     | Full month                        | 17%                             | 17%                              |
|                          |                     | The year 2005 - 2015              | 1 - 7 times per month            | 63%                             | 77%                              |
|                          |                     |                                   | 7 - 14 times per month           | 13%                             | 3%                               |
|                          |                     |                                   | 14 - 21 times per month          | 0%                               | 3%                               |
|                          |                     | Full month                        | 23%                             | 17%                              |
|                          |                     | The year 2015 - now               | 1 - 7 times per month            | 73%                             | 77%                              |
|                          |                     |                                   | 7 - 14 times per month           | 3%                               | 3%                               |
|                          |                     |                                   | 14 - 21 times per month          | 0%                               | 0%                               |
|                          |                     | Full month                        | 23%                             | 20%                              |
| The height of the floodwaters |                     | Year 1995 - 2005                 | < 10 cm                          | 7%                               | 23%                              |
|                          |                     |                                   | 10 - 20 cm                       | 17%                             | 20%                              |
|                          |                     |                                   | 20 - 30 cm                       | 13%                             | 0%                               |
|                          |                     |                                   | > 30 cm                          | 63%                             | 57%                              |
|                          |                     | Year 2005 - 2015                 | < 10 cm                          | 3%                               | 23%                              |
|                          |                     |                                   | 10 - 20 cm                       | 13%                             | 20%                              |
|                          |                     |                                   | 20 - 30 cm                       | 13%                             | 0%                               |
|                          |                     |                                   | > 30 cm                          | 70%                             | 57%                              |
|                          |                     | Year 2015 - now                  | < 10 cm                          | 3%                               | 27%                              |
|                          |                     |                                   | 10 - 20 cm                       | 17%                             | 27%                              |
|                          |                     |                                   | 20 - 30 cm                       | 13%                             | 0%                               |
|                          |                     |                                   | > 30 cm                          | 67%                             | 47%                              |
| Long-standing water      |                     | Year 1995 - 2005                 | < 6 hours                        | 63%                             | 90,0%                            |
|                          |                     |                                   | 6 - 12 hours                     | 0%                               | 10,0%                            |
|                          |                     |                                   | > 12 hours                       | 37%                             | 0,0%                             |
|                          |                     | Year 2005 - 2015                 | < 6 hours                        | 53%                             | 90,0%                            |
|                          |                     |                                   | 6 - 12 hours                     | 7%                               | 10,0%                            |
|                          |                     |                                   | > 12 hours                       | 40%                             | 0,0%                             |
|                          |                     | Year 2015 - now                  | < 6 hours                        | 57%                             | 90,0%                            |
|                          |                     |                                   | 6 - 12 hours                     | 3%                               | 10,0%                            |
|                          |                     |                                   | > 12 hours                       | 40%                             | 0,0%                             |
4.3 Coping strategies/capacity of community

Coping strategies carried out by the community before the flood disaster occurred by changing physical and building aspects. As for the activities carried out, among others, by raising the house so that it is not affected by floods and tides and raising the road in residential areas. In addition to preventing flooding and tidal water from entering the house, the community-made a cover in front of the front door of the house so that water could not enter the house. For more details, a description of the coping strategies undertaken in Tanjungmas and Bandarharjo society can be seen in the following figure.

![Figure 4. Examples of coping strategies, i.e. floodwater barrier cover in front of the door and elevation of the house building](image)

4.4 Response capacity

Response capacity at the time of the flood and afterwards carried out by providing food assistance, medicines and home rehabilitation for communities affected by the flood disaster. From the survey shows that all respondents in Bandarharjo (100%) received food assistance and medicines at the time of the flood. Most of the assistance was given in a fast timeframe, which is within one day of the disaster occurring in the region.

| Parameter | Key characteristics | Bandarharjo Village (N = 30) | Tanjungmas Village (N = 30) |
|-----------|---------------------|-----------------------------|-----------------------------|
| Response Capacity | Receive assistance during floods | Yes | 100% | 43% |
| | | No | 0% | 57% |
| | Period of time receiving assistance during floods | One day | 87% | 23% |
| | | > 1 day | 13% | 77% |
| | Receive house rehabilitation program after floods | Yes | 10% | 3% |
| | | No | 90% | 97% |
4.5 Adaptive capacity

Adaptive capacity is the action of a group or individual/household or government to take actions that can help avoid loss and accelerate recovery from the effects of disasters. Based on the survey results, it can be obtained a description that there are high social relations in the community. This is indicated by the majority of respondents' answers (Bandarharjo 93% and Tanjungmas 97%), which state that they have good social relations in the community. Meanwhile, the Semarang City government's poverty alleviation program in the form of rice and health assistance was also able to reduce the impact of the flood disaster in the region. More than half of the respondents stated that they received a reduced rice program (RASKIN) and inadequate health insurance (JAMKESKIN). Can be seen in the following table.

| Parameter                | Key characteristics          | Bandarharjo Village (N = 30) | Tanjungmas Village (N = 30) |
|--------------------------|------------------------------|------------------------------|------------------------------|
| Social capital           | Good social relationship     | Yes 93%                      | 97%                          |
|                          |                              | No 7%                        | 3%                           |
| Receive government's     | Rice aid (RASKIN)            | Yes 53%                      | 40%                          |
| poverty program          |                              | No 47%                       | 60%                          |
| Health insurance         | Health insurance             | Yes 53%                      | 40%                          |
|                          | (JAMKESKIN)                  |                              |                              |
|                          |                              | No 47%                       | 60%                          |

4.6 Physical resilience

Resilience, when viewed from the outcome approach, shows how individuals or groups experience change after a disaster occurs. Changes that occur can be worse, the same or better than the conditions before the disaster. Seen from the physical resilience outcome, the majority of respondents have high physical endurance. This is shown from the results of a survey of respondents where 100% of respondents in Tanjungmas and Bandarharjo can access clean water and electricity after a disaster. However, physical resilience in the sanitation aspect did not show good results because some respondents stated that sanitation suffered damage after the flood.

| Parameter    | Key characteristics                      | Bandarharjo Village (N = 30) | Tanjungmas Village (N = 30) |
|--------------|------------------------------------------|------------------------------|------------------------------|
| Electricity  | HH supplied with electricity?            | Yes 100%                     | 100%                         |
|              | Can still access electricity after flooding? | Yes 100%                     | 100%                         |
| Clean water  | HH supplied with clean water?            | Yes 100%                     | 100%                         |
|              | Can still access clean water after flooding? | Yes 97%                      | 100%                         |
|              |                                          | No 3%                        | 0,0%                         |
| Sanitation   | Is sanitation worse after flooding?      | Yes 46,7%                    | 83,3%                        |
|              |                                          | No 53,3%                     | 16,7%                        |
4.7 Economic resilience

Meanwhile, if resilience is seen from the outcome approach for aspects of economic resilience, most respondents have an adequate level of economic resilience. This is evidenced by the majority of respondents who stated that they did not experience a decrease in income due to flooding (Bandarharjo 70% and Tanjungmas 53%). Likewise, for other economic resilience parameters in the form of unemployment, the majority of respondents who stated they were not unemployed due to flooding in the region (Bandarharjo 83% and Tanjungmas 96%).

### Table 6. Economic resilience

| Parameter     | Key characteristics | Bandarharjo Village (N = 30) | Tanjungmas Village (N = 30) |
|---------------|---------------------|-----------------------------|-----------------------------|
| Income        | Revenues fell due to floods | Yes 30% | 47% |
|               | No                  | 70%      | 53%       |
| Employment    | Unemployed due to floods | Yes 17% | 3,3% |
|               | No                  | 83%      | 96,7%     |

4.8 Crosstab analysis: relation between adaptive capacity and economic Resilience

The SPSS crosstab test results between adaptive capacity and economic resilience show significant results. This is indicated by the Asymp. value. Sig. (2-sided) with a value of 0.025 <0.05. This means that there is a statistically proven strong relationship between adaptive capacity and economic resilience. For complete results can be seen in the SPSS test output table below.

### Table 7. Crosstab table between adaptive capacity and economic resilience

| ECONOMIC RESILIENCE (Revenue) | No | Yes |
|-------------------------------|----|-----|
| ADAPTIVE CAPACITY             |    |     |
| No                            | 16 | 15  |
| Yes                           | 21 | 8   |

### Table 8. SPSS crosstab test results between adaptive capacity and economic resilience

| Chi-Square Tests                        | Value | df | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|-----------------------------------------|-------|----|-----------------------|----------------------|----------------------|
| Pearson Chi-Square                       | 5,000a| 1  | .025                  |                      |                      |
| Continuity Correction                   | 2,066 | 1  | .151                  |                      |                      |
| Likelihood Ratio                         | 5,161 | 1  | .023                  |                      |                      |
| Fisher's Exact Test                      |       |    | .083                  | .083                 |                      |
| Linear-by-Linear Association            | 4,833 | 1  | .028                  |                      |                      |

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is, 60.

b. Computed only for a 2x2 table
5. Conclusion

Based on the results of the analysis that has been done before, it can be concluded as follows:

If seen from the resilience model, Joerin et al. [6] the resilience of the Semarang coastal communities affected by climate change in the form of flood and tidal disasters, can be classified typology scenario A-2. The typology is indicated by the absence of changes in conditions before the disaster and after the disaster. This is shown by the economic resilience of the community, especially the aspects of community income that have not changed before and after the flood disaster in the region. Likewise, for physical resilience, no changes occurred in the study area (Tanjungmas and Bandarharjo).

The resilience of communities in the Coastal areas of the city of Semarang (primarily physical and economic resilience) affected by flood and tidal disasters can be adequately maintained. This can happen because it is a combination of aspects of coping strategies undertaken by the community prior to the onset of the flood disaster by making flood barriers at the front door of the house and raising the building; adaptive capacity aspects such as good social relations in the community and poverty reduction program by the Semarang City government such as inadequate rice aid (RASKIN) and health insurance (JAMKESKIN) as well as aspects of response capacity such as food and medicine aid to the community during the flood disaster which are carried out effectively and efficiently.

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