



# Challenges of Climate Change: Resilience Efforts in Rural Communities of Kaliwlingi Village based on *Pengembangan Kawasan Pesisir Tangguh* (PKPT) Program

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Artikel Masuk : 14 Februari 2017

Artikel Diterima : 23 Maret 2017

Tersedia Online : 27 Maret 2017

**Abstract:** Kaliwlingi Village in Brebes City has experienced climate change impacts such as tidal flood and land abrasion. The climate change causes the dynamics of the coast and sea levels dramatically and fosters the coastal communities to have adaptation strategies. This paper aims to identify how the community of Kaliwlingi Village adapts to the climate change that affects to a social economic condition of the inhabitants. The study used qualitative method by interpreting data taken from *Pengembangan Kawasan Pesisir Tangguh* (PKPT) program, interviews, and observations. The study highlights that PKPT program has a significant impact, especially regarding disaster mitigation. PKPT program is successful in collecting the common rules of the community to become social capital accommodated in the local institution. Furthermore, the PKPT Program is also fostering the local economy.

**Keywords:** climate change, resilience, social capital

## Introduction

Climate change is a global issue, especially in coastal areas. The impact of climate change occurred in the coastal area lead to the increase of sea level significantly and causing the tidal flood. In the 4<sup>th</sup> assessment of IPCC report 2007 mentioned that changing of sea level on average during the 20<sup>th</sup> 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 (IPCC, 2007). The 4<sup>th</sup> IPCC 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 waterlogging, agriculturally unsuitable due to salt stress, especially in the peri-urban area, increasing coastal storm damage and flooding, sea-shore erosion, saltwater 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

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which contributing to loss of biodiversity, fisheries and recreational opportunities, among other (Awuor, Orindi, & Adwewa, 2008).

Basically, climate change is causing environmental degradation (Robichaud & Anantatmula, 2011), increased infrastructure requirements (Smith et al., 2011) and the vulnerability of communities to deal with disasters caused by climate change (Lizarralde et al., 2015). In Indonesia, especially in some areas of Java, has experienced abrasion and tidal flood as the result of climate change impacts. This issue has a direct impact on the lives of people living in coastal areas because 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) and the impact on some sectors, particularly with regard to socio-economic (O'Brien et al., 2004).

In coastal areas, the climate change has more significantly impact because the people who live in coastal areas rely on fisheries and marine sector (O'Reilly, Alin, Plisnier, Cohen, & McKee, 2003). The problems ultimately impact on socio-economic conditions of coastal areas and the ecology of coastal areas (Smith et al., 2011). 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 (Sheppard et al., 2011). One of them is to increase the adaptive capacity of society through the way of life, social relationships cohesion and institutional, policy support (Kalikoski, Neto, & Almudi, 2009). Increasing the adaptive capacity conducts through (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). The adaptive capacity of the local community is unique and dynamic (Adger, 2003; Marfai & Hizbaron, 2011). The perception of the community to the threat of hazards will influence the community response and adaptive capacity forms (Marfai & Hizbaron, 2011). Furthermore, the adaptive capacity of the community is also influenced by the characteristics of the community including the social and cultural conditions and the availability of local resources (Luers, Lobell, Sklar, Addams, & Matson, 2003; Marfai & Hizbaron, 2011).

Kaliwringi Village is one of the villages in the coastal areas of Java, precisely in Brebes City, Central Java. The problem mainly occurred in Kaliwringi Village associated with the climate change is the tidal flood that occurred in May until July. The majority of Kaliwringi'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 laborers because of the tidal flood. Therefore, fishermen could not go to sea and fish farmers could not harvest fish due to the stagnant ponds. The changing of livelihood from fishermen and fish farmers as long as the tidal flood happened to unskilled laborers cannot increase the income, but merely to "survive". The impact of climate change on socio-economic condition encourages the community to be able to adapt. The change of livelihood as laborers, in fact, is a form of adaptation to climate change. But, it requires a sustained effort associated with an increased capacity Kaliwringi's inhabitant in facing the challenges of climate change.

There are many types of research that explain about community adaptation, such as Marfai and Hizbaron (2011); Marfai, Sekaranom, and Ward (2014) who reveal about physical adaptation strategies. However, understanding the role of social variables in climate change adaptation strategies are also important (Jones & Clark, 2014). This paper purposed to identify how the community of Kaliwringi Village adapts to the climate change that affects to the social economic condition of the inhabitants. This paper emphasizes about how community adapts by increasing their capacity to facing the challenges of climate change by interpreting data of *Pengembangan Kawasan Pesisir Tangguh* (PKPT) program, interviews, and field observations. PKPT is a program initiated by the Ministry of

Marine and Fisheries in 2015 and based on participation of the community to develop the resilient coastal area.

## Research Method

This research uses the qualitative method to explore and understand the meaning of the data collected from the participants and analyses performed by emphasizing the mindset inductively from the particular to the general to interpret the meaning of data (Creswell, 2010:18-29). This qualitative method is a dynamic and growing research using data processing of interviews and observations. The interviews were conducted on fishermen and fish farmers to understand about their resilience, while the observations were conducted to understand social economic conditions and their success to adapt. This study also used *Pengembangan Kawasan Pesisir Tangguh* (PKPT) Program as the reference the community efforts. The analysis was the textual analysis in order to interpret the adaptation efforts of Kaliwlingi's inhabitants. The information collected is associated with the ability and potential to adapt. Table 1 shows the requirements data and analysis method.

**Table 1. Requirement Data and Analysis**

Data	Collecting Data Method	Analysis
The impact of problems for the community due to climate change	- Observation - Interviews	Issues related to environmental, social and economic
Characteristics of the community	- Observation	Potentials to be developed
Adaptation	Interpret PKPT program Data	Adaptation efforts that have been made
Matters on which the success of the community resilience	- Observation - Interviews	Adaptation is being built by the Kaliwlingi's inhabitants Matters on which the success of community resilience in facing the challenges of climate change

## Results and Discussion

### *The Impacts of Climate Change in Kaliwlingi Village*

Kaliwlingi Village with an area of 1,627 hectares located in the North Coast of Java precisely in Brebes City, Central Java Province. Kaliwlingi Village is a fishing village that located in the estuary of Pemali River. More than 50 percent of inhabitants' occupy as fishermen and fish farmers. It started in 1980's when tiger shrimp trend was booming. The Kaliwlingi's inhabitants were clearing the mangrove ecosystem for shrimp ponds and caused mangrove ecosystem degradation (Ministry of Marine and Fisheries, 2016b).

The environmental degradation in the Kaliwlingi Village accumulated by the exaggerated use of ponds and loss of function of the mangrove areas also causing decrease the productivity of fisheries as an 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 still very depends on nature. As fishermen and fish farmers, the community's income depends 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, the tidal flood also degrade the quality of neighborhoods.

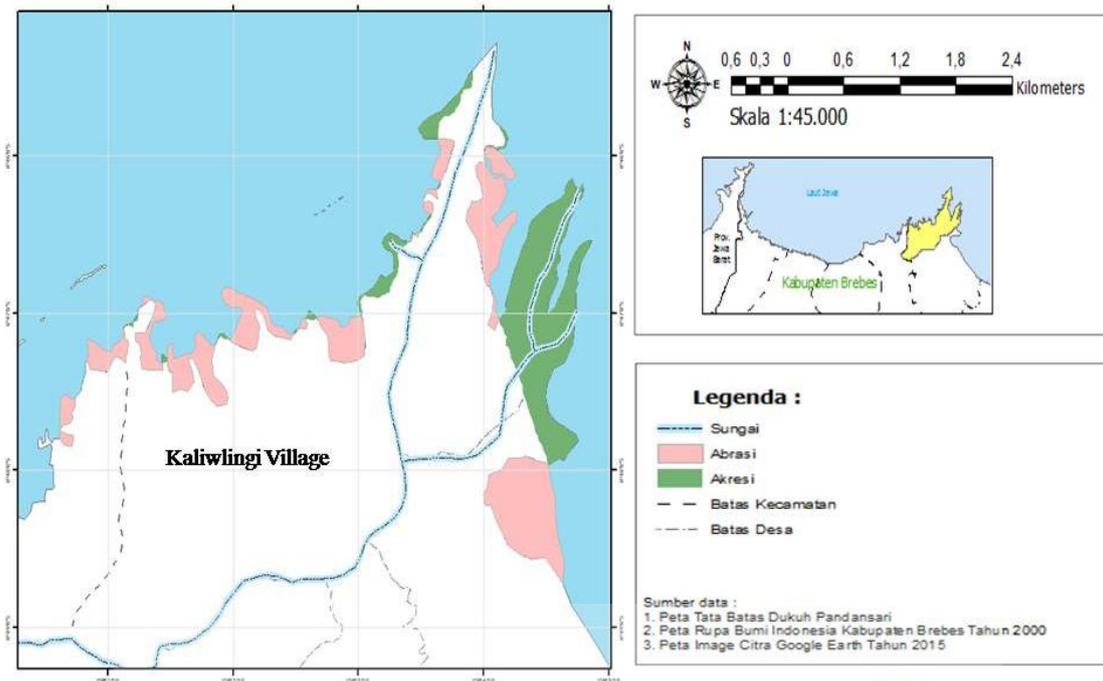
Due to the hazard, public facilities and infrastructure such as roads, bridges and other public facilities were damaged. As a result, community activities, such as education, health, sanitation, and the economy threatened. This period lasted without any attempt to reform. The inhabitants are getting familiar with their activities though it had to compromise with the disease and environmental degradation. Figure 1 shows the tidal flood hazard in Kaliwlingi Village happened on 2007.



**Figure 1. Tidal Flood on Kaliwlingi Village on 2007**

Figure 2 shows the map of abrasion and accretion in Kaliwlingi Village on 1980-2014. Abrasion occurred in Kaliwlingi Village has destroyed the ponds. Environmental destruction and degradation make shrimp farms fail. Covering an area of 800 hectares of land was lost due to the abrasion as the result of mangrove damage. On the other hand, the local inhabitants also suffered losses and the risk of losing their occupations.

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* (the land as a result of sedimentation) to cultivation ponds. The conflict also ensued between inhabitants and government about ownership of the *deltaber* where the actual signage is set up by the Government Act No. 16 The year 2004 (*Peraturan Pemerintah No.16 Tahun 2004*) which explains that *deltaber* belongs the state despite the fact it applies only to paper. This conflict has damaged the relationship amongst friends, relatives, and even family to ruin people's lives.

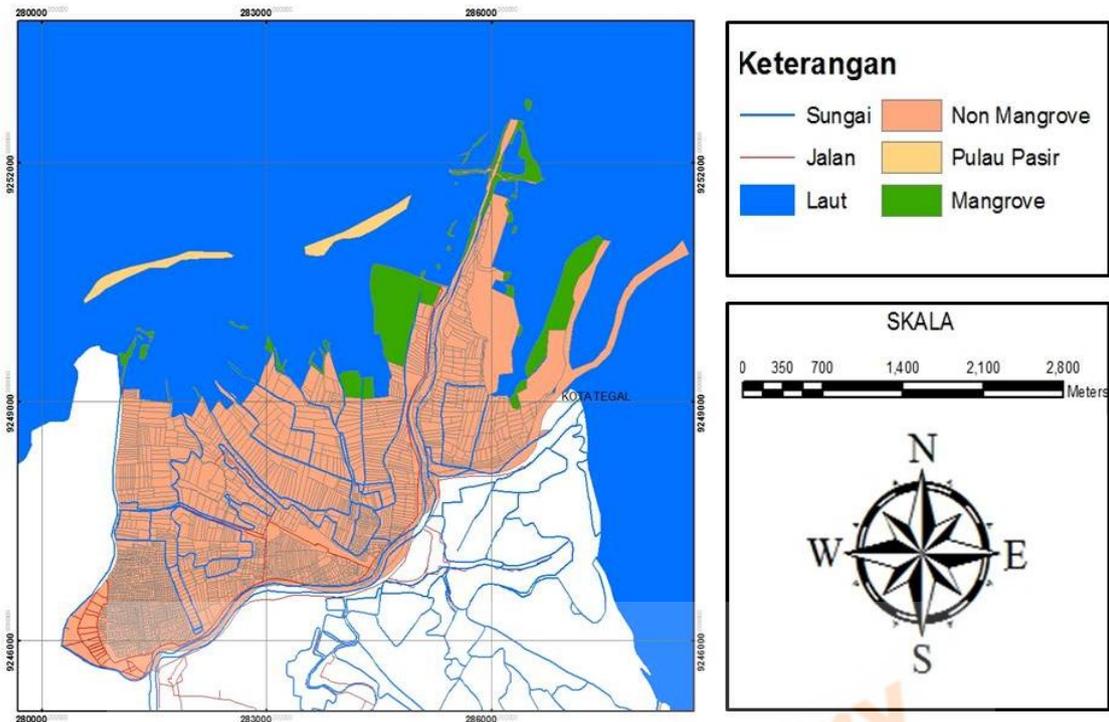


**Figure 2. Map of Abrasion and Accretion in Kaliwlingi Village on 1980-2014**

### *Potentials of the Kaliwlingi's Community*

Kaliwlingi's inhabitants have the same purpose of changing their conditions addressing the impact of climate change. Rural communities are homogeneous, highly depend 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. Figure 3 shows the map location of the conserved mangrove ecosystem in Kaliwlingi Village on 2005-2016. The process of conserved mangrove ecosystem is beginning with the establishment of a social community of mangrove ecosystem conservation named "Mangrovesari" by the inhabitants in 2005. This community managed to conserve an area of 207 hectares of mangrove ecosystems of the year 2005 to 2016, and still growing.

Figure 4 shows the mangrove ecosystem condition today in Kaliwlingi Village. These changes affect the development and diversity of aquaculture production (see Figure 5). The major commodities in the Kaliwlingi Village are shrimp, milkfish and crab farming. These commodities are depending on the condition of mangrove ecosystems. Although these commodities are developed, in fact, the community cannot improve the society welfare 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 house so as not flooded. This effort will continue 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.



**Figure 3. Map of Conserved Mangrove Ecosystem on Kaliwingi Village 2005-2016**



**Figure 4. Mangrove Ecosystem on Kaliwingi Village 2005-2016**



**Figure 5. Aquaculture on Kaliwlingi Village 2016**

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* (mangrove seeds). 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*. It becomes an additional income for fishermen and fish farmers. Figure 6 shows the seed bank of Kaliwlingi Village.



**Figure 6. The Seed Bank of Kaliwlingi Village**

The “Seed Bank” proposed to the company, NGO's and governments to finance conservation. The seed bank continues to growth not only the perpetrators of conservation but also become a supplier of mangrove seedlings for conservation in other areas. Now, “The Seed Bank” has become the largest supplier of mangrove trees in the area.

Mangrove ecosystem that well preserved turned out to attract tourists. This opportunity is well recognized by the community and government. Government invests in building tourism infrastructure, while Mangrovesari in charge of managing tourism. Mangrovesari has grown from a community of mangrove conservation into a community of eco-tourism in the Kaliwlingi Village followed by changes in the livelihood of fishery communities into the tourism community. The tourism principle emphasizes the direct community involvement of all tourism development activities from planning, implementation, and monitoring. Community placed as the main factors, which have the 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 in building the infrastructure and repairing public facilities damaged by climate change to support tourism activities in Kaliwlingi Village.

### ***Adaptation Efforts***

In 2014, the Kaliwlingi 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.

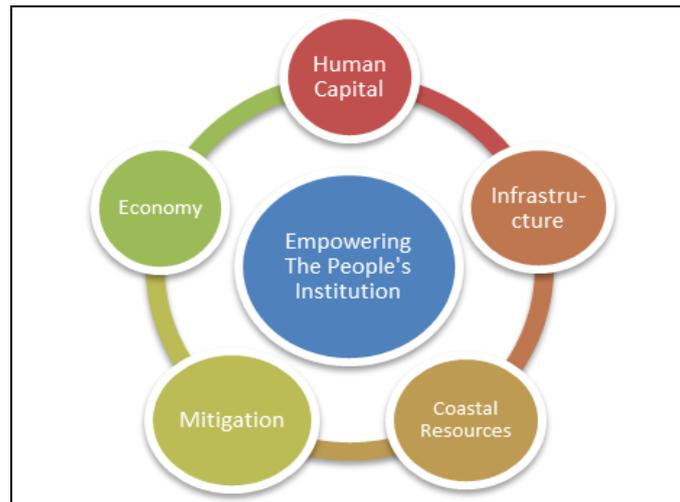
The success of the preservation of the mangrove ecosystem is not accompanied by the improving of settlements quality. Sharing society is limited in mangrove conservation, while the ability to improve the housing quality depends on the ability of each household or individually. It is because the community has the mindset of 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.

The government involvement began with a program named as *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 shown in Figure 7. As a result, the agreed common rules that prohibit logging of mangrove and the *deltaber* are a mangrove conservation area.



**Figure 7. People Built the Dyke on Kaliwlingi Village**

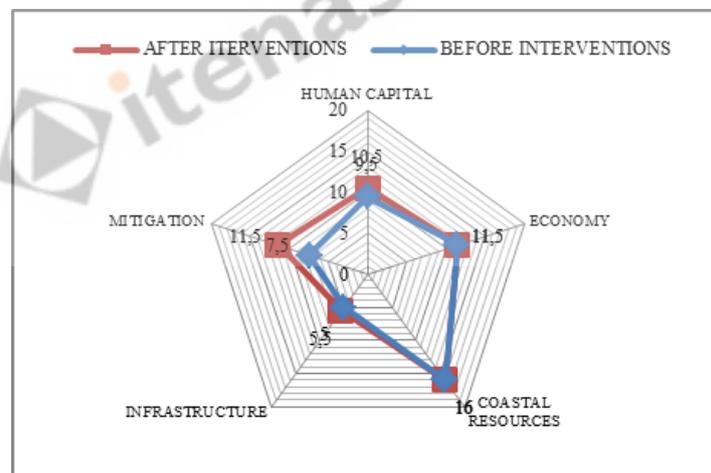
Further effort is Development of Resilient Coastal Area or *Pengembangan Kawasan Pesisir Tangguh* (PKPT) in 2015-2016. This program focuses on the coastal resilient area. The program has five focus points of treatment, based on the common problems that occur in coastal areas in Indonesia. The focus points are human resources, infrastructure, economy, environmental resources, and disaster mitigation conducted bottom up by the institutional community as shown in Figure 8 (Ministry of Marine and Fisheries, 2016a).



Source: Ministry of Marine and Fisheries, 2016a

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

In the PKPT program, the vulnerability to climate change is measured by five criteria, namely human resources, infrastructure, economy, environmental resources, and disaster mitigation as shown in Figure 8. The benchmarks are used to determine the priority in which it may be applied. Figure 9 shows the criteria measured after and before the intervention of PKPT program in Kaliwlingi Village.



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

PKPT program has a significant impact, especially in terms of disaster mitigation. 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. Figure 10 shows the community participation in PKPT program.

PKPT program brings 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. 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.



**Figure 10. PKPT Program on Kaliwingi Village 2015-2016**

### ***Social Capital of Kaliwingi's Inhabitants as Strengths in Facing the Challenges of Climate Change***

An adaptation made by the community is an instinct for survival. However, 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 the common rules. It is necessary that adaptive measures are not carried individualistic by citizens as before. Therefore, the community needs to be financially independent in implementing the common rules. Mangrovesari develops conservation activities into an industry and later evolved into the tourism industry. The existence of local community institution has the ability to collect the social capital, especially in economic perspective as the adaptive strategy. It is similarly with Adger (2003) who argues that social capital, framing by public and private institutions, increasing the understanding of community within the economics as a natural adaptation process. Social capital encourages the social networks and norm in the community in the production of adaptive capacity (Pelling & High, 2005).

Kaliwingi's inhabitants desire to improve the quality of life that deteriorating due to climate change as a strong foundation to adapt. The most effective way to reduce the impact of climate change is mangrove ecosystems conservation. At the end, we can learn that adaptation efforts can be successful if it is supported by a common desire to make life better.

The revitalization impact to the community lives. Changes in activity ensued as the development of tourism activities. Aquaculture as the main livelihood has been shifted to the sideline and the livelihood of the tourism sector and its derivatives are now the main livelihoods. 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

The environmental destruction and degradation force fish farmers and fishermen in Kaliwlingi Village to change livelihood. Moreover, the environmental changes such as erosion and accretion also lead to social conflicts for the community. Rural communities are homogeneous. However, they highly depend on natural resources and driven by a sense of common fate for damages and losses, 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. Thus, it will be tough to adapt without any mitigation. PKPT program has a significant impact, especially in terms of disaster mitigation, both in physical and economic aspects. The community of Kaliwlingi Village has the common rules to prohibit logging of mangrove and the *deltaber* as a mangrove conservation area. These common rules are collected into social capital and accommodated in a local institution. The existence of "Mangrovesari" as an institution is to mobilize villagers to implement the common rules. 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 in building 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 push the importance of the process to increase 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.

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