Preliminary study on socio-economic aspect towards Jakarta climate resilient (case study: Cengkareng District, West Jakarta and Penjaringan District, North Jakarta)

Tusy Augustine Adibroto¹*, Pini Wijayanti², Rizky Pratama Adhi¹, and Rudi Nugroho¹

¹ Center for Environmental Technology, Agency of the Assessment and Application of Technology, Indonesia
² Bogor Institute of Agriculture, Bogor, Indonesia

*tusy.adibroto@bppt.go.id

Abstract. This paper is the preliminary of guidance development for mitigation and adaptation efforts to overcome annual flood, which is exacerbated by the land subsidence in the north Jakarta. In addition to the physical studies of hydrodynamic modeling, a survey on socio-economic aspect was also conducted to the affected communities. In order to establish decisions for the option of flood disaster mitigation and adaptation efforts, the results of scientific studies that discuss both technical aspects and socio-economic and cultural characteristics should be gained. The aim of this study was to assess the social, economic, and cultural aspects of the communities in selected flood vulnerable locations. This paper is part of the entire study "Hydrodynamic Modeling for Flood Reduction and Climate Resilient Infrastructure Development Pathways in Jakarta". The results of the socio-demographic analysis indicated that the study area is densely populated and flood vulnerable. Thus, it requires immediate mitigation efforts to reduce the flood risk in the future. The relevant and appropriate conceptual framework in the context of social resilience in 3 (three) phases of disaster; before the occurrence of floods, when facing floods, and during recovery after a flood are analysis of public perceptions of flooding, analysis of exposure, and vulnerability.

1. Introduction

1.1 Background

At present, flooding is still a major environmental problem for Jakarta in the future. This phenomenon is caused by natural factors such as increased intensity of rainfall in upstream areas, local rainfall, and increased sea levels; also, by human factors such as excessive groundwater extraction and urbanization followed by expansion of urban areas and land conversion [1]. Especially North Jakarta, which is the most vulnerable to climate change in Southeast Asia [2], is severely threatened by coastal flooding, land subsidence and sea level rise [2,3].

The Jakarta flood risk value is expected to continue to increase in the future [4]. In general, flood risk values are estimated by multiplying the chance of flood hazard in a number of return periods with potential losses caused by flooding on these opportunities [5]. The research shows that due to a combination of land subsidence, increased rainfall and increased sea levels, the risk of flooding in Jakarta in 2030 is expected to increase 1.8 times higher than in 2015 [4]. The main factor increasing
risk this is a land subsidence, which will last for the next decade even though groundwater extraction is stopped [6]. The most significant reduction in land surface in Jakarta in the period 1997-2005 occurred in the north-west [3]. The study showed that from 2007 to 2010, the average land subsidence in 3 (three) stations in North Jakarta varied from 11-19 cm / year, in addition to sea level rise reaching 2-4 mm / year in 1992-2009 [3]. The value of flood losses represents a decrease in people's welfare. Although most people who live in flood-prone areas are accustomed to flooding and suffer losses due to flooding, the decline in welfare is something that should be avoided. This is because the continued decline in welfare will have an impact on the decline in health, a decrease in decent living standards, and cause other social problems.

The DKI Jakarta Provincial Government has tried to make a number of mitigation efforts to reduce the adverse effects of flooding, carried out through dredging, cleaning and widening of rivers (otherwise known as normalization programs), increasing pump capacity, and improving river and sea dikes. Adaptation efforts will be carried out through the creation of giant sea walls and the construction of reservoirs in the upper Ciliwung. However, these mitigation and adaptation efforts will not necessarily reduce the risk of flooding in the future, given that changes in natural factors (such as rainfall and sea water increase) and human factors (population increase, urbanization and land-use change) are not uncertain and very much related to changes that occur in the area around Jakarta (Bodetabek). Therefore, various mitigation and adaptation efforts are still needed, besides being adjusted to the availability of government budgets as well as the socio-cultural characteristics of the community in flood-prone locations and the principles of sustainable development. In-depth scientific studies that discuss the technical aspects of the choice of mitigation and adaptation efforts and the characteristics of socio-cultural and community culture are needed as input for decision making.

1.2. Objective, Target and Scope
1.2.1. Objective. The objective is to conduct a detailed study of the social, economic and cultural aspects of communities in flood-prone locations, which include socio-economic conditions and community demographics, community perceptions of flood risk, potential losses that will be caused by flooding and willingness to be relocated to support mitigation efforts or adaptation from the government.

1.2.2. Target. While the target of this activity is to obtain data for socio-economic conditions, level of perception, vulnerability, resilience, and willingness to be relocated from the community in the study area.

1.2.3. Scope. The scope of Socio-economic and Culture Study Activities for Flood-Susceptible Communities in Jakarta are:
   a. Literature study: conducted by examining the contents of scientific journals and previous studies to build a conceptual framework to prepare detailed components of questions in the questionnaire in surveys and focus group discussions. To describe the characteristics of the socio-economic and impact of floods, a study was carried out in a number of agency reports in the study area, and in publications a number of agencies (BPS: West Jakarta, North Jakarta, DKI Jakarta, and Provincial BPBD).
   b. Focus Group Discussion (FGD): conducted in January 2017 by involving local government officials, such as the Village Head, Sub-District Head, BPBD, and representatives of the flood task force. And in April 2017 with more comprehensive participants came from various stakeholders (academics, central and provincial governments and local communities).
   c. Field survey: a survey with interviews conducted in January 2017 against 342 households after a study from the modeling team (technical aspects) obtained results in the area of flooded area and depth of flooding in various flood scenarios and their mitigation. Sampling frames of research respondents were all households that were routinely affected by flooding in Kapuk Muara Village, Penjaringan District - North Jakarta and Kapuk Village, Cengkareng District - West Jakarta. The workflow of this study is illustrated in Figure 1.
d. Data were analyzed using qualitative and quantitative analysis. Qualitative analysis was applied to describe the characteristics of the demographic description and the impact of the flood in the study area. Quantitative analysis is carried out after survey and FGD data are obtained by statistical and econometric methods.

e. Compilation of Final Report.

Figure 1. Study Workflow

2. Characteristics of the Study Area
This chapter discusses the results of the literature study to describe the social demographic characteristics and prepare the conceptual framework of socio-economic studies. The selected locations are in Penjaringan District - North Jakarta and Cengkareng District - West Jakarta. The illustration of the study location is shown in Figure 2.

Figure 2. Research Sites in Penjaringan District - North Jakarta and Cengkareng District - West Jakarta

2.1 Socio Demographic characteristics
The study location is a densely populated and densely populated urban village. In 2015, the total population was 309,215 people and the number of households was 101,086 households (KK), where the Kapuk village was the village with the highest population of 148,197 people and the largest number of households was 48,034 households [7]. In 20 years, the population and household in 4 (four) urban villages showed a rapid increase. The population in the Kapuk village, Kedaung Kali Angke, Kapuk Muara, and Pejagalan increased by 2.9; 1.8; 3.5; and 1.7-fold, and the number of households increased by 2.4; 1.7; 4.4; and 2.4-fold.
Cengkareng Sub-District is the most populous sub-district in West Jakarta City. Of the nine sub-districts in West Jakarta, 23% of the population lives in the Cengkareng Subdistrict area [8]. The population in this sub-district has increased 2.4-fold over a period of 20 years, and its population density exceeds the average population density of DKI Jakarta in 2015, which is 15,374 people per km² [7]. Demographic details of Cengkareng District in Table 1 below.

### Table 1. Characteristics of Socio Demography in Cengkareng District, West Jakarta

| Year | Sq. (Km²) | Neighbourhood (RT) | Upper Neighbourhood (RW) | Households | Inhabitants | Density (Inhabitants/km²) |
|------|-----------|--------------------|-------------------------|------------|-------------|--------------------------|
| 1995 | 27.93     | 768                | 71                      | 65.402     | 209.391     | 7.497                    |
| 2005 | 30.09     | 974                | 83                      | 96.208     | 230.623     | 7.664                    |
| 2010 | 26.54     | 998                | 84                      | 101.108    | 304.945     | 11.490                   |
| 2015 | 26.54     | 1,013              | 84                      | 159.108    | 495.850     | 18.683                   |

**Source:** [9][10][11][12][13]

Of the 6 (six) sub-districts in North Jakarta, 19% of the population lives in the sub-district of Penjaringan [14]. The population in this sub-district has increased 1.2-fold over the past 15 years. The demographic details of Kecamatan Penjaringan are presented in Table 2 below.

### Table 2. Socio Demographic Characteristics of Penjaringan District, North Jakarta

| Year | Sq. (Km²) | Neighbourhood (RT) | Upper Neighbourhood (RW) | Households | Inhabitants | Density (Inhabitants/km²) |
|------|-----------|--------------------|-------------------------|------------|-------------|--------------------------|
| 2000 | 35.49     | 768                | 63                      | 47.372     | 251.633     | 7.090                    |
| 2005 | 35.49     | 800                | 65                      | 19.487     | 178.026     | 5.016                    |
| 2010 | 35.49     | 841                | 70                      | 66.531     | 216.842     | 6.110                    |
| 2015 | 45.41     | 867                | 72                      | 102.777    | 305.121     | 6.390                    |

**Source:** [15,16,17,18,19]

When viewed from the age group, the population of the 2013 projection for Kecamatan Penjaringan shows that the population is dominated by productive age, where the age group 15-64 reaches 241,229 people or 74.65%. The population of women is more than men with a ratio of 97.8 [20]. While based on the 2014 projection, Cengkareng Subdistrict was also dominated by productive age which reached 395,827 or 71.18%. Male population is more than women with a ratio of 105 [13].
Kapuk Kelurahan 9.3 billion [13] while the Kapuk Muara village was 3.06 billion [20]. Picture of the study location is shown in Figure 3.

| Area          | Sq. (km²) | Neighbourhood (RT) | Upper Neighbourhood (RW) | Households | Inhabitants | Density (Inhabitants/km²) | Sex Ratio |
|---------------|-----------|--------------------|--------------------------|------------|-------------|--------------------------|-----------|
| Kapuk         | 5.63      | 222                | 16                       | 48,034     | 148,197     | 26.323                   | 104.81    |
| Kapuk Muara   | 10.06     | 101                | 10                       | 11,907     | 36,578      | 3.637                    | 104.14    |

*Source: [13][19]*

Based on population, Kapuk Village is more than eight times denser than Kapuk Muara Village (Table 3). This is in line with the very high changes in the composition of the population that occurred in Kapuk Village (Table 4).

| Area          | Birth (Inhabitants) | Mortality (Inhabitants) | Migration In (Inhabitants) | Migration Out (Inhabitants) |
|---------------|---------------------|-------------------------|-----------------------------|-----------------------------|
| Kapuk (2015)  | 2,178               | 518                     | 1,735                       | 1,777                       |
| Kapuk Muara (2013) | 551   | 92                     | 1,043                       | 854                         |

*Source: [13][19]*

2.2 Characteristics of Land Use

Land use in both kelurahan is dominated by housing, industry and offices as shown in Figure 4. The condition of housing and environmental facilities in a region can illustrate the level of welfare and health of the region. In Kapuk Village 46.54% of the buildings are permanent [13], while in the Kapuk Muara village 81.58% of the buildings are permanent and there are no apartments [19].

![Figure 4. Percentage of Land Use in the Study Area](image)

Note: *Perumahan* (in English means Settlement), *Industri* (in English means Industry), *Perkantoran/Bisnis* (in English means Office/Business), *Taman* (in English means Park/Green Open Space), and *Lainnya* (in English means Others)

*Source: [13,18]*

Although dominated by land use for housing, the existence of processing industries is very influential on the economic life of the people in Cengkareng Subdistrict, especially in the Kapuk Village (53%) [21], because this industrial business can absorb labor and is one of the eyes livelihoods of the surrounding community. Industrial activities in the study locations are dominated by large and medium industries which include the textile industry and textile products (convection, apparel, and
garments). The comparison of the number of large and small industries in the study area is shown in Table 5.

Table 5. Number of Large and Medium Industries and the Number of Workers in the Study Area

| Area                  | Number of Large and Medium Industries (unit) | Labor (peoples) |
|-----------------------|---------------------------------------------|-----------------|
| Kapuk (2014)          | 62                                          | 3848            |
| Kapuk Muara (2013)    | 55                                          | 6382            |

Source: [13][19]

2.3 Flood Disaster History
The study area is a flood-prone area. Table 6 and Table 7 show the number of flood events and their impacts during the 2015-2016 period. During this time, Kapuk Village was more frequently affected by flooding and more affected communities.

Table 6. Impact of Floods in Kapuk Village, Cengkareng District - West Jakarta, in 2015-2016

| Flood       | Number of Affected | Flood Height (cm) | Duration (Date and Day(s)) |
|-------------|--------------------|-------------------|----------------------------|
|             | Neighbourhood      | Upper Neighbourhood | Households | Inhabitants |                     |                          |
| January 2015| 4                  | 0                 | 1468        | 5538        | 20 - 40             | 23 – 24, (Two Days)     |
|             | 14                 | 114               | 10637       | 41924       | 20 - 100            | 02, 09 – 14, (Seven Days)|
| Desember 2015| 1               | 1                 | 0           | 0           | 10 - 20              | 13 (One Day)            |
| February 2016| 14             | 37                | 0           | 0           | 5 - 30               | 26 - 27, 29, (Three Days)|
| March 2016  | 3                  | 10                | 0           | 0           | 5 - 15               | 1 (One Day)             |

Source: [22][23]

Table 7. Impact of Flood in Kapuk Muara Village, Penjaringan District - North Jakarta in 2015-2016

| Flood       | Number of Affected | Flood Height (cm) | Duration (Date and Day(s)) |
|-------------|--------------------|-------------------|----------------------------|
|             | Neighbourhood      | Upper Neighbourhood | Households | Inhabitants |                     |                          |
| Januari 2015| 5                  | 0                 | 0           | 0           | 20 - 30              | 23 - 24, (two days)     |
| Februari 2015| 5                 | 3                 | 8           | 24          | 20 - 100             | 02,09 - 11, (four days) |
| Februari 2016| 1                 | 0                 | 0           | 0           | 20                  | 26, (one day)           |

Source: [22][23]

3. Literature Study
3.1 Resilience Concept
Resilience comes from the Latin word "resilio", meaning "to jump back" [24]. A number of literatures interpret the concept of resilience in a variety of ways. Resilience as adaptive flexibility in responding
to disasters [25]. Resilience as the ability of people to recover from adversity [26]. Disaster resilience is the ability of the community to overcome a number of shocks, social losses, and changes in the political environment [27]. In general, resilience is defined as a flexible response to the dangers that occur and shows the ability to "bounce back" to the previous state after the danger occurred and caused damage. Resilience depends on changes or adjustments that require a fast and flexible response [28] in all phases of the disaster and can be conceptualized as a link between 4 (four) interrelated dimensions namely technical, organizational, social, and economic [29], as shown in Figure 5 below.

![Figure 5. Resilience Framework [29]](image)

### 3.2 Concept of Perception of Flood Risk

Community perceptions of flood risk refer to the risks felt by the community towards flooding in the context of limited and uncertain information about flooding in their area. Perception will motivate people to mitigate flood risk and also encourage demand for government efforts to mitigate and protect against flooding. Therefore, the perception of flood risk that is "felt" can provide useful information in flood risk management [30], where the perceived risk will affect the response and risk management of a community in the future [31].

| Social Resilience Indicators | High | Medium | Low |
|-----------------------------|------|--------|-----|
| Community participation     | Community participation | Community participation |
| Education                   | Education | Exchange of Information |
| Exchange of Information     | Social support | Social support |
| Learning                    | Sense of community | Sense of community |
| Social support              | Level of Trust | Level of Trust |
| Sense of community          | Coordination | Community efficacy |
| Level of Trust              | Ability to cope with emergency | Improvisation, inventiveness |
| Coping style                | ability to cope with emergency situation/disaster | coping style |
| Leadership                  | Leadership | Leadership |

Table 8. Indicators in Measuring Social Resilience

Source: [32]

The key to success in flood management is related to how communities and local leaders respond to the risk of flooding and how they work together [33]. However, everyone in the community element may have a difference in assessing the risk of flooding, because they do not have the same information about the possibility of flooding [34].

Many factors will influence people to take flood mitigation measures, such as experience of past flooding [33][35], lack of dependence on government protection efforts, emotions, and fear [36]. Losses due to flooding can be minimized by mitigating and adapting both those carried out by the
government (public) and personally. Self-motivation to reduce flood losses can be affected by several obstacles such as limited time, money, knowledge, or social support [36].

3.3 The concept of Flood Vulnerability Analysis (Flood Vulnerability Analysis)

Two types of exposure indicators in floods [34]. First, exposure related to the element of risk (usually related to elements of the flood location), such as: elevation, distance to the river, and return period. Second, exposure that focuses on the characteristics of floods in general, namely: duration, depth, and current strength.

The actual damage from flooding depends on the vulnerability of the socio-economic system and the affected ecological system [37]. Indicators of vulnerability measure how sensitive elements are exposed to risk will react or change when threatened with several types of hazards [34]. Flood vulnerability analysis can be demonstrated by the flood-damage function), which connects the value of damage to elements exposed to risk to indicators of exposure and vulnerability. Information about flood damage, exposure indicators and vulnerability indicators are important for building stage damage curves. Figure 6 shows how this analysis is related.

![Figure 6. Indicators in Flood Vulnerability Analysis](source)

4. Analysis

The FGD with representatives of the community and industry produced fairly comprehensive information to describe the socio-economic conditions of the community. The FGD results showed a good understanding from community representatives on the causes of floods in Penjaringan and Cengkareng sub-districts. Some of the causes of flooding described in the FGD include; 1) high intensity of rainfall with frequent frequency, 2) siltation of rivers, 3) limited green areas, 4) rivers full of garbage, 5) land subsidence, and 6) pump usage that is not optimal. Some of the causes of the flooding have now been addressed by both the government and the community. However, the potential for future floods due to natural factors must still be watched out.

Social resilience is measured based on a total score of 8 (eight) attributes of social security. From the results of the questionnaire, the assessment of social security from survey respondents was higher than the assessment of FGD participants. Respondents in Kapuk Muara have the highest social resilience compared to other kelurahan. From the point of view of the community, the attribute of high social resilience is a sense of togetherness, a level of mutual trust and effectiveness. There are 3 (three) indicators that have the highest average value, namely sense of togetherness (4,10), trust (4,01) and learning (3,99). In other words, there are 3 (three) things that make the people in the study locations have social resilience, namely feeling part of the community, knowing each other and trusting the people around, and when facing flooding, they take experience from the events of previous floods.

Community perceptions at the location of the study on flood hazard varied between kelurahan. Although the community in the study location is between two major rivers, namely Cengkareng Drain and Angke Drain, their "perceived probability" is lower than "perceived consequences". It can be seen
in Figure 6.2 that they were not too worried about the possibility of a larger flood in the future, but they were more worried about the impact of the flood and were worried about staying in that location. On a scale of 1 to 5, the average perceived probability is 1.6 and "perceived consequences" is 2.5. The highest value of "perceived risk" is given by households in Pejagalan Village. The community in the study location is accustomed to flooding and is aware of the risk of flooding that might occur. The response of the community when they learned that there would generally be a flood was to move items upstairs. After the floods arrived, and the height of the floods increased, a number of respondents said they would decide to evacuate. However, 40% of respondents said they would not evacuate even though the floods were rising. This is done because the community considers that the items in the house need to be maintained, besides that the community also thinks that the refugee sites are relatively limited so they are more comfortable to stay in their homes when there is a flood. One of the refugee locations is SD Kapuk 05 Pagi in Kapuk.

From the results of the FGD in April 2017 some of the inputs obtained from academics, the Central Government (i.e Bappenas) were about the need to highlight the findings of the survey about the refusal of the grass-root community towards the relocation plan by taking a participatory approach. To determine the location of relocation it is necessary to study the pattern of community movements for economic activities so that the maximum distance of the location can be obtained. In addition, the relocation building should be no more than 4 floors so that the community that had lived in the land-site still feels comfortable. Also, new economic activities should be sought based on the potential of the local community which is enhanced through empowerment activities that are integrated with economic policy. There is input that suggests the emphasis on collaboration and synchronization between various relevant stakeholders in locations such as the Ministry of Public Works and the relevant SKPD of the Provincial Government.

5. Conclusion

From the results of the study and FGD conducted, the following conclusions were obtained:

a. Socio-demographic analysis shows that the study area is a flood-prone area, experiencing high and densely populated land subsidence, requiring immediate mitigation efforts to reduce the risk of flooding in the future.

b. The relevant and appropriate conceptual framework for use in the next stage of study is social resilience in 3 (three) phases of disaster, namely before a disaster occurs, when facing disasters and after a disaster; and need deep vulnerability analysis such as community perceptions of flooding, as well as analysis of exposure and vulnerability.

c. Regarding the tendency to refuse relocation, a participatory approach and study of community movements related to economic activities are needed so that the maximum radius for the relocation location can be estimated.

d. It is necessary to think about new types of economic activities that are in accordance with the potential of the community and that appropriate community empowerment is carried out.

e. There needs to be continuous socialization of the community affected by the development plan in order to produce better conditions.

f. In the context of implementing relocation there is a need for various stakeholder collaboration and synchronization approaches related to flooding and management of water resources.

References

[1] Brinkman, J J and M Hartman 2009 Jakarta flood hazard mapping framework, in International Conference on Urban Flood Management edited (Paris A reference) pp 1-9

[2] Yusuf, A. A., and H. Francisco 2009 Climate change vulnerability mapping for Southeast Asia (Singapore : Economy and Environment Program for Southeast Asia (EEPSEA), pp 10-15

[3] Abidin, H. Z., H. Andreas, I. Gumilar, Y. Fukuda, Y. E. Pohan, and T. Deguchi 2011 Land Subsidence of Jakarta (Indonesia) and its relation with urban development Natural Hazards 59(3): 1753-1717
[4] Budiyono, Y., J. C. J. H. Aerts, D. Tollenaar, and P. J. Ward 2016 River flood risk in Jakarta under scenarios of future change Nat. Hazards Earth Syst. Sci. 16(3): 757-774
[5] Meyer, V., D. Haase, and S. Scheuer 2009 Flood risk assessment in European river basins-concept, methods, and challenges exemplified at the Mulde river Integrated Environmental Assessment and Management 5(1): 17-26
[6] Bakr, M. 2015 Influence of Groundwater Management on Land Subsidence in Deltas: A Case Study of Jakarta (Indonesia) Water Resources Management 29(5): 1541-1555
[7] BPS (Badan Pusat Statistik) DKI Jakarta 2016 Jakarta dalam Angka 2016, BPS Provinsi DKI Jakarta (Jakarta)
[8] BPS (Badan Pusat Statistik) Jakarta Barat 2016a Jakarta Barat dalam Angka 2016, BPS Jakarta Barat (Jakarta)
[9] BPS (Badan Pusat Statistik) Jakarta Barat 1996 Kecamatan Cengkareng dalam Angka 1996, BPS Jakarta Barat (Jakarta)
[10] BPS (Badan Pusat Statistik) Jakarta Barat 2001 Kecamatan Cengkareng dalam Angka 2001, BPS Jakarta Barat (Jakarta)
[11] BPS (Badan Pusat Statistik) Jakarta Barat 2006 Kecamatan Cengkareng dalam Angka 2006, BPS Jakarta Barat (Jakarta)
[12] BPS (Badan Pusat Statistik) Jakarta Barat 2011 Kecamatan Cengkareng dalam Angka 2011, BPS Jakarta Barat (Jakarta)
[13] BPS (Badan Pusat Statistik) Jakarta Barat 2016b Kecamatan Cengkareng dalam Angka 2016, BPS Jakarta Barat (Jakarta)
[14] BPS (Badan Pusat Statistik) Jakarta Utara 2016c Jakarta Utara dalam Angka 2016, BPS Jakarta Utara (Jakarta)
[15] BPS (Badan Pusat Statistik) Jakarta Utara 1996 Kecamatan Penjaringan dalam Angka 1996, BPS Jakarta Utara (Jakarta)
[16] BPS (Badan Pusat Statistik) Jakarta Utara 2001 Kecamatan Penjaringan dalam Angka 2001, BPS Jakarta Utara (Jakarta)
[17] BPS (Badan Pusat Statistik) Jakarta Utara 2006 Kecamatan Penjaringan dalam Angka 2006, BPS Jakarta Utara (Jakarta)
[18] BPS (Badan Pusat Statistik) Jakarta Utara 2011 Kecamatan Penjaringan dalam Angka 2011, BPS Jakarta Utara (Jakarta)
[19] BPS (Badan Pusat Statistik) Jakarta Utara 2016a Kecamatan Penjaringan dalam Angka 2016, BPS Jakarta Utara (Jakarta)
[20] BPS (Badan Pusat Statistik) Jakarta Utara 2016b Statistik Daerah Kecamatan Penjaringan 2016, BPS Jakarta Utara (Jakarta)
[21] BPS (Badan Pusat Statistik) Jakarta Barat 2016c Statistik Daerah Kecamatan Cengkareng 2016, BPS Jakarta Barat (Jakarta)
[22] BPBD (Badan Penanggulangan Bencana Daerah) Jakarta 2015 Rekap Rinci Banjir Bulanan 2015 BPBD Provinsi DKI Jakarta (Jakarta)
[23] BPBD (Badan Penanggulangan Bencana Daerah) jakarta 2016 Rekap Rinci Banjir Bulanan 2016 BPBD Provinsi DKI Jakarta (Jakarta)
[24] Klein, R. J. T., R. J. Nicholls, and F. Thomalla 2003 Resilience to Natural Hazards: How Useful is this Concept? Environmental Hazards 5(1): 35-45
[25] Cutter, S. L., L. Barnes, M. Berry, C. Burton, E. Evans, E. Tate, and J. Webb 2008 A Place-Based Model for Understanding Community Resilience to Natural Disasters Global Environmental Change 18(4): 598-606
[26] Buikstra, E., C. Rogers-Clark, H. Ross, D. Hegney, C. King, P. Baker, and K. McLachlan 2011 Ego-resilience and psychological wellness in rural communities, in Continuity versus Creative Response to Challenge: The Primacy of Resilience and Resourcefulness in Life and Therapy, edited (18): 273-290 e-ISSN 9781619427075
[27] Adger, W. N. 2006 Vulnerability Global Environmental Change 16(3) 268-28
[28] Berkes, F., and H. Ross 2013 Community Resilience: Toward an Integrated Approach Society & Natural Resources 26(1): 5-20
[29] Bruneau, M., S. E. Chang, R. T. Eguchi, G. C. Lee, T. D. O’Rourke, A. M. Reinhorn, M. Shinozuka, K. Tierney, W. A. Wallace, and D. v. Winterfeldt 2003 A Framework to Quantitatively Assess and Enhance the Seismic Resilience of Communities Earthquake Spectra 19(4): 733-752
[30] Bubeck, P., W. J. W. Botzen, L. T. T. Suu, and J. C. J. H. Aerts 2012 Do Flood Risk Perceptions provide useful insights for flood risk management? Findings from central Vietnam Journal of Flood Risk Management 5(4): 295-302
[31] Adger, W. N., S. Dessai, M. Goulden, M. Hulme, I. Lorenzoni, D. R. Nelson, L. O. Naess, J. Wolf, and A. Wreford 2009, Are there social limits to adaptation to climate change? Climatic Change 93(3-4): 335-354
[32] Khalili, S., M. Harre, and P. Morley 2015 A temporal framework of social resilience indicators of communities to flood, case studies: Wagga wagga and Kempsey, NSW, Australia International Journal of Disaster Risk Reduction 13: 248-254
[33] Fatti, C. E., and Z. Patel (2013), Perceptions and responses to urban flood risk: Implications for climate governance in the South Applied Geography 36: 13-22
[34] Messner, F., and V. Meyer (2007), Flood damage, vulnerability and risk perception - challenges for flood damage research, in Flood risk management - hazards, vulnerability and mitigation measures, edited by J. Schanze, E. Zeman and J. Marsalek, (Springer: Dordrecht) pp 149-168
[35] Siegrist, M., and H. Gutscher 2008 Natural hazards and Motivation for mitigation Behavior: People Cannot Predict the Affect Evoked by a Severe Flood Risk Analysis 28(3): 771-778
[36] Grothmann, T., and F. Reusswig 2006 People at Risk of Flooding: Why Some Residents Take Precautionary Action While Others do not Natural Hazards 38(1-2): 101-120
[37] Cutter, S. L. 1996 Vulnerability to Environmental Hazards Progress in Human Geography, 20(4): 529-539