

# Building Resilience, Tackling the Challenge of Climate Change: A Case Study of Rural Community in Kaliwlingi Village

Mustovia Azahro<sup>1</sup>, Angga Dwisapta Ardi<sup>2</sup>

<sup>1</sup>mustovia.azahro@gmail.com

<sup>2</sup>ardidwisapta27@gmail.com

## ABSTRACT

The fourth assessment of IPCC report (2007) mentioned that changes in sea level on average during the 20th century was 0.17 meters (with range from 0.12 to 1.22 m) and it is projected to increase to 0.59 meters (with range from 0.18 to 0.59 m) by 2100. Coastal communities have put efforts in adapting to changes that occur in coast. However, climate change also causes changes in dynamic patterns of the coast including changes in sea level dramatically. This paper highlights a case study in Kaliwlingi Village, one of vulnerable village located in Brebes District, north coast of Central Java Province. The estuary of Pemali River lies on this village and it is an area that experience heavy tidal flood and abrasion. These problems have changed community livelihoods, from fishermen or fish farmers to unskilled labors.

This paper argues that livelihood change should not lower local community income. In responding to this, it is essential to restore local wisdom in the community that has been eroded. Local wisdom, that emphasis on harmonious relation within community and between community and nature, needs to build resilience. Resilience is capacity of a system to absorb shocks or disturbances, reduce stress, and to recover towards equilibrium state after disturbance (Holling, 1973). It is an adaptation within a system. This paper describes how the community of Kaliwlingi Village adapt to the climate change that affects to their social economic conditions.

Keywords : climate change; resilience; local wisdom; social capital

## Introduction

Climate change is a global issue, especially in coastal areas. The impact of climate change that occurred in the coastal area is the increase of sea level significantly, causing the tidal flood. In the 4th assessment of IPCC report (2007) mentioned that changes in sea level on average during the 20th century was 0.17 (0.12 to 1.22) meters and it is projected to increase to 0.59 (from 0.18 to 0.59) meters by 2100. In Indonesia, especially in some areas of Java has experienced abrasion as a result of climate change.

This issue has a direct impact on the lives of people living in coastal areas, because of the

increase of sea water resulting in intrusion and flood. Various problems eventually arise such as the difficulty of access to water (Smith *et al.*, 2011<sup>i</sup>) and the impact on some sectors, particularly with regard to socioeconomic (O'Brien *et al.*, 2004<sup>ii</sup>).

Kaliwlingi Village is one of the villages in the coastal areas of Java, precisely in Brebes County, Central Java. The problems that occurred in Kaliwlingi Village associated with climate change is the tidal flood that occurred in May until July. The majority of Kaliwlingi's inhabitants occupy as fishermen and fish farmers. In the month of May to July, they are

forced to change their livelihood as fishermen or fish farmers to unskilled labors because of the tidal flood so that fishermen can not go to sea and fish farmers can not harvest fish due the stagnant ponds. But the problem is it never increase their income because of they change their livelihood to unskilled labors.

The impact of climate change on socio-economic condition of the inhabitants requires them to be able to adapt. The change of livelihood as labors in fact a form of adaptation to climate change. But, of course, required a sustained effort associated with an increased capacity Kaliwlingi's inhabitants in facing the challenges of climate change.

### Challenges and Climate Change Resilience

Climate change is a global problem today which resulted in various impacts. IPCC's Fourth Assessment Report predicts that the average of increase in sea water by 2 mm/year and going on since the 1990s. The direct impact of rising sea levels are flooding or water logging, or will be agriculturally unsuitable due to salt stress, especially in the peri-urban space where agriculture is practised, increased coastal storm damage and flooding; sea-shore erosion; salt water intrusion into estuaries and freshwater aquifers and springs; changes in sedimentation patterns; decreased light penetration to benthic organisms leading to loss of food for various marine fauna; and loss of coral reefs, contributing to loss of biodiversity, fisheries and recreational opportunities, among other (Awuor *et al*, 200<sup>iii</sup>). Basically, climate change is causing environmental degradation (Robichaud & Anantatmula, 2011<sup>iv</sup>), increased infrastructure requirements (Smith *et al*, 2011<sup>i</sup>) and the vulnerability of communities to deal with disasters caused by climate change (Lizarralde *et al*, 2015<sup>v</sup>).

In coastal areas, the impact of climate change is more significant because of the people who live in coastal areas dependent on fisheries and marine sector (O'Reilly *et al*, 2003<sup>vi</sup>). The

problems ultimately impact on socio-economic conditions of coastal areas and the ecology of coastal areas (Smith *et al*, 2011<sup>i</sup>). The condition was eventually pushed the importance of the process of awareness and capacity as well as support from various stakeholders to solve the problems posed by climate change iklim (Sheppard *et al*, 2011<sup>vii</sup>). One of them is to increase the adaptive capacity of society through the way of life, social relationships cohesion and institutional, policy support (Kalikoski *et al*, 2009<sup>viii</sup>). These methods are (i) community visioning; (ii) institutional analysis; (iii) evaluation of capacity changes; and (iv) transfer of findings and methods to other sea change communities. (Smith *et al*, 2011<sup>i</sup>).

### Research Method

The purpose of this paper is to identify how the community of Kaliwlingi Village adapt to the climate change that affects to social economic condition of the inhabitants. Based on it, the research uses qualitative research. Qualitative method is a method to explore and understand the meaning of the data collected from the participants and the analyzes performed by emphasizing the mindset inductively from the particular to the general to interpret the meaning of data (Creswell, 2010:18-29<sup>x</sup>).

This qualitative research method is a dynamic and growing research using data processing of interviews and observations. The analysis is textual analysis in order to interpret the adaptation efforts of Kaliwlingi's inhabitants. The interviews were conducted on fishermen and fish farmers. The information collected is associated with the ability and potential to adapt.

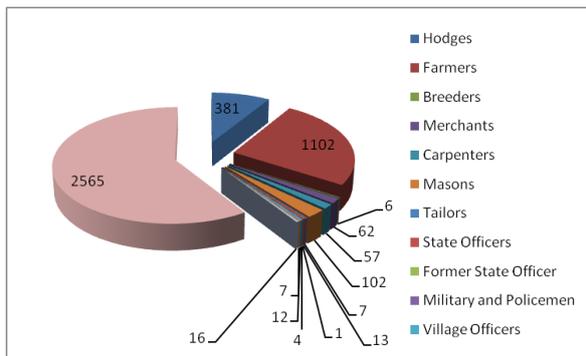
**Table 1.** Requirements Data and Analysis

Data	Analysis
Characteristics of the community	Potential to be developed
The impact of problems for the community due to	Issues related to environmental, social and economic

<b>climate change</b>	
<b>Adaptation</b>	Adaptation efforts that have been made
	Adaptation is being built by the Kaliwlingi's inhabitants
<b>Matters on which the success of the community resilience</b>	Matters on which the success of community resilience in facing the challenges of climate change

### Rural Community of Kaliwlingi

Kaliwlingi Village with an area of 1,627 hectares located in the North Coast of Java precisely in Brebes County, Central Java Province. Kaliwlingi Village is a fishing village that located in the river estuary that divides the city of Brebes. Abrasion has occurred in the village of Kaliwlingi, where erosion has destroyed the ponds. It started in 1980's when the booming trend of tiger shrimp. The Kaliwlingi's inhabitants were clearing the mangrove ecosystem for shrimp ponds that resulted into mangrove ecosystem degradation.



**Fig.1** Occupations of Kaliwlingi Villagers, 2016

Along with this, environmental destruction and degradation make shrimp farms had to failed. Covering an area of 800 hectares of land lost due to abrasion result of damage to the mangrove. Villagers suffered losses and the risk of losing their occupations. The environmental degradation in the Kaliwlingi Village accumulated by exaggerated use of ponds and loss of function of the mangrove areas also causing decrease the productivity of fisheries, as economic commodity in the coastal area. Such a condition has continued

until today yet Kaliwlingi's inhabitants dominated by fishermen and fish farmers, as the livelihood is still very dependent on nature. As fishermen and fish farmers, their income is depending on the weather changes. Extreme weather causing fishermen to stop fishing, while the tidal flood caused ponds exposed to abrasion and harvest failure. Such conditions force fish farmers and fishermen changing livelihood as unskilled labors although it is not a job that can increase income, but merely to "survive". Not only damaging ponds, tidal flood also degrade the quality of neighborhoods.



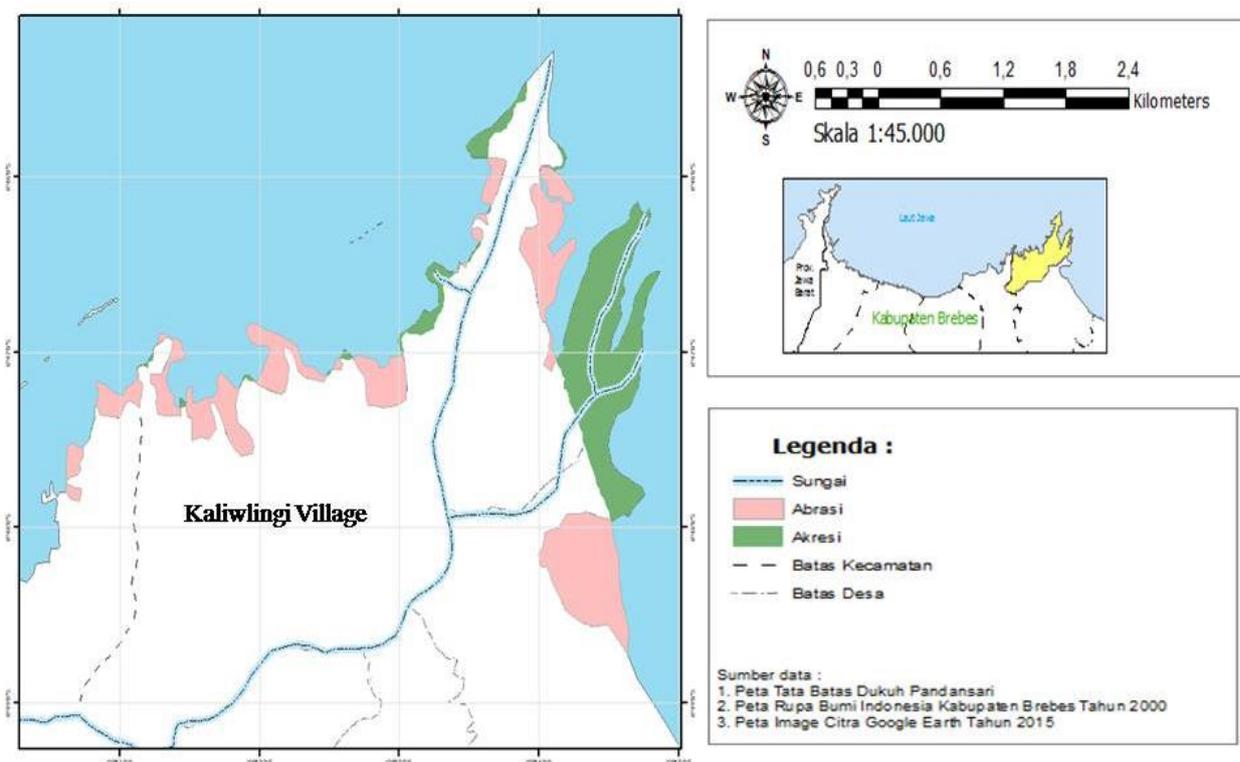
**Fig.2** Tidal flood on Kaliwlingi Village 2007

Public facilities and infrastructure such as roads, bridges and other public facilities were damaged. As a result, community activities such as education, health, sanitation and the economy threatened. This period lasted without any attempt to reform. The inhabitants are getting familiar with their activities. Although it had to compromise with the disease and environmental degradation. The environmental changes such as erosion and accretion also lead to social conflicts for the community. The social conflict between the inhabitants and the government happened because the inhabitants have to pay the property taxes, in spite of the ponds that affected abrasion has been lost but they still have to bear the tax imposed on them. On the other hand, accretion caused social conflict amongst communities, they dispute over

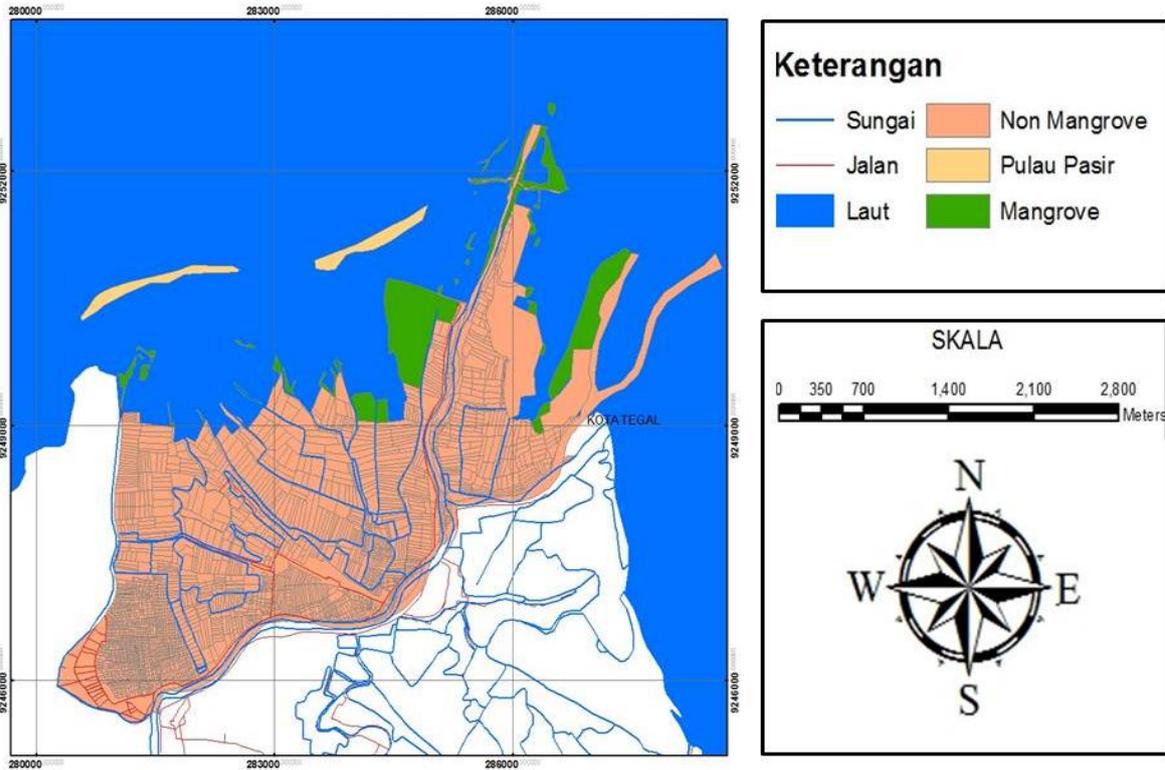
deltaber to cultivation ponds. The conflict also ensued between citizens and government about ownership of the deltaber where the actual signage is set up by the government regulation (Peraturan Pemerintah Nomor 16 Tahun 2014) that Deltaber belongs the state despite the fact it applies only on paper. This conflict has damaged the relationship amongst friends, relatives and even family to ruin people's lives.

Rural communities are homogeneous, yet highly dependent on natural resources, and

driven by a sense of common fate for damages and losses they have been experienced, raising awareness of inhabitants to preserve the mangrove ecosystems. Beginning with the establishment of a social community conservers of mangrove ecosystem "Mangrovesari" by the inhabitants in 2005, slow but sure this community managed to conserve an area of 207 hectares of mangrove ecosystems of the year 2005 to 2016, and still growing.



**Fig.3** Map of Abrasion and Accretion on Kaliwlingi Village 1980-2014



**Fig.4** Map of Conserved Mangrove Ecosystem on Kaliwlingi Village 2005-2016

Conservation efforts evolved into a new effort to develop eco-tourism destination in the region. Community has grown from a community of mangrove preservation into a community of eco-tourism in the Kaliwlingi Village followed by changes in the livelihood of fishery communities into the tourism community.

These changes affect the development and diversity of aquaculture production. Shrimp, milk fish and crab farming become a major commodity in the Kaliwlingi Village. All three of these commodities are of course dependent on the condition of mangrove ecosystems.



**Fig.5** Mangrove Ecosystem on Kaliwlingi Village 2005-2016



**Fig.6** Aquaculture on Kaliwlingi Village 2016

Although these commodities were developed, in fact they have not been able to improve the welfare of society. This is due to the high expenses they have to pay as a result of the declining quality of their settlement. For example, people have to elevate their homes so as not flooded. This effort will continue to do periodically along with the high sea level rise due to climate change. Another example is

to build artesian wells for access to clean water even though would worsen salt water intrusion in the long term.

The success of the preservation of the mangrove ecosystem was not accompanied by success in improving the quality of settlements. Sharing society was limited in mangrove conservation only, while improving the quality of repairs carried individualistic and even tended without any effort. This is because of the growth mindset about how to increase the income of citizens without how to reduce expenses resulting from the settlement degradation as a result of climate change. Furthermore, it should be recognized government involvement in improving the quality of housing environment is a necessary.

**Local Wisdom and Social Capital of Kaliwlingi's Inhabitants as strengths in facing the challenges of Climate Change**

Efforts have been made, obviously not a sustained effort. And by 2014, the rural community began to learn how to adapt to climate change. The adaptation process is not separate from the mitigation into short-term solution other than the adaptation itself. Disaster mitigation in the resilience of climate change is the reduction of vulnerability of climate change. If climate change is like a disease and the neighborhood is his body, the mitigation is a "potion" to reduce the impact and adaptation are "immune" that heals from within. So it will be very difficult to adapt without any mitigation. This is where government intervention in providing a catalyst in the adaptation of society to climate changes.

Begins with a Penataan Lingkungan Permukiman Berbasis Komunitas or Community-Based Neighborhood Development Program (PLP BK), a quality improvement program of community-based settlements by restoring local wisdom as a shaper of the social order. Not only the physical building, this program also

emphasizes the importance of common rules for communities to manage the environment. Bottom-up development with participatory rural appraisal encouraged. As a result, the agreed common rules that prohibit logging of mangrove and the Deltaber is a mangrove conservation area.



**Fig.7** People built the dyke on Kaliwlingi Village, 2014

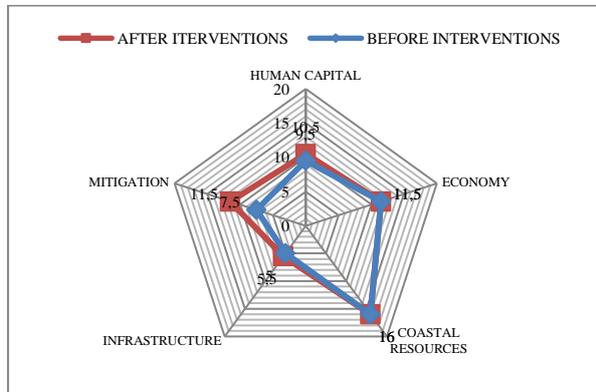
Further effort is Development of Resilient Coastal Area or Pengembangan Kawasan Pesisir Tangguh (PKPT) in 2015-2016 is a program that focuses on *coastal resilient area*. The program has five focus points of treatment, based on the common problems that occur in coastal areas in Indonesia. The focus points are human resources, Infrastructure, Economy, Environmental Resources, Disaster mitigation conducted bottom up by the institutional community.



**Fig.8** Focus Point of PKPT on Kaliwlingi Village 2015-2016

In this program, the vulnerability to climate change was measured by five criteria above.

The benchmarks are used to determine the priority in which it may be applied. Then evaluated by the same criteria at the end of the program to measure the success of intervention.



**Fig.9** Resilience of Coastal Area of Kaliwlingi Village 2015-2016

Like the previous one, it had a significant impact, especially in terms of disaster mitigation because it built the mitigation infrastructure such as dykes, and Disaster Mitigation Post. In addition, setting up community's resilience to climate change in the economy is also conducted through the development of batik mangrove industry and development of sustainable ecotourism management.



**Fig.10** PKPT on Kaliwlingi Village 2015-2016

The Programs bring a significant impact on the settlement of social conflicts that have been going on. Tidal flood disaster-prone areas revitalized into a tourism area and at

some point the dyke was built as a short-term treatment. *Aturan bersama* (The common rules) of society managed to become social capital. Regular meetings of community members were conducted to discuss the problems and determined the solution. Institutional of "Mangrovesari" reinforced by the legal and financially independent.

Adaptations made by the community is an instinct for survival, the difference is a social bond that builds a sense of kinship to the threat of climate change. This threat has become a common interest and the reason for the establishment of "Mangrovesari". The existence of "mangrovesari" is an institution that mobilizes villagers to implement *Aturan Bersama*. It is necessary that adaptive measures are not carried individualistic by citizens as before. Therefore, the community needs to be financially independent in implementing *Aturan Bersama*. To that end, Mangrovesari develop conservation activities into an industry and later evolved into the tourism industry.

### The Seed Bank and Community Based Eco Tourism

Preserving mangrove is not easy. Failure is a common thing they experienced. The unsuitable process of planting methods leads to low levels of life mangrove. It is fully recognized by the community. Then they built a mangrove nursery as a place to seeding. Planting efforts have been successful, the next challenge is the limited members to collect propagule. Here is the beginning of the founding of The Seed Bank. Communities are trying to empower fishermen and fish farmers to collect propagule. Propagule which has been collected then deposited into the Seed Bank for seedlings. Of course there is a price for a single propagule. And this becomes an additional income for fishermen and fish farmers.



**Fig.11**The Seed Bank of Kaliwlingi Village 2016

Then how Mangrovesari finance The Seed bank? Of course from the conservation they did. They propose to the company, NGO's and governments to finance conservation. The seed bank continues to experience growth. Not only the perpetrators of conservation. They even become a supplier of mangrove seedlings for conservation in other areas. And now, The Seed Bank has become the largest supplier of mangrove trees in the area. Is this not an industry?

Mangrove ecosystem that is well preserved turned out to attract tourists. This opportunity is well recognized by the community and government. Government invests to build tourism infrastructure while Mangrovesari in charge of managing tourism. This principle emphasizes direct community involvement of all tourism development activities from planning, implementation and monitoring. Community placed as the main factors, which have an interest to participate directly in decision-making to improve their welfare. The benefit is not necessarily held by members of the community. Through Community Based Eco Tourism, then the benefits of conservation and tourism invested to build the infrastructure and repairing public facilities damaged by climate change to support tourism activities in the village of Kaliwlingi.

Of course, revitalization impacted on their lives. Changes in activity ensued as the development of tourism activities. Aquaculture

as the main livelihood has been shifted to sideline and the livelihood of the tourism sector and its derivatives are now the main livelihood. Unskilled labor is not an option anymore at the time of the tidal flood. Ecotourism sector and its derivatives are more considered to be "resistant" to climate change are the good opportunities. Society returned to find the rhythm of life after their resources were degraded.

### **Conclusion**

Abrasion has occurred in the village of Kaliwlingi, where erosion has destroyed the ponds. Along with this, environmental destruction and degradation of land capacity to make tiger shrimp farms failed. Covering an area of 800 hectares of land lost due to abrasion result of damage to the mangrove. Villagers suffered losses and the risk of losing their occupations. Extreme weather causing fishermen to stop fishing, while the tidal flood caused ponds exposed to abrasion and harvest failure. Such conditions force fish farmers and fishermen changing livelihood as laborers although labor is not a job that can increase income, but merely to "survive".

The environmental changes such as erosion and accretion also lead to social conflicts for the community. Rural communities are homogeneous, yet highly dependent on natural resources, and driven by a sense of common fate for damages and losses they have been experienced, raising awareness of villagers to preserve the mangrove ecosystems. The mitigation is a "potion" to reduce the impact and adaptation are "immune" that heals from within. So it will be very difficult to adapt without any mitigation.

*Aturan Bersama* is a social capital that prohibit logging of mangrove and the Deltaber is a mangrove conservation area. The existence of "mangrovesari" is an institution that mobilizes villagers to implement *Aturan Bersama*. It is necessary that adaptive measures are not carried

individualistic by citizens as before. Therefore, the community needs to be financially independent. The benefits of conservation and tourism industry invested to build the infrastructure and repairing public facilities damaged by climate change to support tourism activities in the village of Kaliwlingi.

In the end, these efforts can't be separated from the problems and potential Kaliwlingi

village. The problems that have been described, pushing the importance of the process to increasing sustainable awareness and capacity while the potential of becoming an expectation to be able to be an opportunity that can be developed. Moreover, local wisdom successfully restored and social conflicts can be reduced.

## References

---

<sup>i</sup>Timothy F. Smith, Philip Daffara, Kevin O'Toole, Julie Matthews, Dana C. Thomsen, Sohail Inayatullah, John Fien, Michelle Graymore. "A Method for building community resilience to climate change in emerging coastal cities." *Future*. (43) p. 673-379. May 2011

<sup>ii</sup>O'Brien K, Leichenko R, Kelkar U, Vanema H, Aandahl G, Tompkins H, et al. "Mapping Vulnerability to Multiple Stressors : Climate Change and Globalization in India." *Global Environmental Change* 2004; 14 (4) : 303-313

<sup>iii</sup>Cynthia Brenda Awuor, Victor Ayo Orindi, Andrew Ochieng Adwera. Climate change and coastal cities: the case of Mombasa, Kenya. *Environment and Urbanization*. Page 231-241. April 2009.

<sup>iv</sup>Robichaud, L. B., & Anantatmula, V. (2011). Greening project management practices for sustainable construction. *Journal of Management in Engineering*, 27(1), 48–57.

<sup>v</sup>Lizarralde, G., Valladares, A., Olivera, A., Bornstein, L., Gould, K., & Dwyne Barenstein, J. (2015). A Systems Approach to Resilience in the Built Environment: The case of Cuba. *Disasters*, 39(s1), s76–s95.

<sup>vi</sup>O'Reilly CM, Alin SR, Plisnier P-D, Cohen AS, McKee BA. (2003). Climate Change Decreases Aquatic Ecosystem Productivity of Lake Tanganyika, Africa. *Nature*, 424(6950):766–8.

<sup>vii</sup>Stephen R.J. Sheppard, Alison Shaw, David Flanders, Sarah Burch, Arnim Wiek, Jeff Carmichael, John Robinso, Stewart Cohen. Future visioning of local climate change: A framework for community engagement and planning with scenarios and visualisation. *Futures*. Page 400-412, January 2011.

<sup>viii</sup>Daniela C. Kalikoski, Pedro Quevedo Neto, Tiago Almudi. Building Adaptive Capacity to Climate Variability: The case of Artisanal Fisheries in the Estuary of the Patos Lagoon, Brazil. *Marine Policy*. Page 742-751. December 2009.

<sup>ix</sup> John W. Creswell. 2010. *Research Design : Pendekatan Kualitatif, Kuantitatif, dan Mixed*. Edisi Ketiga. Terj. Achmad Fawaid. Yogyakarta : Pustaka Pelajar.