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HOUSEHOLD VULNERABILITY TO ENVIRONMENTAL CHANGE: EXAMINING ADAPTIVE CAPACITY OF HOUSEHOLDS TO FLOOD RISKS IN PALEMBANG

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ABSTRACT

Urban flood has plagued many metropolitan cities in Indonesia due to various reasons such as mismanagement of land use, overpopulation and poor drainage systems. Palembang on the other hand, is one of metropolitans in Indonesia, where most of its areas are dominated by wetlands, where many large and small rivers are located. The high demand to residential areas has caused many landuse changes from wetlands to dry lands by doing reclamation. As the result, the incidence of flood in Palembang has increased significantly in past years, which leave the society grappled with emerging challenges. This study aims to identify the adaptive capacity of the society affected by flood. The area selected as the case study is Macan Lindungan village which severely hit by flood. The survey was conducted on 210 families (KK) and the analytical method used is descriptive method of statistical analysis and correlation analysis to identify level of adaptive capacity and adaptive capacity relationship among the contributing factors. In addition, the analysis was also performed spatially to project the condition of the adaptive capacity based on the location in the study sites. This study demonstrates that the flood particularly exacerbates the economy of low-income society. Moreover, adaptation still largely focus on structural as elevating homes and storing other valuables, while the non- structural adaptation still focus on emergency funds. Finally, it concludes that preparedness of the society should be supported by both structural and non-structural policies from the government so that the risk of flood can be comprehensively reduced.

Keywords: Adaptive capacity, Big cities, Environmental, Flood, Low income, Vulberability

INTRODUCTION

High growing urban development in Indonesia requires a lot of areas for development. However, some cities have limited space to grow due to various reasons. Some high land cities have hilly areas that prevent for development while some other cities have limited due to water body or wetlands. In some cities that have a lot of wetlands, some wetlands are drained to be used for development areas. These activities are commonly found in the cities in Sumatra and Kalimantan Regions, such as Riau, Jambi, Palembang, Palangkaraya and Banjarmasin. These have increased the vulnerability to flooding, because less space for water.

In some areas of Indonesia, floodings are impacts of land use change. In Jabodetabek area, the landuse change in the upstream region of Bogor, Puncak and Cianjur (Bopuncur) has led to the increase of run-off to the downstream section to Jakarta (Sagala et al 2013a). Similarly, Sagala et a1 (2013b) observed in Palembang that wetlands conversion to drylands have occurred tremendously from early 1900s to the present that caused limited space for water.

One of the areas experiencing land use change is a large wetland conversion in Palembang City. In needs of spaces for built up areas, wetland areas in Palembang have been reclaimed. The demand for wetlands conversion are mostly due to housing and ecomic expansions of the city. Private developers conduct reclamation and make land available for new housing developments. As the impact of land-use changes, increased incidence of floods have occurred in the several decades. Some people have started to adjust their housing and actions to the flood events. This study, focusing on flood vulnerability to the people and how people have developed their adaptive capacity to environmental changes. Further, this study examines how these adaptation can be enhanced to achieve community resilience. Some parts of the discussion and the result of this research include the people's perception of the flood disaster that occurred and how the adaptation of society in the face of floodsThis paper focuses on household vulnerability to environmental change. Household vulnerability is defined as a function of sensitivity, exposure, and the state relative to a threshold of damage (Luers, 2005). The vulnerability is a factor that determined the magnitude of the impact will be received in the future community. One of the activity taken to reduce the vulnerability of communities that are socially acceptable to take action adaptation. The vulnerability environmental changes and increased flood risk studied that exist in the location. The impact of the floods experienced by the adaptations so that people can reduce existing flood risk.

MATERIALS AND METHODS

Household Vulnerability and Adaptive Capacity to Environmental Change

Vulnerability is generally defined as the susceptibility to damage, and is often measured in terms of impacts to physical, economy and social aspects. It is also seen as the sensitivity to or exposure of a system (people or place) to shocks, stresses or disturbances, the state of the system relative to a threshold of damage, and the system's ability to adapt to changing conditions (e.g. Luers et al., 2003; I PCC, 2001 ; Turner et al., 2003a, b; Smit and Pilifosova, 2002; Dowing, 2001; Mitchell et al., 1989; Chambers, 1989).

The forces that cause these problems include external phenomena such as climate variability and change, floods, and market fluctuations.Vulnerability can be affected by several factors, such as demography, social-psychology and physical characteristics of the system. In this study, the vulnerabilities are focused on physical and economic impact of flooding to the residential areas.

Vulnerability differs from one person to another and one community to another. The differences could also be due to their

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differences in term of adaptive capacity (see next section Adaptive Capacity).

Adaptive Capacity

Adaptation is a concept of behavioral changes or developments that allow living creatured or system to cope with various changes that occur in an effort to survived (Futuyma, 1979; Winterhalder, 1980; Kitano, 2002). Adaptation can to be in groups and individuals. Adaptation is a long-term process that is carried out by someone in an effort adaptation to various environmental changes occur (Dobzhansky et al, 1977; O'Brien and Holland, 1992). One component of life is associated with cultural adaptation, where the culture is one of the important components in an act of adaptation, culture acts as a persuasive medium so that an adaptation actions undertaken by the community (O'Brien and Holland, 1992).

Adaptive capacity is one of the major variables in land use change or variability of climate. The success of an action performed by a human adaptation depends heavily by human adaptive capacity. Adaptive capacity is defined as a potential or capability of a system, region or community to adaption to the impacts or effects of climate change (Smit and Pilifosova, 2001). Some definitions related to adaptive capacity as expressed by Carl Folke (2002) adaptive capacity is the ability of a social-ecological system to cope with new situations without losing options for the future. Keskitalo (2006), adaptive capacity is defined as the ability of the wider system to address the risks and opportunities related changes. Brooks and Adger (2005), adaptive capacity is the ability of a system to adjust the characteristics or behavior, in order to expand the reach of these systems in the face of current climate variability or future climate conditions.

Adaptation society is formed by experienced of community in the face of climate change or land use change (Grothmamn and Patt, 2003). Climate change is happening slowly and in a long period of time shaping the knowledge society to change the existing environment. As an illustration of the community began to elevate their homes when flooding several times in their home (Grothmamn and Patt, 2003). Knowledge society is formed after the same events repeatedly occur as well as enviromental change occurs slowly shaping the knowledge society. Public perception of knowledge come form communities to climate change or enviromental change (Grothmamn and Patt, 2003).

Methodology

In April 2014, questionnaires were administered through stratified random sampling approach to the households (n — 210) living in Macan Lindungan Village. Macan Lindungan Village is one sub urban city of Palembang who have wetland conversion are high and have a history of regular floods occur every year. Total population of the three research areas are approximately 20,000 individuals. The process of taking samples was based on the household total population, as many as 210 households from three research areas. The number of samples was decided upon alpha level of trust: 0.01 for population with 1,000 to 10,000 individuals, so the size of samples was 173 - 209 (Bartlett et al., 2001). To avoid errors while inputting the data, some questionnaires' content are not being recorded, and other error, the total number of samples taken were 210. Based on this, the sample is divided proportionally. We also noted household's house location coordinate utilizing Global Position System (GPS) device to measure the location respondents' houses.

The questionnaire comprised a list of structured questions developed for environmental change, vulnerability and adaptive capacity. The informantion about environmental change covered by how wetland change every year, rainfaal, and phenomenon of sea level rise in coastal South Sumatera. The Vulnerability get from observation and quisionerr. The questions covered socio-demographic profile of the households such as gender, occupation, age, education, income, and presence of children.

In Macan Lindungan Village, the sample comprises 51% males and 49% female. Most of household members born in the village and have stayed in their hamlets more than 10 years. While the plan was to cover households with a variety of ages, most particiapants were under 30 years old. The occupations in study case are dominated by housewife (24,5%) and private company service (19,1 %). Levels of education in both study case location are dominated by people who have graduated from primary schools, junior high schools and high schools. Most of the households have their income over than 2,000,000-4,000,000 IDR monthly / 200-400 USD monthly.

Table 1. Household Characteristics

Charateristics	**Variabel**	**Percentase** (%)
Sex	Man	51.0
	Woman	49.0
Type Job	Entreprenuer	15.7
	Civil Servant	15.7
	BUMN	11.1
	Private Company Service	19.7
	Housewife	24.5
	Farner	4.0
	Other	9,4
Income per Month	<200 usd	19.2
	200-400 usd	43.4
	>400usd	37.4
Length of Stay	<15 year	74.7
	15-30 Year	23.7
	>30 Year	1.5
Education Level	Elementary	10.6
	Junior High School	41.9
	Diploma	20.7
	Senior High School	1.5
	Bachelor	20.7
	Undergraduate	4.5

RESULTS AND DISCUSSIONS

Environmental changes in the wetland Area

Environmental change in Palembang occurs due to urban developments. The change has cause a number of ecosystem inability to internalized the impact. One impact occurs on loss of biodiversity while others in term of damages of natural channels (creeks) and natural ponds.

Palembang is one of the cities that experienced significant economic growth. Economic development will increase the demand for land up in Palembang City. The level of land use can not be removed with the growth of land up in the city woke Palembang.Lahan is generally increased housing and settlement, trade and service center, and a variety of other areas awakened.

Figure 1. Wetland Area in Jakabaring

Palembang Urban Development generally concentrated in the city center with a number of land up around 4.5% (in 1919) at which time most of Palembang City in the form of wetland and river. Conditions currently has a land area of Palembang woke 34.5%, an increase in the amount of land up is caused by the growth of economic activities in Palembang City as the tourism economy, trade and services, as well as the development of a variety of other important facilities that encourage people to reside in the City Palembang. Changes in land use in Palembang City led to the attraction of activities outside of the city to be located in Palembang City.

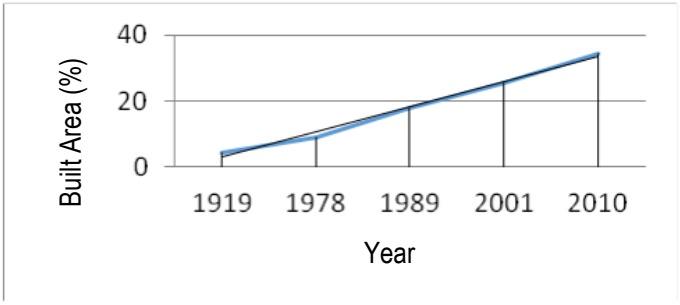

Figure 2. Built Up Area in Palembang City
Source: Bappeda Palembang 2010

Wetland in Palembang City changes relatively high. Total wetland for almost 80% in 1919, remaining wetland is about 25% in 2010 (figure 1).

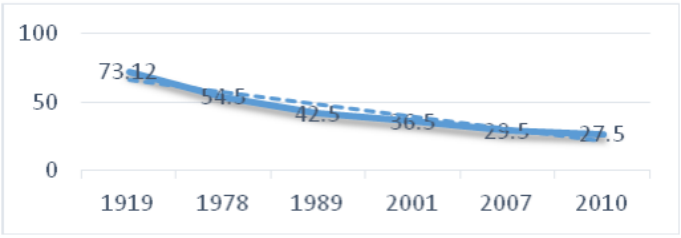

Figure 3. Loss of Wetland Area in Palembang City
Source : Bappeda Palembang 2010

Wetland change to built up area in Palembang triggered flooding. Flooding becomes regular disaster in the Palembang City. The flood disaster at first suburb commemorate Palembang mostly wetland area. Palembang development progress over the impact on land use areas are turning into a wetland land up. Palembang mostly consists of wetland areas that are prone to flooding, especially when the rains come. Land that is not waterlogged terrain as much as 49%, which is seasonally flooded there as much as 15%. The continuously flooding soils as much as 37%.

Environmental change is one of the impacts result from the development of a region. Environmental changes often caused by the inability of an ecosystem to accommodate elements that are inside. One of the environmental change phenomena that occurs is a change from wetland area into built up area in the city of Palembang. The one area that are changing the environment that is high enough in Macan Lindungan Village. Environmental changes which occur commonly on wetland into housing.

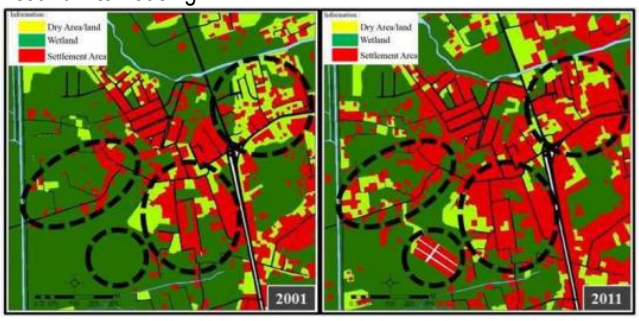

Figure 4. Land Use Change between 2001-2011
Source : Analysis, 2014

The figure above shows the development of wetland use changes into built up especially housing. Settlements and housing increased 29.51 Ha (16.18%), the land area decreased by 26.66 Ha of Wetland and dry land decreased by 2.63 hectares in the past 10 years. An average of 2.95 Ha wetland changes each year,. If the house has a floor area of an average l00m°, the number of houses built in one year was 300 houses.

The phenomenon of wet land use changes into settlements area is also accompanied by changes in rainfall and temperature increased global events which have an impact on sea level rise. Rainfall in the city of Palembang showed in figure 33.1 -564.2 mm in the last decade. In addition to the high rainfall, the events of sea level rise in coastal South Sumatra which influenced the increased in global temperatures. It is estimated that each year there is an increased in sea level as far as 0.5-0.7 cm per year (Latif, 2011). Palembang and the surrounding areas have a very high risk of coastal inundation. This was due to a combination of vulnerability factors such as 1ow soil surface to sea level on average, down slope topography, land that is widely used for residential and industrial, largest population, and increasing sedimentation of Musi river.

Environmental changes in the wetland into residential land, the increased in precipitation and sea level rise phenomenon allegedly caused more frequent flood. Flooding occurred as a result of the decreasing ability of the land to accommodate the run-off from rainfall who increased. In addition, the phenomenon of sea level rise is also increased the threat of floods, due to high sedimentation Musi river caused the event of sea level rise is run off to the area around the Musi river. The figure below indicates how an increased in flooding events in one location in the Macan Lindungan Village at BSI residence. BSI is one residence developed by hoarding wetland to built up or house.

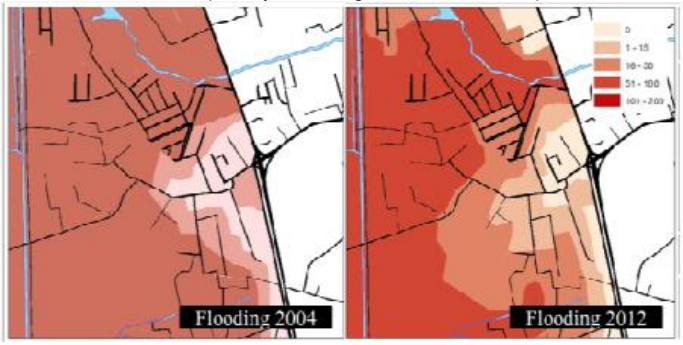

Figure 5. Floods Occurred after landuse change in Macan Lindungan Village
Source: Analysis, 2014

Based on the figure above, there are some changes with the depth of the inundation which got deeper in 2012 compared to 2004. From the total 124 Ha area of study in the BSI residential area, the coverage of uninundated land seemed a little bit increasing with the reate of 9.76% from 2004 to 2014. On the other hand, the coverage of flood with the inundation level of 0-15 centimetres was increasing 30.27%. On the contraty, the flood coverage of 16-50 centimeres was decreasing 65.89% from 2004 to 2010. However, those loose number became worse since it turned into a more deeper inundation with the level of 50-100 centimetres or equal to knee to waist of normal adult. This level of inundation covered 52.54% of total area of inundation in 2012. This 50-100 centimetres inundation had not existed in 2004, yet the 16-50 centimetres inundation already covered 84.62% of all flood area and it only shared 28.92% coverage in 2012. The environment change (land use, rainfall, SLR) encourage the rise in the intensity of the flood disaster that occurred. The environment change will increased the threat of flooding to the study sites.

Communities Vulnerability

Vulnerability is one of the components that determine the magnitude of impact that will be felt by the public when a catastrophic event occurs. Vulnerability in the study area were analyzed based kerentana physical and socio-economic vulnerability of society. Physical vulnerability is the vulnerability of existing structures in facing the threat of flooding. physical vulnerability is measured based on the condition of existing buildings such as the location of study type, and number of floor material. Socio-economic vulnerability of the socio-economic conditions of the people who might be affected in the study area. Here is how to map the orientation of the observation and questionnaire distribution in analyzing vulnerability.

Figure 6. Household Inventory of Vulnerability and Adaptive Capacity Analysis

Physical vulnerability are analyzed based on observations to 623 existing homes in the location study. The physical vulnerability of existing building types, most of the existing housing in the location study is a single house (80.3%), elevate house (12.6%) and row house (6.1%). Most of the house is a single residential housing constructed by the community and are generally established by the new residents. Meanwhile, the stage is generally established by local people who have to understand how the characteristics of the floods that frequently occur in the location smdy. The house is a series developed by a housing developer and occupied by new residents.

Table.2 Phycal Vulnerability

Phsycal Vulnerability		**Percentase** (%)
Type House	Single-House	80.3
	Elevate House	13.6
	Row-House	6.1
Material	Brick	89.2
	Wood	10.8
Number of Floor	One-Floor	88.9
	Two-floor	12.4
	Three-Floor	0.3

Source: Analysis, 2014

The next component is physical vulnerability of the material used in the construction of housing is largely a brick (89.2%). Most of the existing building is a permanent structure. Construction using bricks more resilient in the face of flooding which occurs. Brick buildings that use materials commonly owned by high-income people.

Number of floor is one of component physical vulnerability. Most of in Macan Lindungan Village have one floor (88,9%), two floor (12,4%) dan three floor (0,3%). With height of 100 cm floodwaters then flooding will certainly expose storey house 1 . Limitations economy is one factor why people choseen 1st floor construction, while high-income earners tend to prefer constructing their homes to more than one floor.

Number of floor is one of the component of physical vulnerability. Most of in Tiger Protection Village have one floor (88.9%), two floor (12.4%) and three floor (0.3%). With a height of 100 cm floodwaters then floods will certainly expose house 1. Economy limitation is one factor who people chose 1st floor construction, while higher income earners tend to prefer constructing their homes to more than one floor.

Other components of vulnerability is the height of the first floor to the ground level . Average height is 25 cm, so that floods with a height of more than 25 cm would inundate houses. The findings of the study indicated that there were some people who did add distance to the ground floor up to more than 100 cm, generally they have the experience of the previous flood events and resillience economy.

The next components were analyzed vulnerability is social and economic vulnerability. Most people said floods did not affect the jobs and their income (84.5%). Community work is not affected by flooding usually works as a civil servant, a private company and entrepreuner service. Most people have a level of income sufficient to meet the needs of their day (80.4%).

Table.3 Social Economic Vulnerability

Social-Economic Vulnerability		**Percentase (%)**
Type Job	Entreprenuer	15.7
	Civil Servant	15.7
	BUMN	11.1
	Private Company Service	19.7
	Housewife	24.5
	Famer	4
	Other	9,4
Income per Month	<200 usd	19.2
	200-400 usd	43.4
	>400usd	37.4
Length of Stay	<15 year	74.7
	15-30 Year	23.7
	>30 Year	1.5

Source: Analysis, 2014

The findings studies area is the high impact new residents communities that lack social capital that exist among the people there. New residents communities who tend not to understand the characteristics of existing areas tend to perform various actions that have an impact on the increasing threat to be received by the local people and new residents such as hoarding wetland and close to waterways.

Figure 7. Water Channel Blocking by New Resident in Macan Lindungan Village

The environmental changes caused catastrophic flooding and existing vulnerabilities would cause flooding risk. The findings study shows people experience losses such as damage to property such as tables, chairs, electronic equipment, electrical installation, plumbing, interios home and building construction. On average each household there is a loss in the location study 25-500 usd.

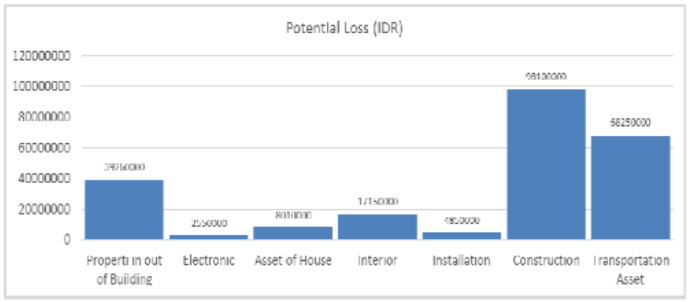

Figure 8. Flood Loss Estimation (IDR)
Source: Analysis, 2014

The Figure in the above show how the flood loss estimation caused by flood in 2012. The potential loss the caused by flood disasters the caused by environmental changes. The biggest disadvantage is common for home construction damage such as walls and floors. The second biggest loss is derived from assets such as cars and transport vehiclel. The biggest loss is common for home construction damage such as walls and floors. The next biggest loss is derived from assets such as cars and transport vehicles.

A. Resilience to Enviromental Change : Adaptation to Flooding

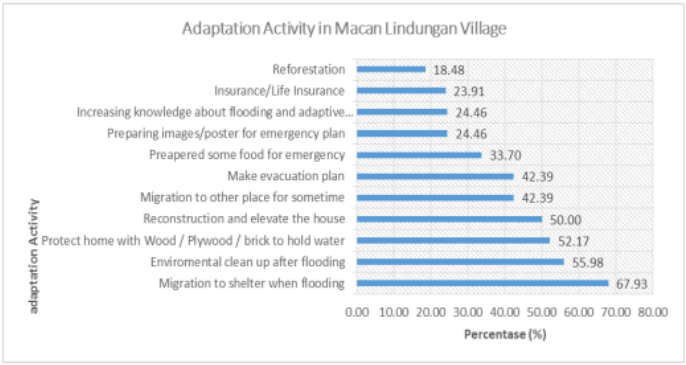

Figure 9. Adaptation Activity in Macan Lindungan Village
Source: Analysis, 2014

The environmental changes become more frequent in the Macan lindungan village and the rise in the vulnerability of communities in the location study increased the risk of flooding. The environmental change is a natural process that occurs in responsed to the increasing changes in wetland into built up. Macan lindungan villange vulnerability is increasing correlated with increasing number of new residents communities who tend to do the construction of houses by landfill and perform wet land conversion. The settlers increased the threat of flooding to the local community. Meanwhile, limited knowledge of their imnew residents communities causes increased susceptibility for doing development in locations such as wet land puddle.

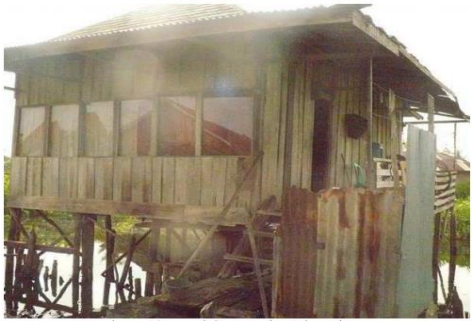

Figure 10. Local Community Adaptation

There are differences in the characteristics of adaptation actions undertaken new residents communities and local communities in the study area. People who have long resided in the location of study has its own way to adaptations such as elevating their homes or construct their house into a home stage. While the imnew residents communities who do not have the knowledge related to disaster threats that tend to build homes with low foundation flood affected vulnerable. An adaptation measured undertaken by the community in the study area. This adaptation action is one action that is formed from the risk perception, intention to adaptive and the last to become adaptation activity.

Figure 11. New Residents Adaptation

Most of people adaptation by migration to the shelter when flooding events (67.93%), protect a home with wood / plywood (55.98%), reconstruction and elevated the house (50%). The actions undertaken by the community relies heavily on the understanding of floods and economic conditions. People who have funds tend to perform better in terms of infrastructure adaptation measures such as elevating the house foundation or migrated to other homes they own. While the lower middleincome people tend to perform various actions such practical measures periodically conduct environmental cleanup. Local communities usually constructed their home by making the evacuation during the floods in their home as a shelter while the new residents communities new residents usually flee to a relative's house they are not submerged in the floods. Adaptation measures undertaken by the community are generally undertaken by this community based on their understanding of their most effective time period for action on adaptation. The following adaptation is based on a community by community implementation.

Figure 12. River in BSI Resident (Government Adaptation)

The most of people perform various adaptation measured Occurs after a disaster (46.2 I%) and pre-disaster (30.41%). The Communities adaptation action after seeing the impact of the disaster they experienced. As an illustration of the people who do not know the

characteristics of floods tend to take preventive measures and reduction of flood risk after receiving the impact of the disaster. In addition, most people assume adaptation after a disaster is the most effective action than before and at the time of disaster. Adaptation measures after a disaster allows the public to consider the height of the floods that occurred in the location previously previous studies.

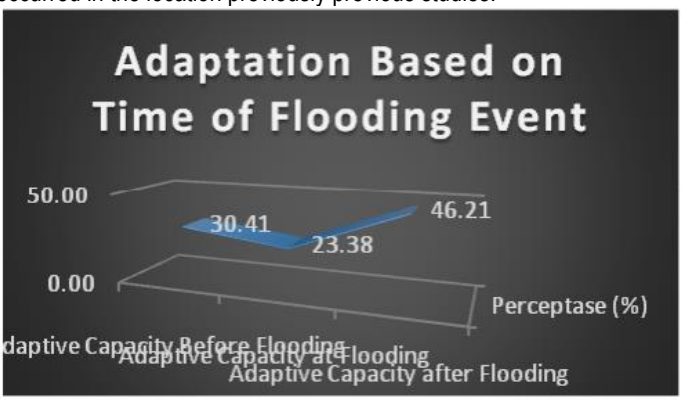

Figure 13. Adaptation Based on Time of Flooding Event
Source : Analysis, 2014

Figure 14. Channel Change by New Resident in Macan Lindungan Village

CONCLUSION

The vulnerability of communities in the study area is categorized as high vulnerable, especially physical vulnerability. Most of the Community in the smdy area are new residents. Therefore, they generally do not understand about the characteristics of the existing wetland environment. Most of the community constructs a house with one floor and the floor level is low (less than 20 cm, with inundation height of about 25 cm). Physical vulnerability of the majority of the community is also increasing because of the location of the construction of their homes on the wetland. Physical vulnerability of local communities is lower than the new residents community, their understanding of the phenomena associated with water inundation make them physically construct their house into a elevate house. The economic vulnerability of communities is moderate because most of people do not work in the study area that floods, so floods do not effect on their livelihoods. The findings of the study are interesting since there is high social vulnerability to the new residents. The new residents who do not understand the characteristics of the area condition, do some action that often increased the threat to the local community due to the wetland hoard. The vulnerability of the location study community is generally very high due to the lack of public understanding of the existing environmental conditions. The development and constructed are done by people often increased the vulnerability due to a lack of public understanding related to the existence of a wetland environment.

The flooding event often exposes the public community responded by doing some action adaptation. Local people have an understanding of phenomena event to constructed their house into elevate houses. In addition to avoid the flooding that regularly commemorate but also help preserve the wetland function as water catchment areas. Local communities with economic limitations generally argued stage house construction is an adaptation of the most effective and cheap and easy to do. While the In new residents communities who do not have the knowledge associated with the existing environmental characteristics tend to make adaptation after their received the impact of the disaster. As an illustration of the community who do in-migration in the early stages before catastrophic exposure generally has a low foundation, after the occurrence of floods and cause harm to them eventually most of them adapt by raising foundation. The economic conditions of new residents communities tend to perform better adaptation measures by way of constructing foundations, sewerage infrastructure and partly built houses into 2 floors or more.

The study area is flooded wetland annually. The vulnerability of the general public due to the lack of public understanding related to the flood disaster. The community began to take action to reduce flood risk as they feel the impact of the flood disaster. As an illustration, people who have been affected by floods due to the condition of the building is lower than the height of a puddle then perform construction by raising. Low- income people who are trying to reduce vulnerability by placing valuables to place higher. The vulnerability of the community generally responded with a variety of adaptation measures to mitigate greater losses, such as damage to the vehicle avoided from the community in a way placed in the location that was not flooded. Most of the people also have to prepare when floods occur, for example by saving and making evacuation plans.

The main problem of the high vulnerability and low adaptive capacity of society is the lack of knowledge associated with the existing environment in the location study. The strengthening the adaptive capacity of community is needed in the future. The government needs to provided support and assistant to the community so that the capacity of the community can be improved. The integration of disaster risk management with the community has not been implemented well. Communities can be empowered through collective action in the community's own environment. The government also needs to intervene in a way that maximizes the drainage function already exists in the location smdy. Provide assistant to the public when the building will be set up on wetland.

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