

## COMMUNITY EFFORTS FOR ADAPTATION AND ANTICIPATE TO FLOOD TIDE (ROB) IN BEDONO VILLAGE, DISTRICT SAYUNG DEMAK, CENTRAL JAVA, INDONESIA

Dewi Liesnoor Setyowati\*, Mohamad Amin\*\*, Tri Marhaeni Puji Astuti\*\*\* and Ishartiwi\*\*\*\*

---

Rob is a natural phenomenon caused by the tide, inundating coastal areas that have an elevation below the sea level. Rob has fluctuations and patterns of inundation, which interfere with the activity of the community. People in the Bedono village were inundated Rob, they must be able to adapt in order to survive. This study aimed to analyze the tidal fluctuations in the Bedono village, and formulate the concept of adaptation and anticipate in maintaining community wisdom to Rob. Rob with greatest fluctuation pattern, occurs from April to June, the height Rob reaches 50-110 cm, with the wide inundation area of 12.7 km<sup>2</sup>. Rob impact on community activities, loss of livelihoods, disruption of access to transportation, and social change. This adaptation is done by people associated with shelter, livelihoods, water, farming systems, social systems. Adaptation tidal flooding has become a culture for the villagers Bedono in the face of Rob. Society has learned from habit, and becomes an unwritten rule to anticipate the impact of Rob that hit their village. Habit for anticipation Rob had been a cultural, reflected in the knowledge, attitudes, and behavior the community in the face of Rob.

**Keywords:** cultural adaptation, disaster education, Rob, tidal floods.

### Introduction

Flood is a natural phenomenon that caused by overflow of water in the drainage system that can cause inundation and some negative impacts and losses. It is difficult to both community and government to overcome with these losses. The flood is caused by various factors both physical factors (such as catchment area, duration and intensity of rainfall, topography, and the capacity of the drainage) as well as the factor derived from human such as over exploitation due to the rapid population growth (Setyowati, 2016). The Flood phenomenon is caused include: rain, tides, water shipment from upstream or flash flood. The flood from tidal-tides called Rob.

Rob is an inundation phenomenon caused by the tidal-flood that flooded and stagnate into coastal areas, which is lower than mean sea level. The puddles of this

---

\* Departments of Geography, Semarang State University Semarang, Indonesia, *E-mail:* liesnoor2015@mail.unnes.ac.id

\*\* Department of soil and water engineering, Lampung University, Bandar Lampung, Indonesia, *E-mail:* amdw81@yahoo.com

\*\*\* Departments of Sosiology Anthropology, Semarang State University Semarang, Indonesia, *E-mail:* marhaenastuti@yahoo.com

\*\*\*\* Department of Science Education, Yogyakarta State University, Indonesia, *E-mail:* buisyk@yahoo.com

Rob usually occurred in four to seven days depend on the rain pattern and sunshine. It can be continuously occurred with water level varies, as a result of the force of gravity, water flows to the lowest and fill the entire space is on the lower part (Suryanti and Marfai, 2008; Ali, 2010). This flood give some negative impact to the city's infrastructure, such as ports, industrial zones and trade as well as inundating educational facilities and residential areas. The impact of flooding to the houses and buildings are cause damaged the floor of the house or building, such as cracked, tilted, weathered and sinking. On the other hand, Rob also affected the drainage system, and cause seawater intrusion so that groundwater becomes salty or brackish due to the inclusion tides in groundwater (Oktavia, 2012).

Tidal floods often occur in many coastal cities in Indonesia. Central Java is one of the areas in Indonesia which is frequently affected by disasters such as land slide, floods, volcanic eruptions and tidal flooding. The tidal flood occur in along the northern coast of Central Java. In fact, there are 26 villages in Central Java submerged because Rob. Rob gives a serious risk besides the abrasion, is resulting in shifting shoreline. Rob phenomenon also affects the lives of coastal communities because they have to adapt with Rob.

The total number of coastal villages in Demak district affected by the tidal flood is 10 villages spread is the village of Sriwulan, Bedono, Purwosari, Sidogemah, Gemulak, Tugu, Timbulsloko, Surodadi, Sidorejo, and Banjarsari. The inundation of Rob not only affect the villagers' fishponds but also public facilities such as administrative offices and schools. The map analysis in period 2003-2013 shows that within 10 years there has been a change the settlements. Changes highest settlement in the Bedono village caused by abrasion and inundations (Damayanti, 2013; Asiyah, *et al.* 2015). At first the village Bedono has seven hamlets: Bedono, Mondoliko, Rejosari Senik, Pandansari, Tonosari, Tambaksari and Morosari. The affect of abrasion is getting worse cause hamlet Tambaksari permanently submerged in sea water. The people living in this region relocated to Purwosari and Sidogemah.

Subsequently in 2004 conducted relocating again the Dusun Rejosari Senik. Rejosari Daleman relocated to the Village Sidogemah. There are five village that still survive and are in the village Bedono. Figure 1 shows the hamlet Rejosari which has become a mangrove forest. Roads were cut off due to the floods and more severe abrasion, making villagers Rejosari gave up and moved to safer areas of impact Rob (Damayanti, 2013).

The impact of Rob occurred in the village of Bedono affect the activities of citizens. Society must deal with and anticipate the phenomenon of Rob. The efforts undertaken by the society toward flood include rise the floor elevation because of water flowed to the house. Some residents who do not have the funds to raise the floor, they built a dike around the house so that water does not get into the house. When flood inundate the road, the activity of economic and education have disturbed. The people can not access the road to go to the school and go to work



**Figure 1:** Broken road in Village Bedono (documentation April 19th 2016)

place. Rob existence has disrupted community activities, occur social change the people. The social changes demanded people to be able to adjust to adapt in its environment. Community adaptation is the wisdom that should be preserved because it allows the community to survive in the Rob area. The objective of the research are: 1) analyze the tidal fluctuations in the Bedono village, 2) formulate the concept of adaptation and anticipate to keep the community wisdom toward rob.

### **Method**

A qualitative approach used in this research. The study was conducted in the village Bedono Sayung District of Demak Regency. The processed data are primary and secondary data. Primary data were obtained from informants selected by snowball sampling technique, with the consideration that the informant is considered to know and be able to provide appropriate information needs on the research.

The data collection is done by observation, documentation, and interviews. The focus of research is the tidal fluctuations (time, altitude, and wide rob), adaptation to Rob, and Rob disaster education based on community wisdom. This study uses measures model of interactive analysis of data reduction, data presentation, and conclusion or verification. Analysis of the data used in this research is the analysis of model data Spradley, form of taxonomic analysis, and thematic analysis.

### **Finding and Discussion**

#### ***The Fluctuation of Rob in Bedono Village***

Rob that occurred in the Village Bedono has inundated the entire area. According to one of the residents, Rob has occurred since long time ago because basically



**Figure 2:** The Location of The Research in Bedono Village, Central Java, Indonesia

Rob is a natural phenomenon. At first incident, Rob did not disrupt people's lives. However, in line with the increasing population, the demand of land has been gradually increased. at years 1999 tidal fluctuations become increasing and cause larger impact. The phenomenon of the reclamation somewhere will cause change direction of ocean waves and causing abrasion on the other side of the beach (Asmawi and Ibrahim, 2013; Hedge, 2010).

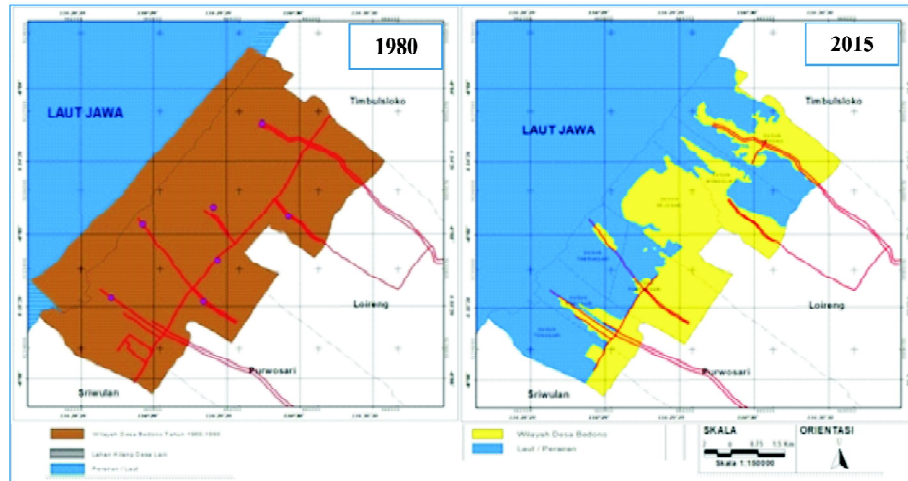
Rob is gradually impacting on the lives of the Bedono villagers. As said by one of the residents, Rob getting worse. Rob initially occurred around 1999, the Rob phenomenon extends and move higher up in 2007 further to the present territory. Since 1999 the villagers of Bedono already familiar with Rob entered to their house. The community can learn and know when Rob would come. They observe season based on the knowledge they learn, while they were worked as a fisherman.

According to the villagers, a higher tide usually occurred in 'mongso kesongo'. The term of 'mongso kesongo' addressed to month April-June. In May, even June to August the tide has an average elevation more than 90 cm. Rob occurred 2 times a month. This process need about 5-6 hours, about 4 hours to tide up and its peak about 2 hours. After experiencing its peak Rob will gradually recede until returning to the normal water level. When the Rob will be accore can not be predicted. But, people can have alook to the monthly data of tidal flood in Bedono Village. By this data, people can aadjust the timing of the tidal. At the time of the highest Rob months ie from April to June, the common Rob starting at noon and downs late in the evening. Meanwhile, in the months during the dry season Rob common during the early hours until morning.

The community in Bedono believe that Rob is not affected by the rainy season. In the rainy season, eventhough there are a lot of rainy day in their area, the elevation of flood is not high even low. But if the Rob followed by flood due to the heavy rains in the upstream, the village of Benono which is located in the downstream will be affected the altitude of Rob. In average, Rob in the Bedono village has 70

cm height from the receded position. Meanwhile, Rob peak has an altitude of about 110 cm from the receded position. With an average height of the embankment road 50-100 cm from the surface of the sea, at the time of the tidal peak, the water will flood the street or the lowest points in Bedono. In line with the Rob, there is a wave that caused the scrape abrasion in Bedono Village area. Rob indirectly cause a reduction in the Village area Bedono both administratively and function.

Based on field observations, Rob which followed by erosion and abrasion will lead to loss of land in the impacted area. This will result in land reduced. Figure 3 shows that the area of the Bedono village in 1980 shown in brown color, has been drowned and become reduced caused by Rob. As shown in yellow color, in 2015 Bedono Village area becomes smaller.



**Figure 3:** Map of Village Bedono in 1980 and 2015

Rob cause further coastline juts into the mainland. In 1980, the Bedono village has an area of 20.18 km<sup>2</sup>. In 2015 the area was reduced to approximately 14.8 km<sup>2</sup>. It means that Bedono area experienced a reduction of up to 5.3 km<sup>2</sup> (Figure 3). This rest of the land has the same problem, reduction become 5.3 km<sup>2</sup>, this area has been submerged by water due to tidal and only remaining 7.4 km<sup>2</sup>, as known as Bedono village. Based on observations and interviews with the villager, trends of the Rob occur in the coastal of Bedono village or area with water border.

#### ***Community Efforts for Adaptation to Rob***

Adaptation is the ability of a society to adapt to changes and its variability, in order to reduce potential damage, benefit from or mitigate the impact (Frankel-Reed., 2011). Rob incident has occurred for many years, so that the villager of Bedono have been adapt to Rob. This adaptation undertaken by the community to

be able to withstand the various effects they experienced. Various impacts can be addressed by the citizens without leaving their house.

Adaptation is a community effort to adjust and deal with the situation in their surrounding area. Adaptation to the tidal flood undertaken by the community is a self-adjustment strategies and used by the community as long as there is Rob in their residential areas. Various kinds of adaptations made Bedono Village community include: shelter, livelihoods, clean water supply, aquaculture systems, and the social system.

Adaptation activity on their house and shelter has been done by the community in order to remain living in their houses Tahun (Marfai, et al., 2008c). The high level of water entering the house enforce the community to do an adaptation to their building. At least there are three kind of action has been done by the community in Bedono Village. For people who have an emergency budget, they built an extra floor for their house. Meanwhile, for those who do not have enough money, they create a dike in their surrounding area or fill the flood with some sand-sack.

Model houses on stilts to elevate the house by making houses on stilts, like custom homes in various regions in Indonesia (Fig. 4). Use of house stage was quite effective in order to overcome the effects of flooding, because when Rob storey houses will be much higher than the water level. Home stage methods have risks of wood used for the home will not last long, the wood easily weathered. Another way is to elevate floor of the house with boards make to use as a replacement floor of the house. the house stage model makes the water part of just flooded the lower floors, the house with models DAK board menjadikan house feels cramped because the walls of the house was only a half, the roof of the house used as the floor of the house.

Adaptation on livelihood shown by the number of people who switched professions from the majority of fish farmers to various professions. Most of the people in productive age population choose to work as industrial workers in some factories located in the industrial area close to their settlement. This switchover was chosen as the impact of lost of land due the rob.

In case of clean water supply, people manage their water supply by built an artesian well. Cement wall applied in the well to retained the water from intrusion, so the sea water does not get into the well. Water from this well will be accommodated in the some water-tank before distributed to the villager's houses.

The water adaptation is a culture system has learned from the experience to anticipate the Rob impact on the pond. Currently, the pond is already protected by a dike, there is absolutely no pond outside embankment to avoid the waves during Rob. Even now, the fish pond or 'tambak' only use net-pond so easily repaired when it damaged. Adaptation action into various impacts of Rob will be able to minimize losses caused by rob.

Losses on house building due to the sea level rise can be reviewed based on the physical function of house building and losses due to the loss of the investment cost of the house. Wuryanti (2002) stated, a loss of physical function and loss expenses incurred as a result of stagnant water can be minimized. If society can adapt to natural changes occurring and can reduce the rate of loss.



**Figure 4:** House Stage: increasing elevation of the floor in the village Bedono

The government's role is very important to handle the various impacts that occur due to Rob. The government as the representative and stakeholder which is supposed to protect the public with the various problems faced by the community. The impact of Rob in many areas, force the government to take an appropriate and fast response and decide the appropriate policy to be able to resolve the issue.

Government is attempting to help in terms of improved public facilities. Repair and road-concreting done by the government to improve the quality and the strength of the road so it would not easily damaged even if submerged by the Rob. However, the submissions to get government support is often hampered by delays in the submission of proposals relating to bureaucracy. For that, the government should facilitate with a better system in resolving community problems, especially related to rob.

Government is attempting to help in terms of improved public facilities. Repair and road-concreting done by the government to improve the quality and the strength of the road so it would not easily damaged even if submerged by the Rob. However,

the submissions to get government support is often hampered by delays in the submission of proposals relating to bureaucracy. For that, the government should facilitate with a better system in resolving community problems, especially related to rob.

TABLE 2: FORM OF ADAPTATION, HANDLING, AND ANTICIPATION OF ROB

<i>No.</i>	<i>Form Adaptation</i>	<i>Handling and Anticipation of Rob</i>
1	Form of Adaptation	<ol style="list-style-type: none"> <li>1. Settlement</li> <li>2. Livelihood</li> <li>3. Clean Water Supply</li> <li>4. Aquaculture System</li> <li>5. Community Social System</li> </ol>
2	Disaster Endurance	Exploiting the potential result of the rob
3	Institutional Effort	<ol style="list-style-type: none"> <li>1. Management of Rob potency</li> <li>2. Repair public facility</li> <li>3. Collaboration with NGO to manage Rob and its potency</li> </ol>
4	Government Effort	<ol style="list-style-type: none"> <li>1. Improvement of government facilities</li> <li>2. Improved transportation</li> </ol>

The Government should cooperate with local government or institution and other related agencies in providing warning systems to inform people about the flooded road line to avoid congestion, especially during out-of-work time (Tu and Nitivattananon, 2011). The impacts of Rob and adaptation are part of the larger question of how complex social, economic and environmental subsystems interact and shape prospects for sustainable development (Munasinghe & Swart, 2005). Adaptation options especially in coastal settlement must be consistent with economic development, environmentally and social sustainable over time. Sustainable development and adaptation to climate change are interlinked. The sustainable development strategies could make adaptation more successful. Furthermore adaptation policies can be a policies which are arranged to help promoting sustainable development.

***Cultural adaptation through Rob Disaster Education to maintain the community's wisdom***

Adaptation as the adjustment to the environment must be adapted to the real situation. Rob as a natural phenomenon, and people can get the adaptation pattern of Rob. The use of appropriate adaptation system, is expected to minimize the cost and the impact caused by Rob. Bedono village is a village that still persist with various kind of severe impact of Rob, evidenced by; 1) lots of land, settlements and roads were flooded during Rob, 2) the number of villager fish ponds were become sea, so that many fish farmers lost livelihood, 3) transportation in the village Bedono inhibited so disrupt community activities, 4) impact on of public services during Rob was also affect community activity.



Bedono villager should be able to adapt to maintain the environment from Rob. the forms of adaptation in the Bedono village: adaptation in term of settlement, aquaculture systems, livelihood, clean water, and social systems that exist in society. Table 3 describes the form of wisdom and community preparedness toward Rob in Bedono Village.

TABLE 3: CULTURAL ADAPTATION, SOCIAL WISDOM AND COMMUNITY PREPAREDNESS TOWARD ROB

<i>Cultural Adaptation</i>	<i>Social Wisdom and Community Preparedness</i>
Form of local wisdom toward Rob	<ol style="list-style-type: none"> <li>1. Rob Fluctuation</li> <li>2. Rise the floor elevation</li> <li>3. Transportation</li> </ol>
Community Preparedness and Adaptation	<ol style="list-style-type: none"> <li>1. Cost preparation</li> <li>2. Rob Observation</li> <li>3. Timing on improve house and infrastructure quality</li> </ol>

In studying the community wisdom toward Rob, it can not be separated from the community knowledge about Rob. Knowledge of Rob usually comes from many years of experience in dealing with Rob. Community wisdom for Rob affected can be observed through how society to equip, maintain, and improve patterns of cultural adaptation they did. Community Wisdom related to equip themselves, can be observed from the community’s efforts to prepare an emergency saving and strength to do an adaptation response. Many impacts caused by flooding, will not escape the cost of adapting. The cost of adaptation is affected by the form of adaptation will be taken. Therefore the cost of preparation undertaken by the community is also a cultural of community wisdom toward rob.

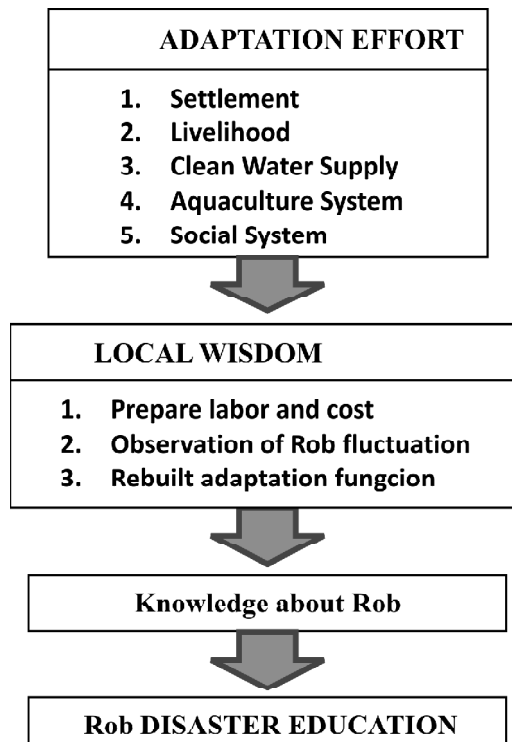
Maintaining cultural can be observed in society themselves toward Rob. Regular observation of the timing and fluctuation of the regular Rob can help the community to predict the Rob. By knowing the timing of the high of Rob, people can anticipate various impacts and help them not getting worse. By knowing the altitude of Rob, the vulnerable communities can observe how the functions of community adaptation is being done. By improving the function of cultural adaptation that are no longer used, such as houses or roads have been inundated, the objective of adaptation expected will be achieved.

Various forms of knowledge about Rob solely addressed help communities to adapt with the impact of Rob. This wisdoms eventually forms a new culture of society toward Rob. An appropriate learning to the community in addressing Rob is people should first understand Rob characteristic. By understanding Rob, people will be understand causes and impact of Rob, so that people can anticipate the worst things. Through an understanding of the community can better prepare for flooding, various forms of preparation will be owned by the community in dealing with rob.

The concept of disaster education toward Rob must be at least implies knowledge, forming attitudes, and skills or behaviors of society. Figure 6 is form of cultural adaptation schemes, wisdom and Disaster educational concept presented in community knowledge about Rob keeps them survive. Several knowledge such as seasons, altitude measurement, the costs of adaptation can they get from their own experience which is gained over many years of living in the tidal flood prone area. In fact, people would like to stay in their current settlement area, people will do some kind of adaptation in order to deal with rob.

Various measures taken by the community to overcome the impact of Rob in their region. Starting from raising a wide range of public and private infrastructure that is submerged in water. Switchover the profession in order to keep earning a living cost to survive. Providing clean water with the use of water reservoirs are also performed.

Tu and Nitivattananon (2011) said that the adaptation related with the develop appropriate and effective adaptation options to reduce the vulnerabilities and risks, assess and evaluate potential adaptation measures, choose preferred adaptation measures, develop action plans that contain of adaptation measures and incorporate



**Figure 6:** Scheme a adaptation culture through Rob Disaster Education

means to address barriers, as well as implement and monitor the adaptation measures for effectiveness evaluation. According to Satterthwaite, et.al (2009), adaptation has to address pre-disaster and postdisaster vulnerabilities. In pre disaster, adaptation should focus on reducing the hazards where it possible or reducing people's exposure to the hazards. It should also focus on reducing the impacts of the hazards, for instance to respond the flood's impacts to people's health, living conditions, assets and livelihoods. In post disaster response, it is not only focus on assisting people to rebuild their homes and livelihood, but also encourage and support measures that reduce risks from likely future hazards.

### **Conclusions and Suggestions**

The pattern fluctuation Rob that occurred in the Bedono Village occurs only once in a day and the usual big-rob occurred in mid year around April. Every month there are 2 times higher Rob. The normal inundation has 50-100 cm with an average tide as high as 70 cm. Meanwhile, the highest Rob is 110 cm high. Extensive inundation caused by Rob in the village Bedono approximately 12.7 km<sup>2</sup>.

As a result of the occurrence of Rob that cause various effects, Bedono village society must adjust to Rob phenomenon. Adaptation is done from the shelter, livelihoods, clean water, aquaculture systems, to the social system in the village Bedono. This adaptation aim to survive and stay in their house. Integration can be observed by the many people who switchover their livelihood to get another income source.

Cultivate the habit of caring Rob to maintain the relationship between the community and the structural behavior of the people that have been done for many years. Society has learned from habits and has become an unwritten rule to be able to anticipate the impact of Rob that hit their village. Habits that have been made is the culture of anticipation Rob, called disaster education of Rob.

### ***References***

- Ali, Muhammad. (2010). Housing Building Losses Due to Rob and Handling Policy Directions in Rural Bandarharjo Semarang. Thesis. Semarang: Diponegoro University.
- Asiyah, S., Rindarjono, M G. Muryani, C. (2015). Analysis of Changes, Settlement and Slum Characteristics Due to Abrasion and Coastal Inundation In Sayung District of Demak Year 2003 - 2013. *GeoEco* 1(1): 83-100.
- Asmawi, M. Zainora and Ibrahim, Ainaa Nawwarah. (2013). Perception of Community on Coastal Erosion Issue in Selangor, Malaysia. *Journal of Clean Energy Technologies*, vol 1, No. 3 July 2013.
- Damayanti, Kurnia. (2013). Abrasion Impact on Social Environment Beach (A Case Study in the village of Bedono, Sayung Demak). Proceedings of the National Seminar on Management of Natural Resources and Environment, 2013. Bandung: Puslitbangkim.
- Frankel-Reed, J., Barbara, F.T., Ilona, P., Alfred, E., & Mark, S. (2011). Eschborn: Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ).

- Hedge, Arkal Vittal. (2010). Coastal Erosion and Mitigation Methods, Global State of Art. Indian Journal of Geo-Marine Sciences, vol 39(4) pp 521-530.
- Marfai, M.A. (2011). The hazards of coastal erosion in Central Java, Indonesia: An overview. *Geografia: Malaysian Journal of Society and Space* 3:1-9.
- Marfai, M.A. and King, L. (2008a). Coastal Flood Management in Semarang, Springer: Environmental Geology. 55: 1507-1518.
- Marfai, M.A. King, L. Singh, L.P. Mardiatno, D. Sartohadi, J. Hadmoko, S.D. Dewi, A. (2008c). Natural hazards in Central Java Province, Indonesia, Springer: *Environ Geol.* 56: 335-351.
- Munasinghe, M & Swart, R (2005). *Primer on Climate Change and Sustainable Development; Facts, Policy Analysis and Applications*, Cambridge University Press, Cambridge. Munasinghe, M & Swart, R 2005, *Primer on Climate Change and Sustainable Development; Facts, Policy Analysis and Applications*, Cambridge University Press, Cambridge.
- Oktavia, M.I. Parman, S. Setyowati, D.L. (2012). Distribution Analysis of Sea Water Puddle tides (Rob) Based on High Water Level and its Impact on Land Use in the District of North Semarang. *Geo Image*. 1(1): 13-20.
- Satterthwaite, D., Huq, S., Reid, H., Pelling., Lankao, P.R., (2007). 'Adapting to Climate Change in Urban Areas : The Possibilities and Constraints in Low- and Middle-Income Nations' in *Adapting Cities to Climate Change; Understanding and Addressing the Development Challenges*, eds. Bicknell, J., Dodman, D., Satterthwaite, D. Earthscan, London/ Sterling, 2009.
- Setyowati, DL, and Rachman, M. (2016). Community Based Flood Disaster Education Model to Improve People's Awareness to Flood in Banjir Kanal Barat, Semarang Indonesia. *Proceeding BESSH-2016*, Vol. 127-Issue.5, 33-38. Academic Fora
- Suryanti E.D, Marfai M.A. (2008). Community Adaptation Coastal Region Semarang Against Dangers of Flood tides Sea Water (Rob). *Journal of Disaster Indonesia*. 1 (5).
- Tu, Tran Thanh and Nitivattananon, Vilas. (2011). Adaptation to flood risks in Ho Chi Minh City, Vietnam. *International Journal of Climate Change Strategies and Management* Vol. 3 No. 1, 2011 pp. 61-73. Emerald Group Publishing Limited.
- Wuryanti, Wahyu. (2002). *Losses Identification Building Houses In Coastal Sea Level Rise Due*. Bandung: *Proceedings Puslitbangkim*.