FINAL REPORT

VULNERABILITY AND ADAPTATION ASSESSMENT TO CLIMATE CHANGE IN BANDAR LAMPUNG CITY

2010

EXECUTIVE SUMMARY

In the future, a changing climate brought about by global warming is estimated to create new patterns of risk, and higher risks generally. Sea level rise due to melting glaciers and polar ice and thermal expansion will contribute to the increase of coastal flooding. Bandar Lampung as a coastal city will be impacted seriously by climate change and sea level rise. At present, some of coastal areas are already affected by sea level rise. Floods and drought also occur quite often. Government of Bandar Lampung City has implemented various program and also developed medium and long-term strategies to manage hazards. Plan for improving infrastructure for climate hazard control such as drainage system and dike has been prepared. However, under changing climate with the increasing frequency and intensity of extreme climate events the current design may not be very effective for managing future climate hazards. Therefore it is also very important to consider climate change in designing climate hazard control system.

ISET under the Asian Cities Climate Change Resilience Network (ACCCRN) with the support from the Rockefeller Foundation, coordinate a study on vulnerability and adaptation assessment to climate change conducted by MercyCorps, URDI and CCROM SEAP-IPB at Bandar Lampung. The study aims (i) to assess current and future climate variability in Bandar Lampung, (ii) to assess vulnerability and adaptive capacity as well as current and future climate risk at *Kelurahan* level, (iii) to identify direct and indirect impact of climate hazards now and in the future at *Kelurahan* level, (iv) to identify the most vulnerable areas and social groups, and dimensions of vulnerability, including adaptive capacity of community to climate change impact, (v) to identify institutional and governance issues that may affect the resilience of the city to current and future climate risk, and (vi) to develop initial recommendations for Bandar Lampung for increasing resilience of the city to current and future climate risk.

BANDAR LAMPUNG CITY PROFILE AND CLIMATE

Bandar Lampung is the capital of Lampung Province. Bandar Lampung is geographically located at $5^{o}20$ '- $5^{o}30$' latitude and 105^{o} 28'-$105^{o}37$' longitude. Bandar Lampung has an area of 19,722 hectares consisting of 13 sub-districts (kecamatan) and 98 village (*Kelurahan*). The city is traversed by two great rivers namely Way Kuala and Kuripan, and 23 small rivers. All of these rivers form a watershed located in the area of Bandar Lampung and most of it lead up to Lampung Bay. Several artificial drainage networks connect river system in this region. The function of this drainage network is to reduce surface runoff as a result of excessive rainwater. Drainage network systems that have been installed in Bandar Lampung include Teluk Betung, Tanjung Karang, Panjang and Kandis.

Citizens of Bandar Lampung fulfil their needs of clean water through regional water company (PDAM) and by retrieving shallow/deep ground water from dug wells. At present, the PDAM is only able to serve 32% of the total citizens. The depth of dug wells is approximately 30 to 50 meters from the soil surface.

Bandar Lampung is an important port city for Sumatra region. Port city of Bandar Lampung is located in a bay-shaped beach so high waves caused by strong winds

will not directly hit the beach area. However, in some coastal areas, there has been abrasion caused by waves. In some locations, coastal areas are densely populated area. To meet the demand for housing, citizens build homes in the reclamation area thus causing accretion. Many of the settlers do not have legal evidence of land ownership. This condition will be one of serious problem in realizing the Bandar Lampung Government's plan to create *Water Front City* region.

The number of population in Bandar Lampung in 2008 was 822,880 people with population density of about 42 people per ha. The population does not spread evenly. Kecamatan with high population density are in Central Tanjung Karang and South Teluk Betung. Based on age group, the largest proportion of the population of Bandar Lampung belongs to age group of 20-24 with population of 95, 597 people, followed by age group of 15-19 with population of 95, 537 people. The productive age (15-55 year olds) in Bandar Lampung reaches the number of 546,920 or 64.75 % of the total population.

Sources of income of the communities vary. Trade is the residents' primary livelihoods. Most of Bandar Lampung's Gross Regional Domestic Product (GRDP) comes from transportation and communications (19.6%), processing industry (17.6 %), services (16,9%) and trade, hotels, restaurants (16,6%). Agriculture contributes only 5% to GRDP.

Based on analysis to long historical climate data, it was found that there was a change in trend and variability of climate variables such as temperature and rainfall. The most tangible evidence can be seen from the increasing trend of mean surface temperature over the last 100 years in the city. The change in seasonal rainfall was also found, i.e. a shift in the monsoon onset and a change in the frequency of extreme rainfall. Based on 14 global climate models (GCMs), it was indicated that wet season rainfall of Bandar Lampung City (DJF) in the future might slightly increase, particularly in area located in coastal region. In contrast, the dry season (JJA) rainfall might decrease. However, the analysis of future climate may need to be refined using climate models with high resolution such as RCM. The use of global model such as GCM will not be able to capture the local effect. Further analysis on extreme weather under changing climate should also be done. Many studies have shown that global warming will bring more extreme events.

IMPACT OF EXTREME CLIMATE EVENTS

Bandar Lampung City is very prone to natural disaster. Types of natural disaster that hit Bandar Lampung city include flood, land slide, high tide causing Robs, tsunami, earthquake and drought. Abrasion, erosion and sedimentation also occur in coastal areas. To evaluate socio-economic impact of climate related disasters, survey and interview was conducted at six *Kelurahan*s, i.e. three for non-coastal *Kelurahan* (Batu Putu, Pasir Gintung, and Sukabumi Indah), and three for coastal villages (Kangkung, Kota Karang, Panjang Selatan). The survey involved 256 people, consisting of 62.28% male and 36.72% female. Besides from survey, the information is also sharpened through *focus group discussion* (FGD) in four *Kelurahan*: Panjang Selatan, Kota Karang, Batu Putu, and Pasir Gintung and literature study.

From the study, it was revealed that the occurrence of climate disasters (flood and drought) indirectly has the potential to change the order of the community's social values. This can be seen from residents' mutual cooperation or kinship in handling problems that occur in the community, work relationships, production transactions patterns and other social values. Social relationships between people at the time of the disaster are still going well. It can be seen from the activities to help each other when disaster strikes. In terms of working relationships, the impact of the disaster caused a declining of patron-client relationship that formerly was part of the social life of coastal communities. The disasters can also lead to increasing incidence of crimes such as theft.

Economic impact of the climate disasters can be evaluated from their impact on main job, and prices of some commodities. The disasters reduce work productivity especially if the main jobs of the society are vulnerable to disasters, such as the agricultural, fisheries etc. The impact of flooding in coastal areas is reducing working people in the fisheries sector, while in coastal areas; flood tides resulted in a decline in farmer incomes. Based on the sectors of the economy, the impact of floods caused loss to the infrastructure sector, housing and fisheries sectors. Meanwhile, drought caused losses in agriculture, fisheries and drinking water. The disaster also caused an increase in prices of some agricultural products like rice, crops and livestock, but this occurs only in the area surrounding the disaster.

Based on the sectors of the economy, flood disasters give the greatest impact on health sector, drinking water sector, housing, fisheries, and public works (the destruction of drainage facilities and other infrastructures). While the most affected sector by drought are drinking water, health, and agriculture. The problem of drinking water shortage increases during long dry season or during flood disaster. Impact of disasters on health is the increase in number of people infected by diseases, particularly malaria, and cough/flu/colds.

Because of the recurrence potential of extreme climate events that can cause disasters in the future; dense public housing condition with relatively indecent environment; and the government's plans to build *water front city* in coastal areas, residents in coastal areas are willing to move as long as they're given facilities and decent houses and the relocation area is not far from the sea, so they can still do their current job (fishermen). Meanwhile some resident in non coastal areas feel reluctant because they are concerned about the availability of jobs. However, if the disaster is severe and forces them to relocate, they expect the government to provide housing and new jobs.

The impact of the disaster resulted in a change in behaviour as a form of adaptation. Adaptation performed by residents during floods are diverse, ranging from staying at home, relocating to un-flooded areas, making embankments, deepening water channels, raising the floor level, adding food and fuel supplies. Drought adaptation in the forms of buying water for daily needs, reducing water consumption, pumping water from the nearest source, relocating to non-flooded areas, holding a ritual to ask for rain.

Forms of adaptation can also be seen on a living strategy. Livelihood strategies that are done by the residents are agriculture intensification and double pattern income. Agriculture intensification is conducted by diversifying crops. Double pattern

income is done in two ways, first by income diversity, which is a combination of livelihoods, *on farm* and *off farm* owned by a person. Usually *Off farm* activities are side jobs besides main jobs. The second is by empowering members of the family, such as wives and children who have grown up.

To better prepare for managing disaster risk, communities expect that early warning system on disasters is in place. However, most of the residents confessed that they have never got any information about the climate or early warning from the government, EWS (Early Warning System), or other related institutions and there is no disaster handling institutions in their area.
This illustrates the lack of government response to the disaster in the community. Most of the residents obtain information on climate forecasts traditionally from traditional leaders and the community leaders. Residents also receive forecast information through the medium of television. Based on some types of disaster-related information, the information on disaster warning is more useful than other information.

CLIMATE RISK LEVEL OF '*KELURAHAN*'

Level of risk of a system to a disaster or extreme climate event (ECE) will depend on capacity of the system to cope with the events (called coping capacity index) and likelihood of the ECE to occur. This study evaluated the level of climate risk at *Kelurahan* (village) level. The coping capacity index is developed based on vulnerability and adaptive capacity index of the *Kelurahan*. The vulnerability and capacity index of *Kelurahan* is measured using a number of socio-economic and biophysical indicators. *Kelurahan* in which many of its household/ building located in river bank, source of drinking water mostly not from PDAM (piping system), high density population, many poor people and big portion of *Kelurahan* area near the river and coastal with less green open area will be more vulnerable (*high vulnerability index*) than *Kelurahan* with less household/building in the river bank, low population density, get better services from PDAM, less poor people, and small portion of *Kelurahan* area near the river and coastal with more green open area (*low vulnerability index*). The consequences (damage, economic loss etc) caused by events will be severe in *Kelurahan* having high vulnerability index. However, the consequence cased by the events in the high vulnerable *Kelurahan* would be less if it has high adaptive capacity. *Kelurahan* with high adaptive capacity index is *Kelurahan* where many of its households are well educated, main income source of communities not sensitive to climate hazards (e.g. trading is much less sensitive than agriculture) and has better health facility and road infrastructure. In this study, we normalized all the scores of the indicators in order to have index of vulnerability and capacity range from 0 to 1.

To classify the *Kelurahan* based on their coping capacity index, the vulnerability (VI) and capacity index (CI) of each *Kelurahan* were subtracted by 0.5. As the normalized VI and CI values range from 0 to 1, by subtracting the index values with 0.5, the VI and CI will range from -0.5 to +0.5. The relative position of *Kelurahan* according to their VI and CI is determined based on their position in the five Quadrants (Figure 1). *Kelurahan*s situated in Quadrant 5 will have high VI and Low CI. Whereas *Kelurahan*s situated in Quadrant 1 will have low VI and high CI. Using this classification system, if *Kelurahan*s situated in Quadrant 5 are exposed to

certain hazards, the impact would be more severe compare to *Kelurahan*s Situated in Quadrant 1. To assess the change of VI and CI in the future, we only consider the change of population density (based on government projection), non-green opened area, and education (based on spatial planning or RTRW) since other data is not available. Factors used for normalizing the score of these corresponding indicators in 2025 and 2050 were the same as those of the baseline year 2005.

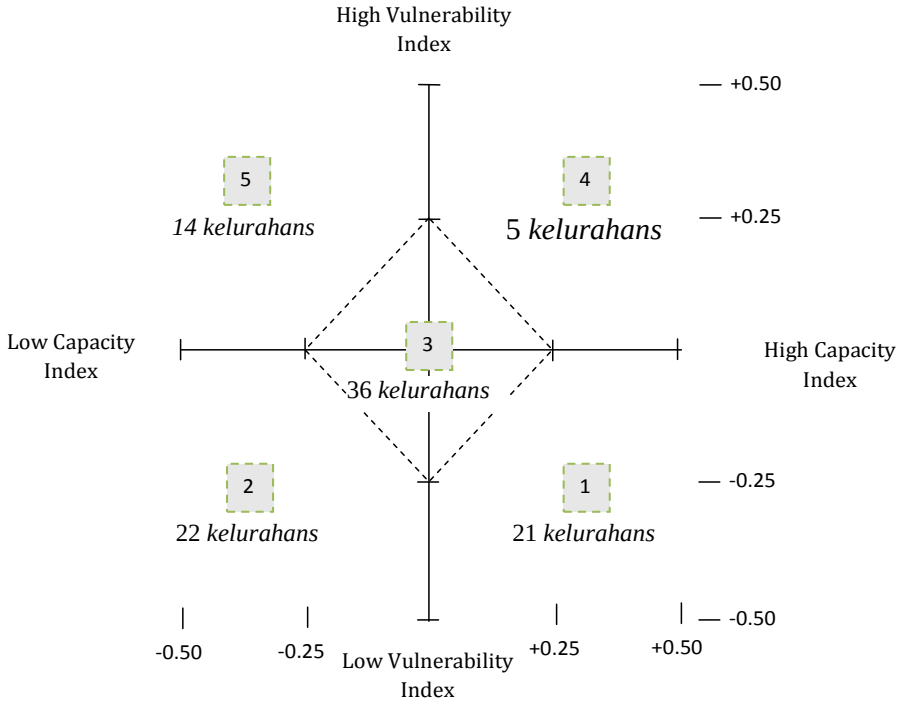

Figure1. Classification of the villages based on their coping capacity index (quadrants 1 to 5) and number of Kelurahan that are situated in each Quadrant at Current Condition (2005)

The analysis suggested that at present about 14.2% of *Kelurahan*s have high coping capacity index (*Kelurahan*s with high vulnerability and low capacity index or high coping capacity index), 5.1% in Quadrant 36.7% in Quadrant 22.4% in Quadrant 2 and 21.4 % in Quadrant 1 (*Kelurahan* with low vulnerability and high capacity index). *Kelurahan* at Quadrant 5 include Bumi Waras, Garuntang, Gunung Terang, Kangkung, Kedaton, Kota Karang, Panjang Selatan, Perwata, Sepang Jaya, Srengsem, Tanjung Senang, Teluk Betung, Way Kandis, Waydadi. In 2025 and 2050, 6-7 *Kelurahan*s in Quadrant 5 will move to Quadrant 4 and 3 indicating that there is an improvement of its coping capacity index. However, coping capacity index of some *Kelurahan*s in Quadrant 3 may change to Quadrant 4 in the future (Figure 2). This suggests that coping capacity of these *Kelurahan*s would decrease in the future (Figure 3).

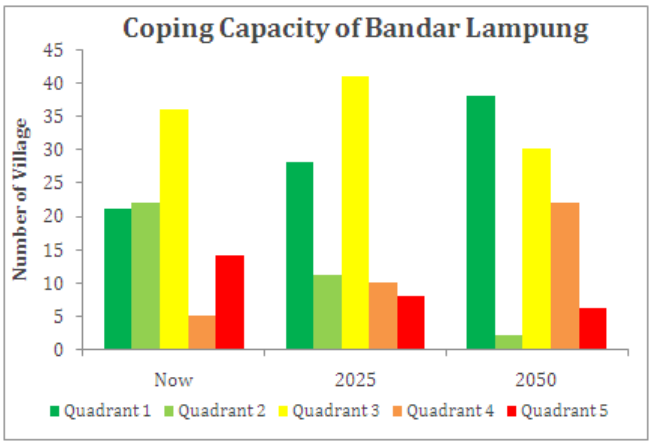

Figure 2. Number of Kelurahans according to the coping capacity index (quadrant 1-5) at present and in the future (2025 and 2050)

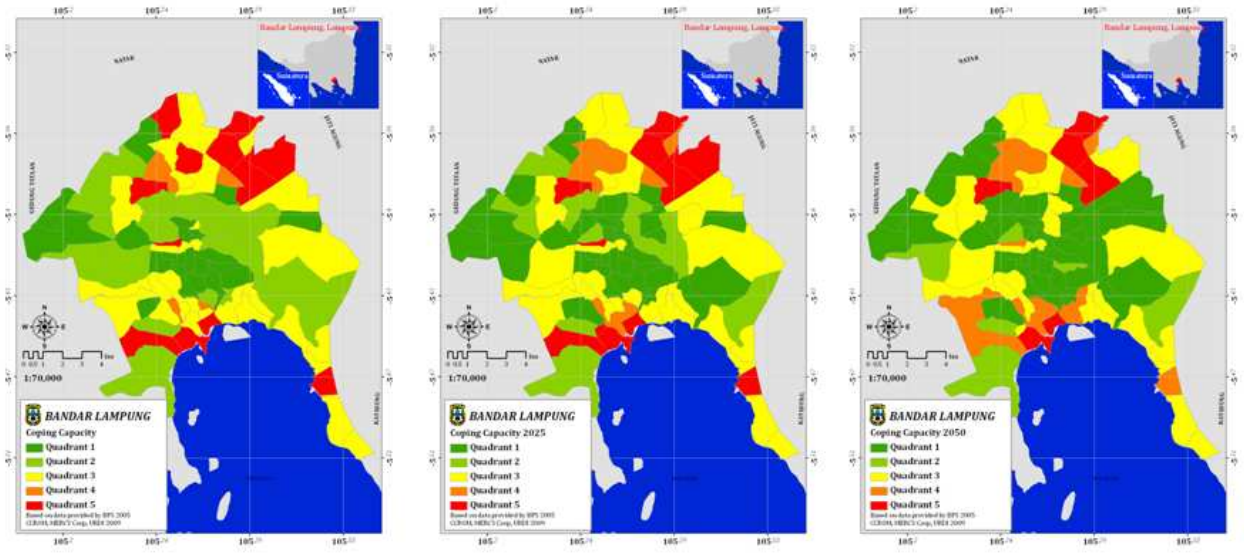

Figure 3. Coping Capacity of kelurahan at Bandar Lampung

To define level of risk of the *Kelurahan* to the impact of climate change was defined as a function of the probability of unexpected (extreme) climate event to occur and the consequence of the events if it occurs. As describe previously, we can expect that *Kelurahan*s with high vulnerability but low capacity indices (at quadrant 5) will be impacted more severe by the extreme events than those with low vulnerability and high capacity indices (quadrant 1). Thus we can define that the climate risk will be very high in *Kelurahan* at Quadrant 5 if probability of the extreme climate events to occur in these *Kelurahan* is high. Climate risk will be very low in *Kelurahan* at Quadrant 1 and the probability of the extreme climate events to occur in these *Kelurahan* is also low.

To allow multiple climate hazards being accommodated in the climate risk assessment, we developed composite climate hazard index (CCHI). The types of climate hazards include flood, drought, landslides, and sea level rise. We classified the climate hazard index (index values ranges from 0 to 4.5) into three categories, i.e. less than 2.0, between 2.0 and 3.5 and more than 3.5. *Kelurahan* with CCHI of 4.5 means that all area of this *Kelurahan* is exposed to flood and drought, and land slide every year and it is completely inundated when robs occur. *Kelurahan* with CCHI of zero means that none of the hazards occur in the *Kelurahan.* We used the rainfall outputs from 14 general circulation models (GCM)[1] run under high emission scenarios (SRESA2) and low emission scenarios (SRESB1)[2].

The study suggested that in 2005, the CCHI in most areas of Bandar Lampung was mostly less than 1.0. In the future, A2 scenario, areas of index> 2 has decreased in 2025, but increased slightly in 2050. *Kelurahan* with high CCHI both at present and in the future is *Kelurahan* Gunung Mas, Teluk Betung Utara Sub-district.

Furthermore, we classified the level of climate risk of the *Kelurahan*s based on their coping capacity index and CCHI (Table 1). The climate risk maps of the Bandar Lampung by *Kelurahan* were produced by overlaying the coping capacity index map and CCHI under current and future climate as shown in Figure 2.

Table 1. Matrix of Climate Risk according the coping capacity index and composite climate hazard index

Coping Capacity Index (Quadrant)	Composite Climate Hazard Index (CCHI)		
	More than 3.5	Between 2.0 and 3.5	Less than 2.0
5	*Very High (VH)*	*High (H)*	*Medium to High (M-H)*
4	*High (H)*	*Medium to High (M-H)*	*Medium (M)*
3	*Medium to High (M-H)*	*Medium (M)*	*Medium to Low (M-L)*
2	*Medium (M)*	*Medium to Low (M-L)*	*Low (L)*
1	*Medium to Low (M-L)*	*Low (L)*	*Very Low (VL)*

The result of analysis suggested that there are no *Kelurahan* with Very High (VH) Climate Risk Category at present (baseline conditions). The highest category is only Medium to High (M-H). There are about 14 *Kelurahan*s (14.2%) with M-H risk category. These include Kota Karang and Perwata (Teluk Betung Barat Sub-district), *Kelurahan* Gunung Terang (Tanjung Karang Barat Sub-district), *Kelurahan* Tanjung Senang and Way Kandis (Tanjung Senang Sub-district), *Kelurahan* Waydadi (Sukarame Sub-district), *Kelurahan* Sepang Jaya and Kedaton (Kedaton Sub-district), *Kelurahan* Kangkung, Bumi Waras, kankung and Teluk Betung (Teluk Betung Selatan Sub-district) and *Kelurahan* Panjang Selatan and Srangsem (Panjang Sub-district). The remaining are 5 *Kelurahan*s (5.1%) as M (Medium) risk,

[1] General Circulation Model is a numerical representation of the climate system based on the physical, chemical and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties.
[2] Concentration of GHG in the atmosphere in 2025, 2050 and 2100 under the SRESA2 would be about 440, 535, 825 ppm respectively and under the SRESB2 about 425, 480, and 600 ppm respectively.

36 *Kelurahan*s (36.7%) as L-M (Low to Medium) risk, 22 *Kelurahan*s (22.4%) as L (Low) risk and 21 (21.4%) *Kelurahan*s as VL (Very Low) risk. In the future (2025 and 2050), more *Kelurahan*s will be exposed to higher climate risk, particularly under scenario SRESB1 (Figure 4). There would be two *Kelurahan*s would move from M-H to High climate risk category, namely *kelurahan* Gunung Mas at kecamatan teluk Betung Utara dan *kelurahan* Garuntang at kecamatan Teluk betung selatan. While many of *Kelurahan*s with L-M risk category would move to Medium risk category (Figure 5).

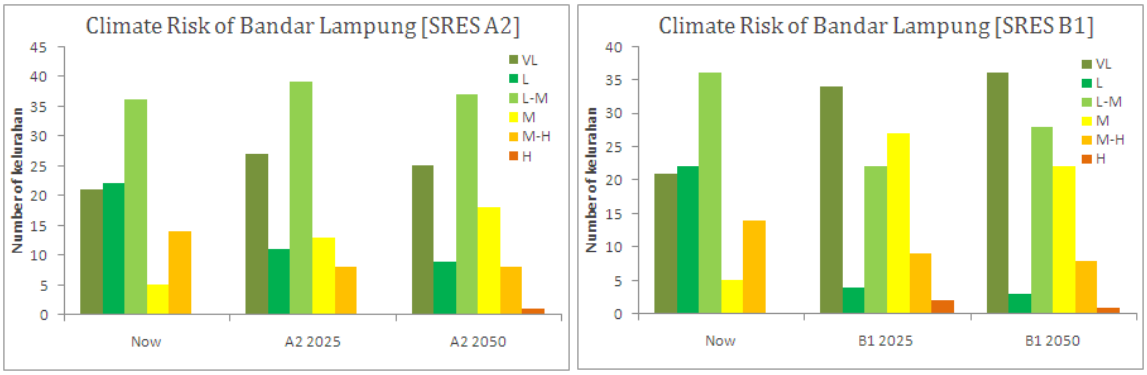

Figure 4. Number of Kelurahan by climate risk index category

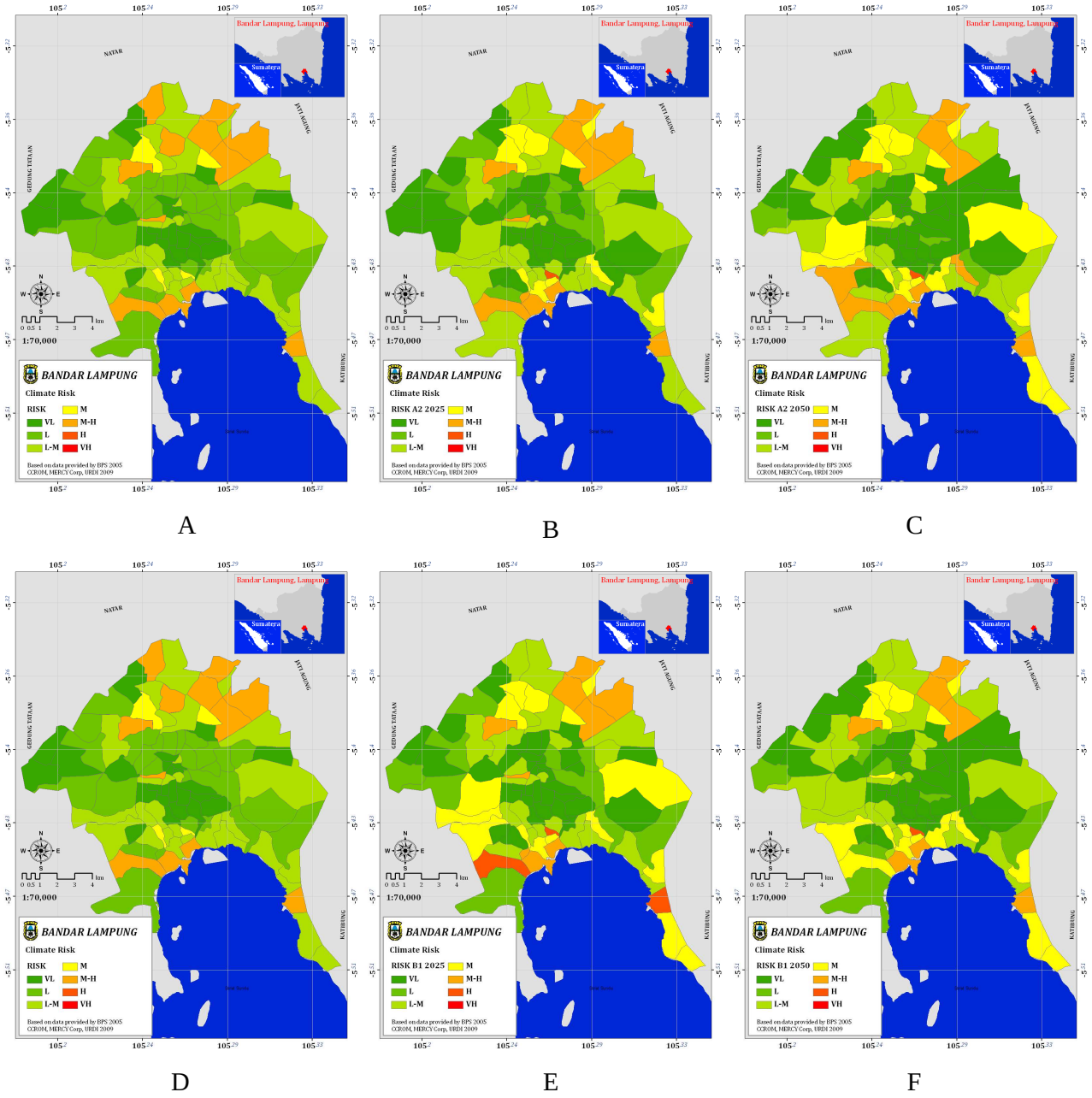

Figure 5. Classification of Kelurahan based on their level of their exposure to climate risk (A)& (D) Climate risk baseline, (B) Climate risk A2 2025, (C) Climate risk A2 2050, (E) Climate risk B1 2025, (F) Climate risk B1 2050

The above analysis demonstrated that how change in socio-economic and biophysical conditions will change coping capacity of the *Kelurahan*s. Adaptation programs should be prioritized in *Kelurahan* with high vulnerability index and low capacity index and being exposed or potentially exposed to high climate hazard index. To reduce the level of risk of *Kelurahan* to the impact of climate change, the infrastructure and community development programs should be directed to improve socio-economic and biophysical indicators shaping the vulnerability and adaptive capacity of the *Kelurahan*s.

GOVERNANCE AND INSTITUTIONAL SYSTEM

Governance and institutions are two determinant factors affecting the resilience of the city to climate change. Good governance and strong institutions will lead to climate change resilience city. There are three important aspects needs to be assessed to assess the resilience of the city to climate change. The first is how the stakeholders play their role in managing climate risk. The second is what are current initiatives and programs (short and long term) to cope with climate risks and how effective they are. Third is what is the capacity of local government and institutions to integrate climate change into short and long term development planing.

From the analysis it was revealed that the management of climate change in City of Bandar Lampung involve stakeholder both from internal and external of the city. Each stakeholder has their own roles and contribution to adapt and strengthen community to climate change. This partnership is a pre-condition to create community that has capacity to adapt to climate change. Overall, local government of Bandar Lampung plays the major roles in climate change both for financial support and implementing program. While the role of provincial government claims not too significant, but it has more roles in coordinating programs and policy from some cities. However, coordination among stakeholders and sectors should be strengthened in order to gain maximum benefits of the program to environment and community.

There are a number of programs and plans prepared by the government to address natural hazards in the city. Current initiatives done by local government as response to disaster management was formulating program and action plan in reducing hazard risk through an intensive study in 2008. Beside the action plan, Bandar Lampung city government has established a Local Disaster Management Board in November 2009 although the board is not yet effective on program implementation.

On the other hand, the city spatial planning of Bandar Lampung might not consider climate change issues. Improper spatial plan (RTRW) will expose the city to higher climate risk in the future. Some problems that potentially cause the difficulty to implement climate proof spatial planning include inconsistency in the implementation of spatial planning, land use change such as areas along the river and others. However, there are room to provide inputs on climate change issues as RTRW Kota Bandarlampung is now on going revision.

Related with institutional capacity of local government, there are some strength related with the establishment of city team, central government and donor support on financing opportunities and some project implementation done by stakeholders. While in the weakness are mostly related with the need to have better coordination

across sectors and across regions in order to reduce the ineffectiveness project implementation. It is also pointed out the need to strengthening the City Team as champion to introduce and to integrate climate-changes issue into local planning document.

Current capacity of local government in integrating climate change into long-term development planning is still limited. This can be understood as climate change is a complex issue. Strong scientific works on climate change scenarios and climate change impacts in Bandar Lampung City will be required to assist local government in developing horizon plan of adaptation[3] to climate change. Technical assistance and capacity building program for local government officers is required to enable them in developing horizon plan of adaptation.

There are a number of good conditions that positively can contribute the process of developing resilience city to climate change. In the existing laws and policies, it is clearly mentioned that the planning document should consider disaster mitigation and adaptation and climate-change issue. Bandar Lampung City Government will also formulate a new medium term development plan as resulted from the direct election which will be taken in June 2010. This is a good opportunity to integrate the climate change aspect into the document, so that it can be legally-binding. It needs political commitment and comprehensive understanding from the City Team to introduce the issues

ADAPTATION ACTION PLANNING

To have resilience city to climate change, it is important to understand how people, community, and sectors response to current climate risk and how the current capacity should be developed to strengthen the capacity in managing future climate risk. Particular pilot projects may also be needed to get lesson learnt how we can effectively manage climate risk and use the lesson learnt to improve the climate change adaptation plan.

Based on study on the Community Based Vulnerability Assessment (CBA) in *Kelurahan* Kankung, Pasir Gintung, Kota Karang; and also considering findings from surveys and literatures, we extract a number of lessons that may contribute in developing adaptation strategies. We learned some of the common qualities that seem to be present in the adaptation strategies at community levels:

- *Quite simply 'they work':* this is a very practical sense of adaptations that have real bearing and effect on their everyday lives.
- *They are inexpensive and work with what materials are available:* for the urban poor, resources are scarce. They, for example, scavenged housing materials from a nearby scrap heap, or even community savings groups that collect very minimal amounts. These are what people can afford and that make sense to them.
- *Accessible in times of need:* In order to raise capital to recover from a flood a family may sell their television, motorbike or other fungible assets, rather than go through a bureaucratic process of applications that might imply lengthy

[3] Horizon plan of adaptation relates to the lifetime of decision-making associated with a particular activity – how far into the future is it planned. Thus it is the period of time over which a particular adaptation program is planned to be implemented (Jones et al., 2004).

paperwork. Generally in the city people want access to resources quickly and this is a very important characteristic of adaptation strategies that work, they are easily managed and accessed.

- *They don't rely upon big government projects or interventions: People* have developed reliance upon community organization and initiatives that better respond to their needs within their own means. While government intervention is appreciated and instrumental local self-reliance seems to be a key characteristic of adaptation strategies.
- *Adaptation to severe climate events must work together with other adaptation strategies:* Those most affected people by climate change may not know or care to plan for it if it doesn't benefit other aspects of their lives. Safety for its own sake is not a motivating factor, but when other benefits can be derived then the solution becomes workable.
- *The whole is greater than the sum of the parts:* Many of the adaptation strategies are successful because they harness the collective efforts and strengths of people. People are concerned about each other and when this concern translates in collective action the results can be significant.
- *Leveraging government support leads to better results:* When communities are able to work together with local and city government (and vice versa) adaptation strategies seem to have been successful.
- *More access to information can lead to better outcomes:* Urban poor communities are usually isolated and so successful adaptation strategies seem to increase access to information.

From the lesson learnt, we can summarize that successful adaptation at community level depends of several factors namely: (i) availability of funding, (ii) capacity levels, (iii) access to information, (iv) collaboration and engagement of local government, (v) migration and growth rates, (vi) public service delivery, and (vii) mobility. Bandar Lampung City is in a good position to move into resilience city as there are already (i) existing cases that exist and workable, (ii) possible social networks of people in similar situations with know how, (iii) local level neighbourhood government, (iv) city and national government programs (*e.g.* PNPM), (v) materials and know-how from industries and economic activities, (vi) local leadership, (vii) community cohesion, and (viii) local civil society organizations, (ix) utilising existing resources (such as subsidies, sharing community narratives and networks, low cost financing of incremental housing improvements, Neighbourhood Vulnerability Index, detailed maps for local neighbourhood government use, alternative social safety nets, and broad based coalition to deal with climate change issues).

Pilot projects are necessary to help local government to better understand how climate change will impact communities and sectors, how current capacity has to be strengthened and spatial plan to be improved to form climate change-resilience city and how to use the good lesson learnt from pilots in designing long term policies and strategies to address climate change. The City Team has facilitated a number of stakeholders to develop a number of pilot projects. The objectives of pilot implementation are (i) to prepare for climate change impact at the city level, (ii) to engage city level stakeholders (city government, NGOs, universities, CBOs, private sectors, community groups), (iii) to implement the pilot projects that test climate change resilience strategy, and (iv) to test the adaptive capacity of the community.

For these pilot projects, the subject is vulnerable people who affected by climate change impact. The beneficiaries are women, children, elderly and men, both in terms of increased awareness, increase local capacity, influence local policy etc.

The activities of pilot project are also designed to meet the following criteria: (i) replicability, (ii) addressing current and future risks, (iii) benefit to local community, (iv) innovation, (v) collaboration, (vi) scalability, and (vii) sustainability strategy. There are some additional criteria that should be conducted by the implementer of pilot project: (i) implementation of pilot project has to be related to the local problems at local administrative or cross border administrative communities on issues of environment, health, education, social, economy in which related to the impact of climate change, and (ii) implementation of pilot project directed for adaptation and response effort activities to the impact of climate change, such as: erosion, flooding, drought, landslide etc.

There are two selected pilot projects of Asian Cities Climate Change Program (ACCCRN) as contributing of development goals and addressing climate change impacts in Bandar Lampung:

(a) Participatory Design of Adaptation of Community Resilience in Kangkung and Kota Karang Sub-district, Bandar Lampung City to Climate Change by Lampung Ikhlas – Local NGO. The objective of the project is "to increase understanding, awareness, and participatory involvement of the community in order to build adaptive capacity to the climate change impacts". Further, the targets of the project are (i) to build understanding and implement program activities for society in Kangkung and Kota Karang Sub-district to the impacts of climate change (within social, economy, and sustainable living sectors); (ii) to increase community capacity to adapt with climate change, (iii) to increase awareness of community in Kangkung and Kota Karang Sub-district to climate change and (iv) to help to increase community living standards in health sector, household economic resilience, environment management, and adaptation to climate change.

(b) Capacity Building of Panjang Selatan Sub-District Society to Cope with Climate Change by Mitra Bentala – Local NGO. The objective of the project is "as an effort to strengthen the capacity of communities in an effort to increase community resilience of Panjang Selatan sub-district to climate change". Further, the short term targets of the projects are (i) to increase the capacity of the community through active involvement and improving knowledge of climate change adaptation efforts; (ii) to build public awareness in understanding and solving problems related to climate change impacts; and (iii) to adapt to climate change through waste management, provision of drinking water refill, and rehabilitation. The long-term target is to (i) to encourage the formation of community groups in the adaptation to climate change; and (ii) to encourage the creation of collective support for the implementation of adaptation to climate change in Panjang Selatan Sub-district; and build adaptation capacity to climate change.

PREFACE

Indonesia has more than 17,000 islands, a coastline of more than 80,000 km, and the majority of population living in coastal zones where most of the country's economic activity takes place. Indonesia is a country prone to natural disasters such as floods, droughts, storms, landslides, volcanic eruptions, and wild fires. In the future, a changing climate brought about by global warming is expected to create new patterns of risk, and higher risks generally. Bandar Lampung is one of the coastal cities that are exposed to such hazards.

At present, some of *Kelurahan*s in Bandar Lampung City are already affected by climate related disasters, such as flood and drought and also robs. In the future, these extreme events may occur more frequent with higher intensity. Most of impacted *Kelurahan*s of Bandar lampung are occupied by households with low income and live in poverty. They are highly vulnerable to the effects of environmental problems. City Government must take this into account seriously in developing its city development plan, while taking immediate actions response to immediate needs of the people in addressing their current problem. Therefore, **Vulnerability and Adaptation Assessment to Climate Change in Bandar Lampung City** was implemented and results of this assessment are presented in this report.

This report describe in detail: (i) characteristics of current and future climate of Bandar Lampung, (ii) Impact of climate hazards and vulnerability of community to extreme climate events, and existing adaptive capacities, (iii) Maps of current and future vulnerabilities and capacity as well as climate risk at *Kelurahan* Level, (iv) Governance and institutional issues that may affect the effectiveness of the implementation of climate change programs, (v) Initial recommendations for increasing resilience of the City to current and future climate risk, and (vi) Recommendation on types of pilot projects for increasing communities' resilience to the impact of climate change.

The study was supported by many institutions. Institute for Social and Environmental Transition (ISET) is managing the Asian Cities Climate Change Resilience Network (ACCRN) as part of the overall Rockefeller Foundation Climate Change Initiative. MercyCorp assists ISET in implementing the ACCRN program in Bandar Lampung in collaboration with Local Government (City Team), Urban and Regional Development Institute (URDI), Centre for Climate Risk and Opportunity Management in South East Asia and Pacific (CCROM SEAP) Bogor Agriculture University, local institutions, local communities, and local NGOs. Their supports during the implementation of the study are paramount and highly appreciated.

We hope Bandar Lampung City Government would use some of the results presented in this report in addressing current problems, in its city development plan, and in implementation of climate change programs.

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Chapter 1 INTRODUCTION

1.1 Background

In the future, a changing climate brought about by global warming is estimated to create new patterns of risk, and higher risks generally. Sea level rise due to melting glaciers and polar ice and thermal expansion will contribute to the increase of coastal flooding. Increasing intensity of tropical cyclones observed in recent decades may be tied to increasing sea surface temperatures. By impacting the hydrologic cycle, global warming is expected to alter climatic ranges, shift regional climatic averages, resulting in shifting of climate zones, and lead to a higher frequency and amplitude of weather events. Climate variability and change occurring against a backdrop of increasing global population and globalization of economic processes may be expected to lead to increased competition over resources and new vulnerabilities. With the increase of climate risk, many countries, particularly least developed and developing countries may have difficulties to achieve the Millennium Development Goals related to poverty, hunger and human health.

Indonesia is a country already prone to natural disasters such as floods, droughts, storms, landslides, volcanic eruptions, and wildland fires. Indonesia has experienced more frequent and severe climate-related hazards in recent years. Floods and windstorms accounted for 70% of total disasters and the remaining 30% of the total disasters are accounted for by droughts, landslides, forest fires, heat waves, storm, *robs* (flood due to high tides) and others. Within the period of 2003-2005 alone, there were about 1,429 disaster incidences in Indonesia. About 53.3 percent were hydro-meteorological disasters (Bappenas and Bakornas PB, 2006)

Rising sea levels pose a further risk. Approximately 24 small islands in Indonesian are already submerged (Ministry of Marine Affairs and Fisheries, 2007). This vast archipelago is extremely vulnerable to sea level rise with over 17,000 islands, a coastline of more than 80,000 km, and the population majority living in coastal zones where most of the country's economic activity takes place. Currently, around 42 million people in Indonesia live in areas less than 10 meters above the average sea level (Government of Indonesia, 2007). Most of households living in the coastal area has an income of between the US$2 and US$1-a-day poverty lines (Indonesia Poverty Analysis Program, 2006), far too many Indonesians live in poverty and remain highly vulnerable to the effects of climate change. The high population densities of Indonesia will further increase its sensitivity to climate hazards.

Bandar Lampung is coastal city which will be impacted seriously by climate change and sea level rise. At present, some of coastal areas at Bandar Lampung are already inundated due to the increase of sea level rise. Floods and drought also occur quite often. Government of Bandar Lampung City has implemented various program and also developed medium and long-term strategies to manage hazards. Plan for improving infrastructure for climate hazard control such as drainage system and dike has been prepared (Bappeda, 2003). However, under changing climate with the increasing frequency and intensity of extreme climate events the current design may

not be very effective for managing future climate hazards. Therefore it is also very important to consider climate change in designing climate hazard control system.

1.2 Objectives

This study was aimed

- To asses current and future climate variability in Bandar Lampung city
- To assess vulnerability and adaptive capacity as well as current and future climate risk at *Kelurahan* (villages) Level
- To identify direct and indirect impact of climate hazards now and in the future at *Kelurahan* level.
- To identify the most vulnerable areas and social groups, and dimensions of vulnerability, including adaptive capacity of community to climate change impact
- To identify institutional and governance issues that may affect the resilience of the city to current and future climate risk.
- To develop initial recommendations for Bandar Lampung City for increasing resilience of the city to current and future climate risk

1.3 Outputs

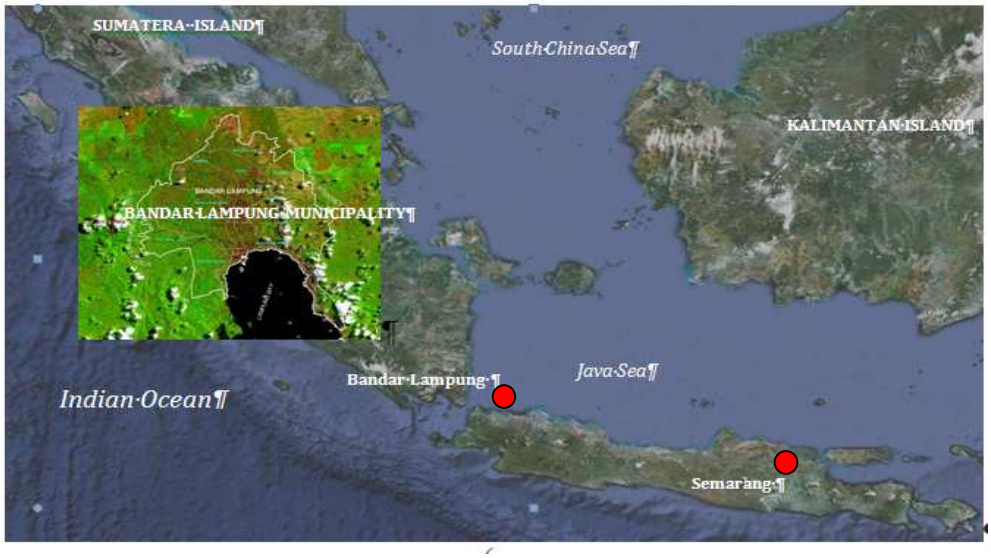
The final outputs of this work will be a report describing

- Characteristics of current and future climate of Bandar Lampung City
- Impact of climate hazards and vulnerability of community to extreme climate events, and existing adaptive capacities
- Maps of current and future vulnerabilities and capacity as well as climate risk at *Kelurahan* Level
- Governance and institutional issues that may affect the effectiveness of the implementation of climate change programs
- Initial recommendations for increasing resilience of the City to current and future climate risk.
- Recommendation on types of pilot projects for increasing communities' resilience to the impact of climate change

Chapter 2 BRIEF DESCRIPTION OF BANDAR LAMPUNG CITY PROFILE AND CONDITION OF RESPONDENCE

2.1 Geographical Location and Context

City of Bandar Lampung is the capital of Lampung Province and is geographically located at 5 o 20 '- 5 o 30' latitude and 105 o 28 '-105 o 37' longitude. The city is located at Lampung Bay and at the southern tip of Sumatra Island and has an area of 19,722 hectares (Figure 2.1). The city is bordered by: 1). Sub-district (*Kecamatan*) of Natar of South Lampung Regency to the north, 2). Sub-districts of Padang Cermin and Ketibung and Lampung Bay to the south, 3). Sub-districtTanjung Bintang of South Lampung Regency to the east and 4). Sub-districts of Gedung Tataan and Padang Cermin of Pesawaran Regency to the west.



Sumber: Google Earth, 2009 dan Citra Landsat ETM+, 2001

Figure 2.1: The position of Bandar Lampung to Surrounding areas.

2.2 Municipal Administration

Administratively, Bandar Lampung City consists of 13 sub-districts (*kecamatan*) and 98 villages (*Kelurahan*) (Table 2.1, Figure 2.2). In term of its area, sub-district Kemiling is the largest and Tanjung Karang Pusat is the smallest.

Table 2.1:. Name of sub-districts (kecamatan), area and number of villages (kelurahan) in Bandar Lampung City

NO	Districts	Area (ha)	Capital	Number of Sub Districts/ Kelurahan
1	Tanjungkarang Pusat	6.58	Palapa	11
2	Tanjungkarang Barat	15.14	Gedong Air	6
3	Tanjungkarang Timur	21.11	Kota Baru	11
4	Teluk Betung Utara	10.38	Kupang Kota	10
5	Teluk Betung Barat	20.99	Bakung	8
6	Teluk Betung Selatan	10.07	Sukaraja	11
7	Panjang	21.16	Panjang Selatan	7
8	Kemiling	27.65	Sumberejo	7
9	Kedaton	10.88	Kampung Baru	8
10	Rajabasa	13.02	Rajabasa	4
11	Tanjung Seneng	11.63	Tanjung Seneng	4
12	Sukarame	16.87	Sukarame	5
13	Sukabumi	10.64	Sukabumi	6
	Jumlah	197.22		98

(http://www.bandarlampungkota.go.id)

Figure 2.2:Map of Bandar Lampung Administration (Source: http://www.bandarlampungkota.go.id)

2.3 Resource Base

2.3.1 Water resources

Bandar Lampung is traversed by two great rivers namely Way Kuala and Kuripan, and 23 small rivers (Bandar lampung Regional Development Planning Agency, 2008). All of these rivers form a watershed located in the area of Bandar Lampung

and most of it lead up to Lampung Bay. Several artificial drainage networks connect river system in this region. The function of this drainage network is to reduce surface runoff as a result of excessive rainwater. Drainage network systems that have been installed in Bandar Lampung include Teluk Betung, Tanjung Karang, Panjang and Kandis.

Citizens of Bandar Lampung fulfill their needs of water through regional water company (PDAM) and by retrieving shallow/deep ground water from dug wells. At present PDAM is able to meet only 27% of the total citizens of Bandar Lampung, while the remaining 73% still have to use water from dug wells. The depth of dug wells is approximately 30 to 50 meters from the soil surface.

2.3.2 Coastal areas

Bandar Lampung is an important port city for Sumatra region. Port city of Bandar Lampung is located in a bay-shaped beach so high waves caused by strong winds will not directly hit the beach area. However, in some coastal areas, there has been abrasion caused by waves.

In some locations, coastal areas are densely populated area. To meet the demand for housing, citizens build homes in the reclamation area thus causing accretion. This situation can become an obstacle in the zoning of the coastal areas. Under such conditions, the realization of the Bandar lampung Government's plan to create *water front city* region should also take into account the costs to overcome the problem of settlements in coastal areas, although many of the settlers do not have legal evidence of land ownership.

Center of economic activities in the Coastal and Beach areas in Bandar Lampung is focused on the Harbor Area.

2.3.3 *Land use*

In 1992, settlement was concentrated in the middle of Bandar Lampung, but 14 years later it grew to the east (Sub-district Tanjung Seneng) and to the northeast (Sub-district Sukarame). The development of residential areas has led to the shrinking of dry land agriculture. Pattern of in land use changes for 14 years (1992-2006) is presented in Figure 2.3.

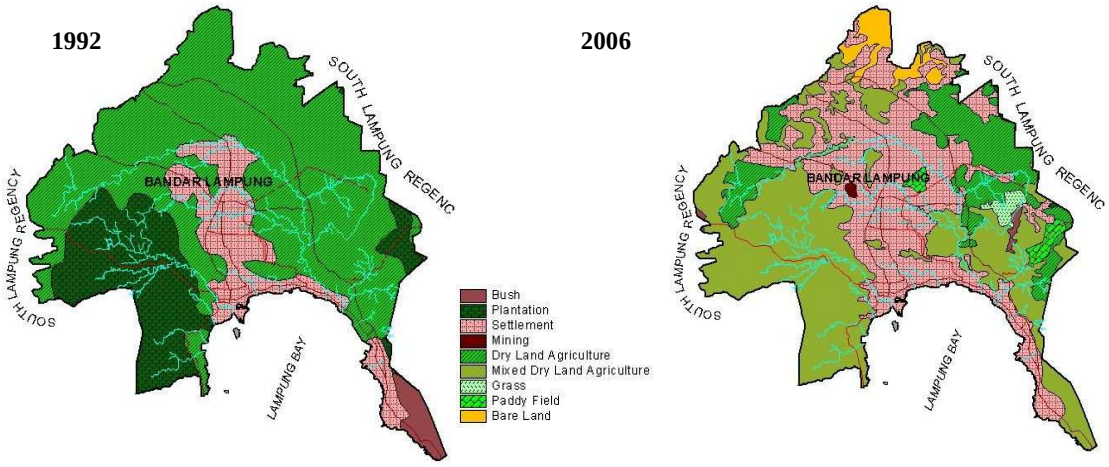


Figure 2.3:Distribution of changes in land use/cover in Bandar Lampung in 1992 and 2006

Land function in Bandar Lampung has changed rapidly. In 1992 there were 4 types of land use/cover, but in 2006 it grew to 9 types. In 1992, the highest percentage of land use was dry land agriculture (60%) but in 2006 the number shrank to only 13.4% (Table 2.2).

Table 2.2:. Land use/cover classification for 1992 and 2006.

Land use/ cover type	1992		2006		1992 – 2006 area changed (ha)
	Area (ha)	%	Area (ha)	%	
Bush	416.2	2.1	81.8	0.4	-325.9
Plantation	3943.8	20.0	20.4	0.1	-3823.5
Settlement	2674.3	13.6	6899.8	35.0	4118.0
Bare land	0.0	0.0	610.3	3.1	594.8
Grassland	0.0	0.0	175.1	0.9	170.6
Dry land agriculture	11873.7	60.2	2641.7	13.4	-8996.9
Mixed dry land agriculture	0.0	0.0	8196.8	41.6	7988.1
Paddy field	0.0	0.0	250.9	1.3	244.5
Mining	0.0	0.0	31.1	0.2	30.3
No data	814.0	4.1	814.0	4.1	0.0
	19722	100	19722	100	

A more detail land use/cover changes in Bandar Bampung City is given Table 2.3. The table shows, for example, that over 14 years dry land agriculture has changed into 8 different types of land uses.

Table 2.3:. Major Land Use/Cover Conversions from 1992 to 2006

No	From Class	To Class	1992-2006 Area (ha)
1	Bush	Settlement	39.4
		Mixed dry land agriculture	366.2
2.	Dry land agriculture	Bush	79.7
		Plantation	7.7
		Settlement	4290.8
		Bare land	594.8
		Grass land	170.6
		Mixed dry land agriculture	3789.7
		Paddy field	153.6
		Mining	9.5
3.	Plantation	Settlement	35.7
		Dry land agriculture	99.5
		Mixed dry land agriculture	3605.0
		Paddy field	90.9
4.	Settlement	Mixed dry land agriculture	227.2
		Mining	20.8

In overall condition, land use in Bandar Lampung is classified into built (utilized) areas and open space. Utilized areas consist of land for yards, offices, trades, services, and industries. Open space areas consist of fields, gardens, forests and others. The utilized areas occupied more than 30% of Bandar Lampung City area, and primarily in the form of settlement. The high settlement area is to meet the high rate of population growth and urbanization (Bandar Lampung Regional Development Planning Agency, 2008).

2.4 Pattern of regional development and function of the City

Bandar Lampung as the capital city of Lampung Province and the center of government, with its high population growth and rapid development, has a very significant effect to the utilization of space and also to the surrounding regions. Zoning of area in Bandar Lampung is therefore become a strategic issue in the City Spatial Planning (RTRW). The current RTRW is RTRW for 2005-2015 (Bandar Lampung Regulation No. 4 /2004). This RTRW provides:

- Guidelines on management of protected and utilized areas
- Guidelines on management of city area
- Guidelines on development of production and residential areas
- Guidelines on facilities and infrastructures
- Guidelines on development of priority areas

2.4.1 City Are Sections (BWK)

Bandar Lampung is divided into 8 (eight) City Area Sections (BWK) in which each section has main and supporting functions. The reasons for the division are:

- Functions and dominance of activities in different regions of the city;
- The similarity of land use;
- The similarity of population density and building density;
- Geometric size/area;

- Existing physical and administrative boundaries;
- Limitation in service coverage capacity;
- Space structure.

Table 2.4:. Functions of City Area Section (BWK) in Bandar Lampung

Domain	**Main Functions**	**Supporting Funcions**
BWK A (Gedung Meneng)	Higher Education, Terminal Area Regional and Settlement Development	Cultural Center, House Rent / Kost, Center for Local and Agricultural Services for Small scale
BWK B (Sukarame)	Large scale residential and City-scale trade	Small Industries Center, Forest City Development, City Development Reserve and Service Center
BWK C (Panjang)	Ocean Harbor Center, Trade, Terminal Products and Manufacturing Industry	Small Industries center, Conservation Area and Forest Protection
BWK D (Sukabumi/ Tanjung Karang Timur)	Trade / Services and Industrial regions	Small Industrial Housing and Heritage
BWK E (Tanjungkarang/ Pusat Kota	General Trade and Public Services	Trade Support Facility / Function Parking / Park, Double Housing and Cultural Center
BWK F (Tanjungkarang Barat)	Trade / Services and Region Conservation	Housing
BWK G (Langkapura/Kemiling)	Horticulture Development, Conservation Area, Tourism / Ecotourism and Settlement Development (Kasiba / Lasiba)	Big Kavling Housing with Small KDB, Small Industry and the State Police School
BWK H (Telukbetung)	Government Center, Wholesale Trade and coastal tourism	General Services, Housing, Small Industry and Conservation

Source: Bandar Lampung RTRW, 2005-2015

In addition to the City Area Section (BWK) established, there are some special management areas in the zoning of Bandar Lampung, namely:)

2.4.2 Water Absorption Area

Water absorption management plan for Bandar Lampung is divided into 6 (six) zone areas:

a. Zone Area 1 (Recharged Area)

Zone Area 1 provides a fairly high contribution to fill deep ground water reserves. In this zone area, strict area controls need to be conducted. Areas included in this zone are Kemiling and West Teluk Betung Sub-districts.

b. Zone Area 2 (Buffer Area)

In this zone there is a plan to build small and medium scale water enclaves (rain water reservoirs) and to apply the rules of open to building area ratio of 70%:30%. These zones are scattered in Sub-distict of Tanjungkarang Barat, Tanjungkarang Timur, Panjang, Tanjungkarang Tengah, Telukbetung Utara, and Telukbetung Selatan.

c. Zona Area 3 (Low Absorption Area)

In this area, water conservation is implemented by applying absorption wells in each building and/or by constructing man-made reservoirs of small and medium scales. Areas included in this zone are Sub-districts Kedaton, Sukarame and Tanjungkarang Barat.

d. Zona Area 4 (Medium Absorption Area)

In this area, building density level is significantly high and has reached the saturation point for residential area. Water is conserved by applying absorption wells to accommodate water from the built area. Areas of this zone are Sub-districts Tanjungkarang Tengah, Sukabumi and Tanjungkarang Timur.

e. Zona Area 5 (High Absorption Area)

This zone is dominated by dense residential area. Conservation pattern should apply absorption wells in every house with volume that accommodates all rain water from roofs and yards. Areas included in this zone are Sub-districts Sukabumi and Tanjungkarang Timur.

f. Zona Area 6 (Sea Water Affected Area)

This zone is located along Lampung Bay Beach including Sub-districts South Telukbetung Selatan and Panjang. The main function of this area is as a buffer or ground water absorption area from the threat of seawater intrusions.

2.4.3 Coastal Areas

Bandar Lampung coastal area extends for ± 27 km, which is located in BWK H (Telukbetung) and BWK C (Panjang). Administratively, the coastal area includes West Telukbetung Sub-district (Keteguhan, Kota Karang, Perwata and Sukamaju Villages), Telukbetung Selatan Sub-district (Way Lunik, Garuntang, Ketapang, Pesawahan, Telukbetung, Kangkung, Sukaraja, Bumiwaras and Pecoh Raya Villages) and Panjang Sub-district (Panjang Selatan, Panjang Utara, Pidada, and Srengsem Villages). Coastal area zoning is adopted through the concept of Integrated Coastal Area Management, which is the concept of zoning and revitalization of community-based coastal areas and divides the coastal areas into zones according to existing potential, condition and area structure.

The concept of beach reclamation is one of the alternatives of strategic area development as the center of economic growth and to handle slums areas along the Bay of Lampung on the condition of strict implementation, including technical, socio-economic and cultural aspects that are adjusted to the concept of Bandar Lampung Ecocity.

In order to further arrange the coastal areas, Bandar Lampung Fisheries and Marine Agency has conducted Advanced Studies of Bandar Lampung Coastal Area Zoning. The study has produced zoning composition plan for buildings and non buildings on the coastal areas of Bandar Lampung that is based on: Zone A Revitalization Area; Zone B Ports, Warehouses and Integrated Industry Area; Zone C Integrated Business Area and Zone D Integrated Tourism Area. Thus the concept of *Water Front City* in Bandar Lampung has been made and continues to be finalised.

In the planning of Bandar Lampung Coastal Areas, sea transportation system is also one of the major components. Port area located in the southern tip of Bandar Lampung has contributed to the dynamics of shipping traffic in this area. This port is the only **Port for Export Activities** owned by Bandar Lampung. Increase in export goods through this port definitely could increase the port levy from the harbor. This facility is one of the supporting factors of trade in Bandar Lampung.

The port of Panjang is a natural port relatively protected from the sea waves, and according to its hierarchy it is an International Port as it is open for foreign trade.

2.4.4 Protected Areas

Management of protected areas in Bandar Lampung is divided into 5 (five) zone areas, namely:

a. Water Absorption Zone

This area is an area that provides protection to the areas underneath it. This zone area covers the hills/mountains in West Tanjungkarang, Langkapura, West Telukbetung and buffer areas (Bandar Lampung 17 & 19 Register).

b. Local Protected Zone

This zone is divided into 3 (three) zone areas, namely (i) coastal border, (ii) river border, and (iii) Heritage & Sciences Reserve Park. Areas included in the zone are areas along the Bay of Lampung, all rivers in Bandar Lampung, Ancient Sites in the areas of Kedamaian, Negeri Olok Gading & other places recommended by the Government of Bandar Lampung.

c. Disaster Prone Area

Included in this area is landslide-prone hills and flood-threatened rivers/valleys and areas along the Teluk Lampung Beach.

d. Catchment Area

This area is a catchment area for the Way Rilau Regional Water Company that covers Register 17 area (Gunung Betung).

e. Flood Buffer Area

The flood buffer area covers Register 19 area.

2.4.5 Utilization of Area

Utilization of area in Bandar Lampung is developed in accordance with the potential for settlement, service/trade, industrial, and tourism areas, as follows:

a. Housing

Large, medium, and small housing development spread throughout the city and has residential land suitability outside protected areas. As for the improvement of housing quality, it includes slum areas, riverbanks, railroad sides, and fishing areas. Those areas are distributed in Tanjungkarang Tengah, Panjang and Telukbetung Selatan Sub-districts.

b. Service/Trade

Trade area development is divided into 5 trade spesifications, namely:

- Regional trade including South Telukbetung area.
- City scale trade including areas along city main roads in South Telukbetung and Central Tanjungkarang Districts.
- BWK scale trade including areas in each BWK center.
- Environmental scale trade including areas in each residential area.
- Street vendors aglomerating with city trade activities and BWK trade

c. Industry

Industrial zone covers Lampung Industrial Zone (KAIL). Industrial zone is in BWK C (Panjang) aglomerating with warehouse and port activities. Small industry Center is in BWK of Panjang, Sukarame, Gedong Meneng, and Langkapura. These unpolluted Home Industry are integrated with residential activities.

d. Government

The center government of the City is in BWK H (Telukbetung) while the center government in every sub-district/village level is in every sub-district/village.

e. Tourism

Beach tourism is in area of Lampung Bay, while city tourism is in city center, city and environmental parks, urban forests, city open green area (RTH) and man-made lakes.

f. Education

Higher education is in BWK A (Gedung Meneng). High schools are in every BWK center, Junior high schools and elementary schools are in the center of residential areas.

g. Social Facility

Facilities of health, religion, sports, and recreation are located in accordance with service hierarchy. Islamic Center is in BWK A (Jl. Soekarno – Hatta)

h. Open Green Area

Open Green Area for Urban Forest Park is in BWK B (Sukarame) and in hilly areas that has a function as open green area. Urban forests spread in city center such as in Way Halim, environmental parks are in environment center area. Cemeteries are in

Telukbetung Barat, Tanjungkarang Barat , Sukarame, Panjang and Kemiling Sub-districts.

2.5 Current Demographic

2.5.1 Population Density

Based on Statistic Center Agency data, the number of Bandar Lampung residents in 2007 was 812,133 and in 2008 was 822,880 (Table 2.5). In 2008 the population consisted of 414,938 males (50.36%) and 407,942 females (49.63%). The annual rate of population growth rate in Bandar Lampung was 1.22%. The highest population growth occurred in 2008 (up 1.30 percent).

Population density in 2008 was at an average of 42 people/ha. According to the criteria of population density, Bandar Lampung has a low population density. Sub-districts that have highest population density are Tanjung Karang Tengah and Teluk Betung Selatan (Bandar Lampung RTRW 2005-2015).

Table 2.5:. Structure of Bandar Lampung Citizens (Bandar Lampung Statistic Center Agency, 2009)

Year	Gender		Total Population	Area (Ha)	Density
	Male	Female			
2005	397.863	395.883	793.746	19.722	40,25
2006	405.208	398.714	803.922	19.722	40,76
2007	409.433	402.700	812.133	19.722	41,18
2008	414.938	402.942	822.880	19.722	41,72

Source: http://Lampung.BPS.go.id

2.5.2 Population Structure

By age

The description of population structure by age will show the number of productive population and the number of unproductive population in Bandar Lampung. Those who belong to productive population are classified as available labor and are important for determining disaster mitigation policy.

Based on age group, the largest proportion of the population of Bandar Lampung belongs to age group of 20-24 (95,597 people), followed by age group of 15-19 (95,537 people). The number of productive age (15-55 years old) in Bandar Lampung was 546,920 people or 64.75% of the total population.

By Religion

Religion plays an important role in creating harmony in society. According to number of the followers, Islam is the most practiced religion (755,851 followers or 89.50% of the total population), followed by Christian/Protestant (31,695 followers), and Catholic (23,891 followers). The other religions practiced in Bandar Lampung are Hinduism and Buddhism.

2.6 Core-Periphery Relationships

As the Capital City of Lampung Province, Bandar Lampung becomes the centers of government, social, political, educational and cultural activities, and also the center of economic activity in Lampung Province. Bandar Lampung is strategic as it is located in a transit area of economic activities between Sumatera and Java Islands. This condition is profitable for the growth and development of Bandar Lampung to be the center of trade, service and industry. Bandar Lampung has experienced a rapid development, marked by increased number of built areas and emergence of new growth center zones (Bandar Lampung Regional Development Planning Agency, 2003).

2.7 Economy and Livelihood

Livelihoods are closely related to level of income, welfare and management of surrounding natural resources. Information on economy and livelihoods can illustrate the level of public welfare, and is one of the important factors that could support community resilience in facing disasters related to extreme climate events and climate change. Population with high dependency on agriculture and fisheries are more vulnerable to climate related disasters.

Workforce is population whose age is 15 years old and over who work or seek employment. There numbers of workforces in Bandar Lampung were increasing from 364,337 people in 2005 to 414,827 people in 2008.

There were 342,334 15-year-old residents who worked in main industry sectors in 2007, with details as follows: 1). In agriculture, forestry, and fisheries, 9,217 people. 2) In processing industry, 31,277 people. 3). In wholesale, retail, restaurants and hotels, 127,814 people. 4). In social services, 89,229 people, and 5) others (mining, electricity, gas, clean water, construction, transportation, warehouse, communications, finance, leasing business, land and business services), 84,797 people (http://lampung.bps.go.id/tabel/tk11.pdf). Thus trade and services are the residents' primary livelihoods.

Most of Bandar Lampung's Gross Regional Domestic Product (GRDP, Table 2.6) comes from transportation and communications (19.6%), processing industry (17,6 %), services (16,9%), trade, hotels, and restaurants (16,6%), and agriculture (5%) Distribution of economic activities in Bandar Lampung can be seen in Figure 2.5.

Table 2.6:. Gross Regional Domestic Product (GRDP) of Bandar Lampung Based on Field of Industry and Market Price in 2004-2007

No.	Economic Activities	2004	2005	2006	2007
1	Agriculture	317.382	336.894	459.996	622.174
2	Mining	89.091	91.919	94.069	95.057
3	Processing industry without the oil and gas	940.423	1.015.321	1.457.313	1.835.621
4	Electricity, and Water	98.126	127.955	153.563	162.058
5	Building	394.064	453.175	602.517	690.780
6	Trade, Hotel, Restaurants	1.152.353	1.163.215	1.462.784	1.740.263
7	Travel and Communication	947.407	1.187.247	1.500.958	2.049.305
8	Monetary, Rental, and Services	913.755	1.113.247	1.252.691	1.491.115
9	Other services	1.235.780	1.306.664	1.394.547	1.764.359
	Gross Regional Domestic Product	6.088.382	6.795.637	8.378.439	10.450.733

(Source: Bandar Lampung in Figures, 2008)

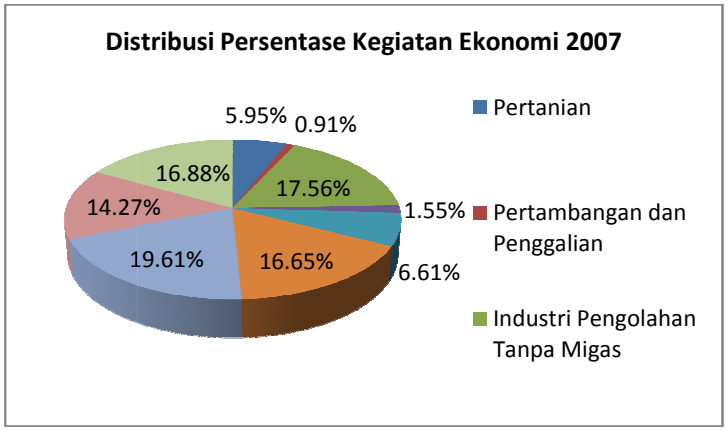


Figure 2.4:Distribution of Economic Activities in Bandar Lampung, 2007

2.8 Respondent Profiles

More detail descriptions of socioeconomic conditions in Bandar Lampung are made by using survey data in 6 villages, which are grouped into non-coastal and coastal areas. The non-coastal villages are: 1). Batu Putu, 2) Pasir Gintung, dan 3). Sukabumi Indah. While the coastal villages are: 4). Kangkung, 5). Kota Karang, 6). Panjang Selatan. The survey involved 256 people, consisting of 62.28% male and 36.72% female. Besides from survey, the information is also sharpened through *focus group discussion* (FGD) in four locations in Villages of Panjang Selatan, Kota Karang, Batu Putu, and Pasir Gintung.

2.8.1 Social Context

A. Education Level

Level of education of a society is an indicator in assessing the ability of the society to accept new knowledge, and to absorb the skills and technology introduced. In general, the higher the educational level of a society, the more aware the society to respond to disaster adaptations. Therefore, the level of education of a society can be used as a benchmark in assessing the community vulnerability towards disasters.

Accoding to survey data (Table 2.7), majority of societies in the observed villages have finished elementary school. Sukabumi Indah Villages has the highest educational level.

Table 2.7:. Educational Level Distribution in Observed Sub-districts in Bandar Lampung, 2009 (%)

Education Level	Panjang Selatan	Pasir Gintung	Kota Karang	Batu Putu	Sukabumi Indah	Kangkung
Unschooled	12,5	6	9	20	-	7,7
SD Kelas 1-3	17,5	4	17,9	17,5	6,4	28,2
SD Kelas 4-6	5	10	7,1	15	-	10,3
SD Tamat	32,5	40	41	25	16,2	35,9
SMP Tamat	30	20	10,7	10	3,2	5,1
SLTA Tamat	2,5	18	12,5	12,5	54,8	12,8
Sarjana Muda/ D3	-	-	1,8	-	3,2	-
Sarjana	-	2		-	16,2	-

Notes: SD (Elementary School), SMP (Junior High School), SMA (Senior High School), Sarjana (graduate degree)

Table 2.8 describes the distribution of education and type of livelihood in each village. Based on the table, majority (47.5%) of respondents in Batu Putu works as home gardener-farmers; and most of them have lower-level education (did not complete elementary school, completed elementary school).

Types of works for People in Pasir Gintung are in trade (20%), service (10%), non-agricultural labours (20%) and other (48%) sectors. Most of the residents who work as traders and non-agricultural labours are lower- and midle-educated (junior and senior high school). The phenomenon of residents with lower-educational level is also observed in service sector. Although Pasir Gintung is nearer to the city, where on farm activities do not exist, the composition of jobs are dominated by lower-educated workers.

Almost all residents in Sukabumi Indah Village work as non-agricutural labors, service labors, or government employees (PNS/ABRI/POLRI). Most of workers in this village have midle- and higher-education levels. For example, government employees are diploma and university graduate. The same goes for residents who work in service sector. Out of 12.9% of the residents who work in that sector, 9.68% of them have higher education.

Table 2.8: Educational Leval Distribution Based on Livelihoods in Observed Sub-Districts in Bandar Lampung, 2009 (%)

Village	Type of livelihoods	Un schooled	SD Grades 1-3	SD Grades 4-6	Graduated SD	Graduated SMP	Graduated SMA	D3	S1	Total
	Non Coastal									
Batu Putu	Farmer, food crop	2,50	-	-	5,00	2,50	-	-	-	10,00
	Farmer, home garden	5,00	7,50	12,50	15,00	2,50	5,00	-	-	47,50
	Trader	-	-	-	2,50	-	-	-	-	2,50
	Service	2,50	-	-	-	-	2,50	-	-	5,00
	Carpenter	-	-	-	-	2,50	-	-	-	2,50
	Agricultural labor	5,00	5,00	2,50	2,50	-	2,50	-	-	17,50
	Non-agricultural labor	2,50	-	-	-	-	-	-	-	2,50
	others	2,50	5,00	-	-	2,50	2,50	-	-	12,50
	Total	20,00	17,50	15,00	25,00	10,00	12,50	-	-	100,00
Pasir Gintung	Trader	4,00	-	-	8,00	4,00	4,00	-	-	20,00
	Public servants (PNS/ABRI/POLRI)	-	-	-	-	-	-	-	2,00	2,00
	Service	-	-	-	4,00	2,00	4,00	-	-	10,00
	Non-agricultural labor	-	2,00	4,00	12,00	2,00	-	-	-	20,00
	others	2,00	2,00	6,00	16,00	12,00	10,00	-	-	48,00
	Total	6,00	4,00	10,00	40,00	20,00	18,00	-	2,00	100,00
Sukabumi Indah	Fishermen	-	-	3,23	-	-	-	-	-	3,23
	Trader	-	3,23	-	-	-	-	-	3,23	6,45
	Public servants (PNS/ABRI/POLRI)	-	-	-	-	-	9,68	-	12,90	22,58
	Service	-	-	3,23	-	3,23	6,45	-	-	12,90
	Non-agricultural labor	-	-	6,45	-	-	3,23	3,23	-	12,90
	others	-	3,23	3,23	-	-	35,48	-	-	41,94
	Total	-	6,45	16,13	-	3,23	54,84	3,23	16,13	100,00
	Coastal									
Kangkung	Fishery	-	7,69	-	-	2,56	-	-	-	10,26
	Trader	5,13	5,13	5,13	2,56	-	7,69	-	-	25,64
	craftsman	2,56	-	-	-	-	-	-	-	2,56
	Service	-	2,56	-	2,56	-	2,56	-	-	7,69
	Carpenter	-	-	-	2,56	-	-	-	-	2,56
	Non-agricultural labor	-	7,69	5,13	2,56	-	-	-	-	15,38
	Others	-	5,13	-	25,64	2,56	2,56	-	-	33,33
	Total	7,69	28,21	10,26	35,90	5,13	12,82	-	-	100,00
Kota Karang	Fishermen	3,57	3,57	1,79	10,71	1,79	-	-	-	21,43
	Trader	-	1,79	-	3,57	3,57	3,57	-	-	12,50
	Service	1,79	-	1,79	3,57	1,79	5,36	-	-	14,29
	Non-agricultural labor	-	-	-	16,07	1,79	1,79	-	-	19,64
	others	3,57	12,50	3,57	7,14	1,79	1,79	1,79	-	32,14
	Total	8,93	17,86	7,14	41,07	10,71	12,50	1,79	-	100,00
Panjang Selatan	Fishermen	7,50	2,50	-	5,00	5,00	-	-	-	20,00
	Trader	-	-	-	5,00	-	-	-	-	5,00
	Service	-	5,00	-	2,50	-	-	-	-	7,50
	Non-agricultural labor	2,50	10,00	2,50	15,00	10,00	2,50	-	-	42,50
	others	2,50	-	2,50	5,00	15,00	-	-	-	25,00
	Total	12,50	17,50	5,00	32,50	30,00	2,50	-	-	100,00

Notes: *SD* (Elementary School), *SMP* (Junior High School), *SMA* (Senior High School), *Sarjana Muda*/D3 (Diploma), *S1/Sarjana* (graduated degree)

Almost similar pattern is observed in coastal areas. In Kangkung Village, for example, most of the residents work as traders, non-agricultural labors and fishpond farmers. Most of residents who work on these sectors have lower-education levels (maximum completed elementary school).

Based on the above illustration, majority of jobs in coastal and non-coastal villages are dominated by lower educated workers (Figure 2.5). Only in public servants/goverment officials and and some traders, the workers are university graduates.

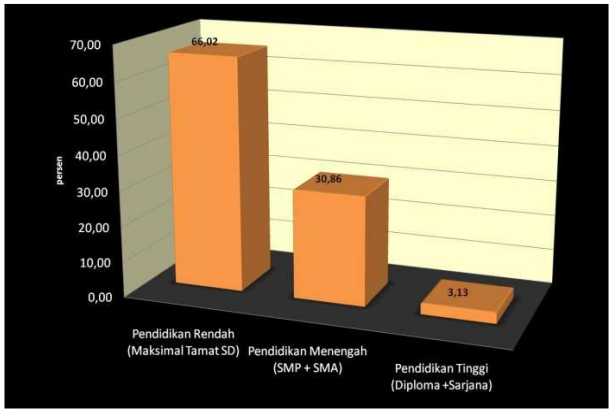


Figure 2.5:Distribution of Educational Level Based on Its Classification in Observed Sub-Districts in Bandar Lampung, 2009.

B. Family decision making

Family member who is dominant in family decision-making is the husband with a percentage of 55.98% (Table 2.9). However, there are peoples that stated that family decision-making cannot be done by husbands only. The husbands who involve their wives in family decision-making are quite large (34.19%). If this number is juxtaposed with the percentage of breadwinners in families, which are husbands and wives, it can be seen that women's consistency in family decision-making is also affected by their involvement in helping their husbands in obtaining family income. From the data, the number of wives' involvement in decision making in non-coastal areas is higher than in coastal areas. For examples, in Batu Putu and Sukabumi Indah Villages, the percentage of husbands and wives as decision makers are 58.82% and 58.33%, respectively.

At village level, participation of family member especially women in decision making can be seen from the number of women invited to attend meetings or village council. The results of FGD show that generally only men are invited. Women will be invited if in the respected families there are no men who can represent the families. The reasons for not inviting women in the meeting are because the meeting is discussing issues related to men, for example, agriculture issues, although based on the illustration of family role in obtaining livelihoods it can be seen that women have a quite significant role in fulfilling family's livelihood including being workers in agricultural sectors. This means that actually agricultural issue is also women's issue.

In a more strategic meeting like in discussing village development plan (Musrembang), women are also less involved. This is due to men's mind set who thinks that women's role in a household is to take care of children and not to go to meetings. However when husbands cannot attend meetings, wives will be asked to come as husband's representative. From this perspective, it can be seen that in a smaller scale, such as family's interest, women have bargaining position that is equal to men's. But in a larger scale, such as society's interest, men's role is more dominant; men thought that their presence can represent women's interest. This shows how weak the women's bargaining point in society's life is.

In relation to disasters, often an early warning system or information related to disasters is given and discussed only with men/husbands. In such cases, however, there is no guarantee that all of the information related to disasters can be conveyed well to women/wives at home. Inaccuracy of information is one of the factors that cause women to be more vulnerable when disasters strike. The same situation applies to disaster programs. Because women are not involved in meetings or council, the needs and interests of women are not heard. For example, in a case when a disaster strikes in an area, the local government provides public bathroom facilities with the walls are only half-covered that causes women to feel uncomfortable in doing bathroom activities. This condition reflects insensitivity towards women's needs.

Table 2.9: Distribution of Family Member Involved in Family Decision-Making in Observed Sub-districts in Bandar Lampung, 2009 (%)

Sub Districts	(N)	Family member who make decision										Grand Total
		H	HW	W	all	H S	S	WS D	WD	HS D	HW S	
Batu Putu	107	41,18	58,82	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
Pasir Gintung	34	67,35	20,41	0,00	4,08	4,08	0,00	2,04	0,00	2,04	0,00	100,00
Sukabumi Indah	49	41,67	58,33	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
Kangkung	24	55,26	26,32	7,89	5,26	0,00	2,63	0,00	2,63	0,00	0,00	100,00
Kota Karang	127	51,92	38,46	3,85	1,92	0,00	1,92	0,00	0,00	0,00	1,92	100,00
Panjang Selatan	38	70,27	16,22	5,41	2,70	5,41	0,00	0,00	0,00	0,00	0,00	100,00
Non Coastal	52	53,27	41,12	0,00	1,87	1,87	0,00	0,93	0,00	0,93	0,00	100,00
Coastal	37	58,27	28,35	5,51	3,15	1,57	1,57	0,00	0,79	0,00	0,79	100,00
Grand Total	234	55,98	34,19	2,99	2,56	1,71	0,85	0,43	0,43	0,43	0,43	100,00

Notes: H (Husband), W (Wife), S (Son), D (Daughter)

C. Family participation in joining trainings

In general, community involvement in training activities on capacity development (e.g. improving skill and capacity for doing other economic activities) was relatively low. Table 2.11 shows that community involvement in the training was only 14.84 percent. Communities in coastal areas are more active in participating in the training than communities in non-coastal areas, particularly communities in Panjang Selatan

village. Within a household, member of the family who normally participate in the training is husband (head of the family), except in Sukabumi Indah.

Table 2.10:. Distribution of Family Member Participation in Joining Trainings in Observed Villages in Bandar Lampung, 2009 (%)

Area/ Village	Total Res (N)	Res Answer (n)	n/N (%)	Involvement of Household Members in Training (from n in %)				Total
				Husbandi	Wife	Son	Daughter	
Non Pesisir (non-coastal)								
Batu Putu	40	3	7,5	66,7	33,3	-	-	100
Pasir Gintung	50	3	6,0	100,0	0,0	-	-	100
Sukabumi Indah	31	5	16,1	40,0	60,0	-	-	100
Sub Total	121	11	9,1	63,6	36,4	-	-	100
Pesisir (coastal)								
Kangkung	39	2	5,1	100,0	0,0	-	-	100
Kota Karang	56	7	12,5	42,8	28,6	14,3	14,3	100
Panjang Selatan	40	18	45,0	44,4	38,9	11,1	5,6	100
Sub Total	135	27	20,0	48,1	33,3	11,1	7,4	100
Grand Total	256	38	14,8	52,6	34,2	7,9	5,3	100

Low level of participation of community in such training may limit their capacity to survive in difficult situation. If a family were exposed to a condition where they may not be able to depend on its main job both in short and long term, the family will face serious problem. They will not be capable of doing other alternative/additional work due to their limited skills. It is quite important for the family to take part in training activities to increase their opportunity to do other and additional jobs.

In the context of urban communities with low levels of economic strata, the increase in skills should not always be obtained by way of formal training, but can also be an informal way. From FGD, it was revealed that the community are seldom followed the formal training. Some communities are even less aware that their livelihood activities essentially require a particular skill. In fact some of the work performed, such as construction workers requires special skills and the skills they acquire was through autodidact. Communities in Sand Gintung village stated that there has never been a good training aid program of formal or informal, aimed at improving the skills of citizens of both local government and local NGOs.

D. Family participation in joining community organizations

In general, residents' participation in community organizations is still relatively low. Table 2.11 shows that residents' participation in organizations is 42.97%, therefore as many as 57.03% of the residents do not participate in organizations. Although relatively small, residents' participation in coastal areas in organizations is relatively

higher than residents' in non-coastal areas. Residents in South Panjang sub-district are more active in organizations than residents in other sub-districts. 70% of the residents in South Panjang are actively involved in organizations.

Based on the data of residents who are active in organizations, it can be seen that husbands are more active in organization activities than wives. The same goes for sons who are more active in organizations than daughters. This condition applies to other areas. Organization is a place for residents to express their creativity and ideas including efforts to make prosperous the local residents. Though the number of participation is quite low which is 42.97%, it is sufficient for an organization to act in the improvement of residents' life quality. Its connection to disaster is the more residents are involved in organizations, the bigger the residents' access to obtain information and disaster relief**.**

Table 2.11:Distribution of Family Member Participation in Community Organizations in Observed Sub-Districts in Badar Lampung, 2009

Sub Districts	Total Respd (N)	Res Answer (n)	n/N (%)	Family Member Participation in Community Organizations (n in %)				Jumlah
				Husband	Wife	Son	Daughter	
Non Coastal								
Batu Putu	40	16	40,00	56,25	43,75	0,00	0,00	100,00
Pasir Gintung	50	9	18,00	66,67	33,33	0,00	0,00	100,00
Sukabumi Indah	31	21	67,74	57,14	42,86	0,00	0,00	100,00
Sub Total	121	46	38,02	58,70	41,30	0,00	0,00	100,00
Coastal								
Kangkung	39	15	38,46	46,67	33,33	6,67	13,33	100,00
Kota Karang	56	21	37,50	57,14	28,57	14,29	0,00	100,00
Panjang Selatan	40	28	70,00	53,57	32,14	10,71	3,57	100,00
Sub Total	135	64	47,41	53,13	31,25	10,94	4,69	100,00
Grand Total	256	110	42,97	55,45	35,45	6,36	2,73	100,00

FGD results revealed various forms of organizations and organizational activities in the observed sub-districts. According to Mr. Mugi, there is a community organization in South Panjang sub-district, which is Bahari Mandiri fishing group. Lately this group has not done many activities, although it used to be active in savings and loan where each member was obliged to pay the minimum of IDR 1,500/month for savings. But because many residents did not pay their debt, the savings and loan activity was hindered and currently is inactive. Though there are fishing groups in South Panjang, there are no cooperatives for fishermen that can support fishermen's operations.

In Batu Putu sub-district there are agricultural and forestry groups. There are 10 joint agricultural groups here. They hold meetings or councils to discuss issues, but group activity to improve farmers' economy, for instance savings and loan activity, has not been done. According to Mr. Jumaidi, a community leader in Batu Putuk Sub-district,

"*...perceived benefit of joining agricultural group is to get information on disease prevention. But there is no support to improve farmers' economy. There is also no fertilizer help. There was rice seed support for residents in 2008.*"

Besides agricultural groups, residents also formed forestry groups in order that the residents can obtain permits for plating in forest lands. Besides groups for males, there are also groups for females with the name of PKK 8, because there are 8 members. One of the activities of this group is cleaning other people garden together. The profit is not directly divided among members, but most of it is used to purchase equipment for party such as plates, glasses, pots, chairs, and some are put into group's savings. The benefit of becoming a member is if a member wants to borrow equipment for party, he does not have to pay for anything, but a non member does. Some of the money obtained from lending equipment to non members will be used to purchase other equipment, and put into group's savings. Another benefit of becoming a member is that they can borrow money from group's savings. The loan is interest free as long as it is a short term loan. But if it is a long term loan there will be interest although small. The idea for the activity came from women.

It is heard that in Pasir Gintung sub-district, there are many unions that are related to the residents' livelihoods. For example, there are unions for meatball sellers, vegetable sellers, security guards etc. Besides those unions, there are also community organizations such as Petir and Paku Banten. The location of Pasir Gintung sub-district that is near to main market causes some residents to work not only as traders but also as thugs. Thus, some residents call that area as Bronx region. This condition triggers the emergence of community organizations like Petir and Paku Banten. The organizations' activities among others are organizing parking lots and securing neighborhoods. Residents think those unions and community organizations bring positive impacts, such as increase of welfare among the residents and decrease of crime and delinquency in Pasir Gintung sub-district.

E. Residents Participation in Institutions

One of the community strengths in facing disaster is the high level of social cohesiveness of the residents, the more cohesive the residents in doing community activities, the stronger their social cohesiveness. This social cohesiveness gives birth to cooperation when disaster strikes. The level of social cohesiveness can be seen from the various types of residents' social activities. Some social activities related to disaster are mutual cooperation, 3M activities, and repairing village infrastructures like village roads, sewers, garbage disposals, and others. Based on data, out of 135 coastal residents (78.5%) rarely conducted mutual cooperation activities. This was done only once a year. Table 2.7 shows that the distribution of coastal residents who conduct mutual cooperation activities. From the illustration, it can be seen that 48.11% are in Kota Karang, 24.53% are in Kangkung, and 27.36% are in South Panjang.

From the FGD results, it is known that mutual cooperation activities in Kota Karang sub-districts have not been well implemented, especially in the matter of togetherness. Actually there is a rule that every Friday there will be mutual cooperation activity to clean the neighborhood. However, in the implementation, the cleaning activity in Kota Karang is more individual, done individually by the residents. The same happens when there is a damaged house. Usually the repair is done by the house owner without any help from neighbors. This individual activity is caused by changes in the residents' livelihoods. Back then in the 70s, most of the residents of Kota Karang were fishermen. But due to the low income nowadays, many residents became plantation workers, entrepreneur, employees, or labors. The

variation in livelihoods causes dissimilarity in work rhythm so it is hard to do activities at the same time. However, the residents are still helpful towards each other.

In contrast to Kota Karang's residents, the residents of South Panjang admited that mutual cooperation in that area still runs well. The activity is done routinely every month or after tides. The activity is not only to clean the neighborhood but also to help the residents who are going to throw a party, like wedding party or to help the residents who are in plight.

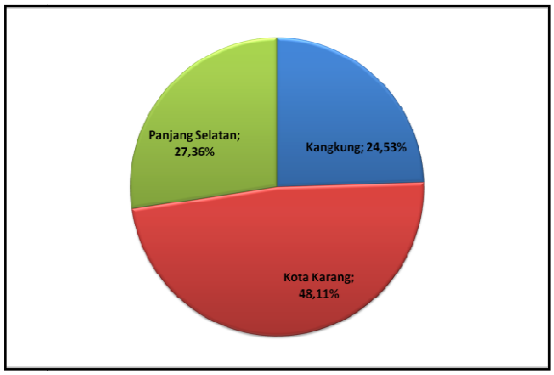
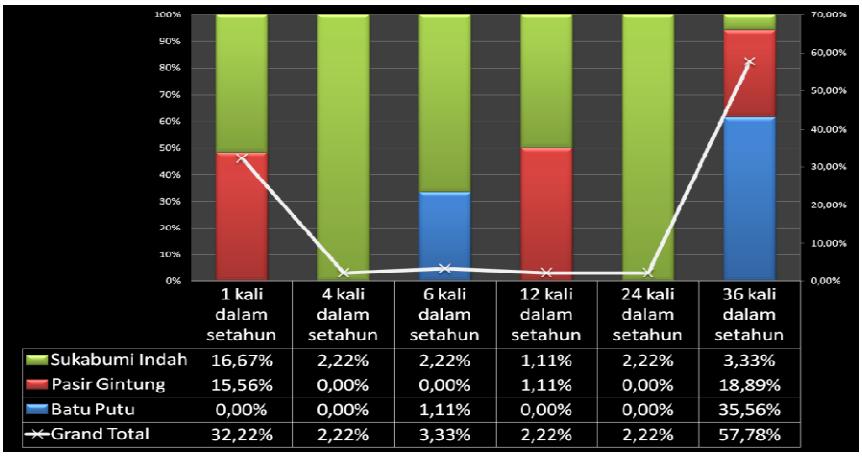


Figure 2.6:. Distribution of Costal Residents Conducting Mutual Cooperation Activities Minimum Once A Year

In non-coastal areas, the frequency of mutual cooperation varied: once a month, twice a month, twice a year, or even once a year (Figure 2.8). Out of 121 coastal area residents, 66.66% of residents participate in mutual cooperation activities. Most of the residents in non-coastal areas conduct mutual cooperation activities 36 times a year or every week (57.78%), and once a year (32.22%). The more often the residents conduct mutual cooperation activities, the bigger is the impact.



	1 kali dalam setahun	4 kali dalam setahun	6 kali dalam setahun	12 kali dalam setahun	24 kali dalam setahun	36 kali dalam setahun
Sukabumi Indah	16,67%	2,22%	2,22%	1,11%	2,22%	3,33%
Pasir Gintung	15,56%	0,00%	0,00%	1,11%	0,00%	18,89%
Batu Putu	0,00%	0,00%	1,11%	0,00%	0,00%	35,56%
Grand Total	32,22%	2,22%	3,33%	2,22%	2,22%	57,78%

Figure 2.7:.Distribution of Non-Coastal Residents' Participation Level in Mutual Cooperation Based on Implementation Frequency, 2009

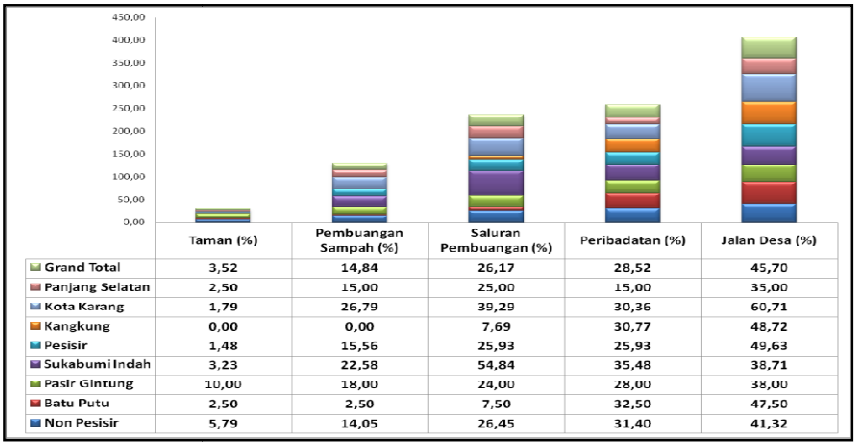
Figure 2.8 shows that road repair activities have the most residents' participation (45.70%) compared to other activities. This condition happens in all sub-districts in both areas, coastal or non-coastal areas. Mutual cooperation activity with the lowest

number of residents' participation is garden improvement. Comparing the 2 areas (coastal and non-coastal), residents in non-coastal areas give more participation than residents in coastal areas except in garbage disposal repair and road repair activities.

The highest residents' participation in mutual cooperation activity to improve gardens (10%) is in Pasir Gintung sub-district and the lowest participation (No residents' participation) is in Kangkung sub-district. Sub-district with the highest residents' participation in mutual cooperation to repair garbage disposal is Kota Karang (26.76%). There is no resident in Kangkung sub-district participating in the activity of garbage disposal repair. Residents in Sukabumi Indah gives the highest participation in sewer repair (54,84) and residents in Batu Putu sub-district gives the lowest participation compared to other sub-districts.

Repair in worship facilities get the highest residents' participation in Sukabumi Indah (35.48%) and get the lowest residents' participation in South Panjang sub-districts. Kota Karang and South Panjang sub-districts have the highest and the lowest residents' participation in road repair.

High resident's participation in mutual cooperation in both areas is admitted by a community leader who is the resource person in FGD. Community leaders in South Panjang, Batu putu and Pasir Gintung stated that relationship among residents in cooperation, mutual cooperation or gathering activities have been petty well, although in Pasir Gintung those activities are not well scheduled and organized.



	Taman (%)	Pembuangan Sampah (%)	Saluran Pembuangan (%)	Peribadatan (%)	Jalan Desa (%)
Grand Total	3,52	14,84	26,17	28,52	45,70
Panjang Selatan	2,50	15,00	25,00	15,00	35,00
Kota Karang	1,79	26,79	39,29	30,36	60,71
Kangkung	0,00	0,00	7,69	30,77	48,72
Pesisir	1,48	15,56	25,93	25,93	49,63
Sukabumi Indah	3,23	22,58	54,84	35,48	38,71
Pasir Gintung	10,00	18,00	24,00	28,00	38,00
Batu Putu	2,50	2,50	7,50	32,50	47,50
Non Pesisir	5,79	14,05	26,45	31,40	41,32

Figure 2.8:.Distribution of Residents' Participation in Mutuial cooperation Activities in Observed Sub-Districts in Bandar Lampung, 2009.

Community participation in social activities particularly on religious discussion (*pengajian*) is very high both in non-coastal (74.22%) and coastal areas (67.77%). Other social activities that get relatively high participation are female tontine (46.09%) and 3M[4] (*menguras, menutup dan mengubur*, Figure 2.9).

[4] Three M means Menguras (cleaning cannal-drainage system), menutup (closing public water tap), mengubur (burying human corpse).

	Non Pesisir	Batu Putu	Pasir Gintung	Sukabumi Indah	Pesisir	Kangkung	Kota Karang	Panjang Selatan	Grand Total
3M (%)	15,70	12,50	20,00	12,90	19,26	12,82	23,21	20,00	17,58
Arisan Bapak (%)	6,61	0,00	4,00	19,35	3,70	2,56	3,57	5,00	5,08
Arisan Ibu (%)	49,59	57,50	24,00	80,65	42,96	28,21	42,86	57,50	46,09
Pengajian (%)	67,77	82,50	54,00	70,97	80,00	84,62	80,36	75,00	74,22

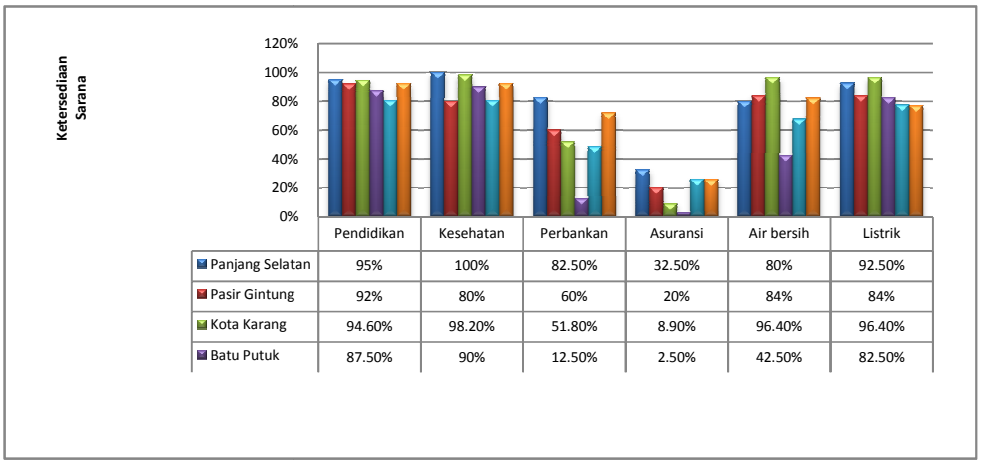
Figure 2.9:.Distribution of Residents' Participation in Several Social Activities in Observed Sub-Districts in Bandar Lampung, 2009

F. Access to Services

Facilities and infrastructures are factors that support the success of disaster adaptation effort. With these facilities and infrastructures various types of residents' life sectors can be develop further and improved. Facilities and infrastructures existing in areas of observed villages that are prone to disaster are education, health, banking, insurance, clean water and electricity.

The majority of the residents in all observed villages said that education facilities, such as school buildings for elementary and junior high school, are sufficient. Health facilities in this area are PUSKESMAS (community health center) or POSYANDU (integrated service center). These health facilities are affordable and can help the residents to treat simple ailments such as cold and cough. However, if the patient worsens, he will be referred to a hospital. In those areas there is community health insurance. However it is not automatically owned, the residents must apply for it first. Residents who do not own community health insurance may use local heath insurance facility. The process to apply for local health insurance is quite complicated and must go through a long bureaucracy.

In general banking facilities are good, with the exception in Batu Putu Villag. Batu Putu is located up in a mountain and far from the city center. Although other village residents say that banking facilities in their area are quite good, however there are only few residents who benefit from those banking services. According to FGD results, the majority of the residents say that their income is relatively small so they have no money to be saved in banks. The same goes for insurance. Not many residents know about the insurance facilities in their area. This is also supported by the fact that they have not got the needs for education, life or health insurances. Although the residents of Sukabumi Indah Village generally have better economic and educational levels, they show the same tendency with the residents from other less prosperous villages.



	Pendidikan	Kesehatan	Perbankan	Asuransi	Air bersih	Listrik
Panjang Selatan	95%	100%	82.50%	32.50%	80%	92.50%
Pasir Gintung	92%	80%	60%	20%	84%	84%
Kota Karang	94.60%	98.20%	51.80%	8.90%	96.40%	96.40%
Batu Putuk	87.50%	90%	12.50%	2.50%	42.50%	82.50%

Figure 2.10:.The Availability of Facilities on Observed Sub-Districts in Bandar Lampung, 2009

Electricity and clean water facilities are available in the observed villages. The electricity is supplied by State Electric Power Company (PLN), while clean water is obtained from local water company (PDAM) or mobile water vendors.

Based on information obtained from FGD, in coastal areas in Panjang Selatan and Kota Karang Villages there is a clean water shortage. The following is an illustration of the needs of clean water in a household in Kota Karang Villages. A mother with six children who live in Kota Karang Village claims that she usually buys galloned "Grand" drinking water at IDR 3,000.00,- IDR 3,500.00 per gallon. One gallon of water lasts for 4 days, so in a month she usually needs 7-8 gallons. For cooking she buys water at price of IDR 2,000,00 per 3 jerry cans (2 liter capacity) that would last for 3 days; so in a month she needs 30 jerry cans of cooking water. Therefore, in a month she must spends IDR 31,000,00-IDR 48,000,000 for water. For washing and bathing she uses water from drilled wells. Water from drilled wells is free but the quality is low (unclean) and tastes hot.

Situation in Batu Putu Village is completely different. Batu Putu Village which is located in mountainous/hilly area has abundant water source. In Batu Putu there are 3 drinking water companies namely Tri Panca, Grade, dan Grand. However, the residents think that the existences of water companies in their area reduce the water flow

2.8.2 Economic and Livelihoods

Information on residents' economic conditions can give an idea of the level of community welfare, and it is one of the important factors that could support community resilience in facing climate change or disasters. The residents' economic condition can be seen from their livelihoods, income, expenses and ownership of land and assets. The following is a general illustration of economic and livelihoods in the 6 observed villages.

A. Livelihoods

The livelihoods of the residents in the six observed villages are presented in Table 2.13. Panjang Selatan, Kota Karang and Kangkung Villages are located in coastal areas, where fishery is one of the dominant livelihoods. Around 20% of the residents of Panjang Selatan, 21.5% of the residents of Kota Karang and 10.3% of the residents of Kangkung admit that they work as fishermen or fishing labors. The survey also shows that 42.5% of the residents of Panjang Selatan work as non-agricultural labors, while in Kota Karang and Kangkung as many as 32.1% and 33.3% have livelihoods classified as 'others'. Fishermen are a livelihood that is influenced by climate condition and weather, so it is uncertain. When climate/weather conditions are good, their income may be plentiful, but in adverse conditions such as during high tides and strong winds, their income may drop drastically. Therefore may fishermen have side jobs such as becoming non-agricultural labors, pedicab drivers or construction workers.

Batu Putu Village is located in the highlands where the condition of land in this area is suitable for plantation crops such as cocoa, coffee, durian, *melinjo* and vanilla. Many residents in Batu Putu work as plantation farmers (47.5%) and agricultural labors (17.5%). The land owned by the residents is varied, but normally they own land less than 1 hectare. Usually in one land, they deliberately plant several types of crops. Some residents also utilise land owned by forestry service. Land lease is IDR 20,000/hectare/year. Small percentages (2.5%) of Batu Putu resident are traders, construction workers and non-agricultural labors. Some people from Batu Butu works as labors and security guards in the 3 water companies.

The location of Pasir Gintung Village is very strategic, which is near main market, bus stations and the largest government general hospital in Lampung Province, so many of the residents work in services sector. The biggest percentages of livelihoods belong to livelihoods classified as others (48%) such as technicians, drivers, and village government officer. The majority of the residents in Pasir Gintung Village (20%) are traders and non-agricultural labours.

In Sukabumi Indah Village, almost all of the residents in the area work outside agricultural sector as non-agricultural labors, service labors and government employees (PNS/ABRI/POLRI).

Table 2.12:. Residents' Livelihoods in Observed Sub-Districts in Bandar Lampung, 2009 (%)

Type of Levelihood	Panjang Selatan	Pasir Gintung	Kota Karang	Batu Putu	Sukabumi Indah	Kangkung
Farmer, food crop	-	-	-	10	-	-
Farmer, home garden	-	-	-	47,5	-	-
Fishermen	20	-	21,5	-	3,2	10,3
Trader	5	20	12,5	2,5	6,5	25,6
Craftsman	-	-	-	-	-	2,6
Public servants (PNS/ABRI/POLRI)	-	2	-	-	22,6	-
Service	7,5	10	14,3	5	12,9	7,7
Carpenter	-	-	-	2,5	-	2,6
Agricultural Labor	-	-	-	17,5	-	-
Non Agricultural Labor	42,5	20	19,6	2,5	12,9	15,4
Others	25	48	32,1	12,5	41,9	33,33

According to the dominant types of livelihoods that are highly affected by climatic conditions; the residents of Panjang Selatan, Kota Karang, Kangkung and Batu Putu Villages may be more prone to climate related disasters. As state previously, however residents in these villages do not depend on one sector only. Their alternative jobs would increase their resilience during adverse climate/weather conditions.

B. Family member Participation In Looking For Family Income

In general, head of the family is obliged to find income for his family. In order to improve family welfare, however, each family member will try to look for additional income. There are 13 models to describe person(s) that contribute to generating income (Table 2.13); these are: 1). husbands alone; 2). husbands and wives; 3). husbands and sons; 4). husbands, sons, and daughters; 5) husbands, wives, and sons; 6). husbands, wives, sons, and daughters; 7). wives alone; 8). wives and sons; 9). sons alone; 10). husbands and daughters; 11) husbands, wives, and daughters; 12). sons and daughters; and 13). daughters alone.

The family that rely on husbands as sole breadwinners is only about 46.56%. There are 31.58% of the residents' families where the husbands and wives work together to support their families. In a situation when husbands can no longer work, the family would rely on wives' support. There are 2.02% of the residents' families that rely on wives income. The largest percentage of families relying on wives' income is in Kota Karang Village. The data also shows that there are residents' families whose family members contribute income to support their family. In this group, adult family members, husbands, wives, sons, and daughters, all have jobs and all of their income is for supporting their family. Therefore, in general, the role of wives (women) in supporting their family life is relatively high. The role of women in family economy is also shown in FGD activities in observed villages. Residents admit that the role of wives in helping their husbands has existed since long time ago.

In many cases of working women, the wives' job is related to the husbands' job. For example in Panjang Selatan and Kota Karang Villages where most of the male residents work in fisheries; many of the working women in these two villages work as fish sellers, either in markets or from door to door. Usually the wives sell their husband's catch, but if the catch is low they sell their neighbours' catch or they buy fish in markets. Besides having permanent jobs, women also have seasonal jobs. According to Mr. Aan, the head of RT 14 Kota Karang Villages,

"...usually women are needed during fish harvesting season. At that time there will be many fish with various kinds and sizes. Before the fish is sold to fish auction or market, the fish must be sorted. Usually the wives will help the husbands sort the fish".

The activity involves not only the wives but also other family members. Similar condition happens to the residents whose main job is in agriculture, where the wives' job is related to the husbands', for example, wives is helping husbands in plantations or fields.

Table 2.13:Distribution of Working Family Member in Observed Sub-Districts in Bandar Lampung, 2009 (%)

SubDistricts (N)		Wage earner in the Family													Grand Total
		H	HW	HS	H SD	H WS	all	W	WS	S	HD	HW D	SD	D	
Non Pesisir															
Batu Putu	115	44,74	39,47	2,63	0,00	5,26	2,63	2,63	0,00	0,00	2,63	0,00	0,00	0,00	100,00
Pasir Gintung	38	59,18	24,49	2,04	4,08	0,00	0,00	0,00	2,04	4,08	0,00	2,04	2,04	0,00	100,00
Sukabumi Indah	49	35,71	60,71	0,00	3,57	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
Sub Total	55	48,70	38,26	1,74	2,61	1,74	0,87	0,87	0,87	1,74	0,87	0,87	0,87	0,00	100,00
Pesisir															
Kangkung	28	31,58	28,95	7,89	5,26	7,89	2,63	2,63	5,26	2,63	2,63	0,00	0,00	2,63	100,00
Kota Karang	132	47,27	21,82	10,91	5,45	3,64	3,64	3,64	1,82	0,00	1,82	0,00	0,00	0,00	100,00
Panjang Selatan	38	53,85	28,21	5,13	0,00	2,56	2,56	2,56	2,56	0,00	0,00	2,56	0,00	0,00	100,00
Sub Total	39	44,70	25,76	8,33	3,79	4,55	3,03	3,03	3,03	0,76	1,52	0,76	0,00	0,76	100,00
Grand Total	247	46,56	31,58	5,26	3,24	3,24	2,02	2,02	2,02	1,21	1,21	0,81	0,40	0,40	100,00

Notes: H (Husband), W (Wife), S (Son), D (Daughter)

C. Income

In general, community income is influenced by their livelihood. The majority of households in South Panjang, Pasir Gintung, Kota Karang, and Batu Putuk have income that ranges from IDR 500,001,00 up to IDR 1,000,000,00. While the majority of households in Kangkung have income that ranges from IDR 1,000,001,00 up to IDR 2,000,000,00. While the majority of households in Sukabumi

Indah have better income, which is above IDR 2,000,000,00. The quantity of this revenue is derived from the sum of fixed income and additional income.

Table 2.14:. Level of Residents' Household Income in Observed Sub-Districts inj Bandar Lampung, 2009 (%)

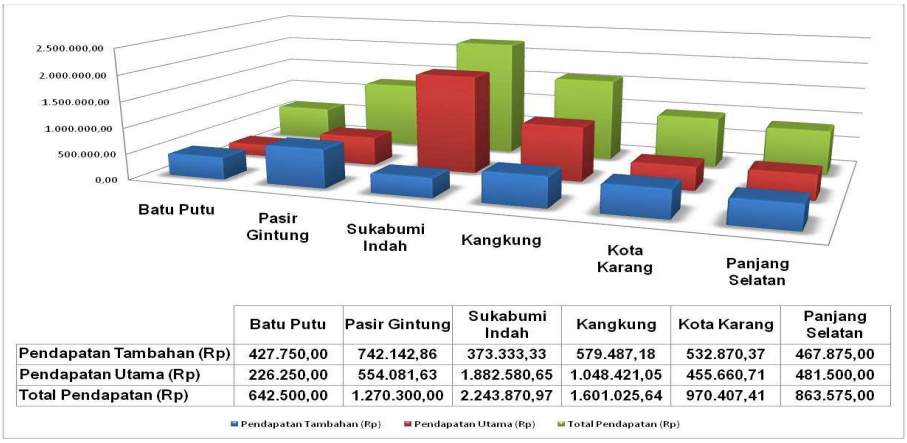
Classification Income (IDR)	Panjang Selatan	Pasir Gintung	Kota Karang	Batu Putuk	Sukabumi Indah	Kangkung
0-500.000	37,5	12	32,2	42,5	16,1	23,2
500.001-1.000.000	37,5	48	42,8	45	9,7	25,7
1.000.001-2.000.000	15	28	16,1	10	35,5	28,2
> 2.000.001	10	12	8,9	2,5	38,7	17,9

According to level of income, the majority of households in the area of Panjang Selatan, Pasir Gintung, Kota Karang and Batu Putu are economically vulnerable. Figure 2.11 shows that average household income in 6 observed villages is IDR 1,213,228.35/month. This income comes from fixed monthly income of IDR 705,421.26/month and from additional income of IDR 534,781.75/month. The average household's income is higher than the Bandar Lampung Regional Minimum Wage in 2008 of IDR 627,500.00. But if compared to the number of family members living in the household, the total income is relatively small and cannot fulfil all the family's needs.

According to information from FGD activities, fishermen are the dominant livelihoods in Panjang Selatan and Kota Karang Villages. During good climate and weather conditions, the fishermen income is relatively large. To obtain additional income during adverse weather conditions, residents in Panjang and Kota Karang Villages sometimes become traders, pedicab drivers, or housing construction builders. In normal condition, income of a fishermen ranges between IDR 20,000.00-30,000.00/day. Income from becoming pedicab drivers is in average of IDR 15,000.00/day. And income from becoming builders is IDR 30,000.00/day. Although the income is large, this last type of job is not available everyday.

Plantation harvest in Batu Putu Village is also greatly affected by natural conditions. During favourable times, the average coffee harvest in a year reaches 500 kilos and the average chocolate harvest reaches 400 kilos. However, there are times of bad season or crop failure. Therefore, in addition to plantation crops, the residents also grow shorter cycle horticultural plants such as vegetables and fruits that could provide additional income.

The average family income of residents in Sukabumi Indah Villages is larger than other villages. Thus, it can be said that this family in this village is relatively more prosperous. This is supported by information that in this village, the residents have more household assets than any other villages.



	Batu Putu	Pasir Gintung	Sukabumi Indah	Kangkung	Kota Karang	Panjang Selatan
Pendapatan Tambahan (Rp)	427.750,00	742.142,86	373.333,33	579.487,18	532.870,37	467.875,00
Pendapatan Utama (Rp)	226.250,00	554.081,63	1.882.580,65	1.048.421,05	455.660,71	481.500,00
Total Pendapatan (Rp)	642.500,00	1.270.300,00	2.243.870,97	1.601.025,64	970.407,41	863.575,00

Figure 2.11:.Distribution of Residents' Household Income Based on Fixed and Additional Income in Observed Sib-Districts in Bandar Lampung, 2009

D. Expenditures

Based on a survey in the observed villages, many families have expenditures higher than their income (Table 2.14 and Table 2.15. Therefore, in order to survive, the residents borrow money to other parties. Generally people borrow money from neighbors, agents or high interest creditors (*rentenir*). Loans from neighbors are usually without interest. However, because the residents' economic condition is relatively the same, the number of neighbors who can give loan is limited.

Table 2.15:. Residents' Expenditure in Observed Sub-Districts in Bandar Lampung, 2009 (%)

Expenditure (IDR)	Panjang Selatan	Pasir Gintung	Kota Karang	Batu Putuk	Sukabumi Indah	Kangkung
0-500.000	12,5	8	8,9	15	3,2	5,1
500.001-1.000.000	45	28	35,7	52,5	12,9	33,3
1.000.001-2.000.000	40	44	39,3	30	45,2	38,5
> 2.000.001	2,5	20	16,1	2,5	38,7	23,1

Mr. Jumaidi, 48 years old, is a Batu Putu resident, whose profession is as a cocoa farmer, as well as a middleman in his village. Farmers from surrounding neighbors sell their cocoa to him, where then he sells the cocoa to a collector in the city. When residents are in need of money, they usually borrow from Mr. Jumaidi and will later pay the loan with their cocoa. Mr.Jumaidi does not give interest. However, when giving loan, he observes the condition of the borrower. Usualy, residents who are given loan are those who have harvested their cocoa but it is still not dried, so the loan will soon be returned as soon as the cocoa is dried.

Another alternative source of funds is to borrow from agents or shops, as done by residents in coastal villages who are about to go fishing. The loan is usually returned

when the residents have returned from fishing and the catch has been sold. Besides that, some residents also often borrow from high interest creditors at an interest of 20%. However, desperate residents still prefer borrowing from high interest creditors rather than from banks because loan procedure is relatively faster, no collateral needed, payment can be done through instalments, and the creditors are actively come to the residents.

E. Ownership of Property and Assets

Information on residential property and assets can show the level of the residents' welfare in an area.

Ownership of Buildings and Land

In general, residents live in houses that they owned with property rights, rented, or belonging to relatives or parents. The average size of house buildings and lands in non-coastal area is higher than in coastal area (Table 2.16). The average size of buildings/land in non-coastal areas is 69.36/174.78 sqm, while in coastal areas is 54.73/68.82 sqm. A house with building and land size as mentioned above is enough for a family of 4-5. If the house size is considered to reflect the general view about residents' welfare, non-coastal residents are in general more prosperous than coastal residents.

Based on the FGD results and field observations, residents' housing in the Panjang Selatan Village appears dense and disorderly oriented. In certain locations, many residents build their houses above the sea due to land limitations. The height of the foundation is intentionally made more than one meter so the water from high tides will not flow into the house. The same conditions are found in Kota Karang Village; where in some locations many residents live in houses built above the sea. Based on the residents' information, residents in RT 8 - RT 14 rent houses from a landlord in Kota Karang Village named Haji Karya. The rent is IDR 50,000.00 per year. But sometimes, according to Haji Karya, due to the difficulty in economy, the residents cannot afford to pay this cheap rent.

Table 2.16:. The Average Size of Buildings and Land Owned by Residents in Observed Sub-Districts in Bandar Lampung, 2009

Sub Districts	The Average Size of Buildings (m^2)	The Average Size of Land(m^2)
Non Coastal		
Batu Putu	58,33	324,23
Pasir Gintung	60,66	92,02
Sukabumi Indah	97,63	115,44
Sub Total Total	**69,36**	**174,78**
Coastal		
Kangkung	44,65	45,60
Kota Karang	67,12	94,85
Panjang Selatan	47,23	55,03
Sub Total Total	**54,73**	**68,82**
Grand Total	61,65	118,91

Non-coastal residents, who have relatively high welfare than others, are from the area of Sukabumi Indah. In this village, most residents stay in a housing complex. And because it is in urban area, land in this location has a relatively higher price compared to land price in other areas.

There is a tendency that prosperous person would build a house made of bricks. In this context, family in non-coastal areas have relatively higher welfare level than the family in coastal areas as housing in non-coastal area are relatively larger (Table 2.16) and mostly made of bricks (Table 2.17).

According to Mr. Zabir, 63 years old, from Kota Karang Village majority of Kota Karang residents are Bugis ethnics. In the area many residents have houses made of wood in the form of stage houses. Wooden stage house is a distinctive feature of Bugis and Lampung ethnic. Besides being a culture identity, stage houses are also considered the most suitable for the condition of Kota Karang Village that is marshy. Wooden houses used to represent the welfare level of a family, but now it is no longer that way. The high price of wood makes the cost to build wooden houses becomes almost the same as the cost of building permanent houses made of bricks. Therefore, now the classification to determine whether a family is prosperous or not, can no longer be based on the materials used to build their houses.

Table 2.17:. Types of Wall Materials of Residents' Houses in Observed Sub-Disticts in Bandar Lampung, 2009 (%)

Sub Districts	Brick Wall	Wood or Bamboo	Grand Total
Non Coastal			
Batu Putu	20,87	13,91	34,78
Pasir Gintung	30,43	7,83	38,26
Sukabumi Indah	26,09	0,87	26,96
Sub Total	77,39	22,61	100,00
Coastal			
Kangkung	11,81	17,32	29,13
Kota Karang	22,83	19,69	42,52
Panjang Selatan	15,75	12,60	28,35
Sub Total	50,39	49,61	100,00

Asset Ownership

In addition to build a house, each family also allocates their income to purchase vehicles, electronic equipment and so forth (Table 2.18). Majority of family appliances owned by the residents are TV, mobile phones and gas stoves. The ownership of TV in non-coastal areas are higher that in coastal areas. In coastal areas, especially in Sukabumi Indah Village, all residents have TVs. In some households there is more than one TV. Therefore, TV can be used as effective means to disseminate information regarding disasters, especially disaster prevention.

Table 2.18:. Residents' Asset Ownership Index of Home Appliances in Observed Sub-Districts in Lampung Tahun 2009 (%)

Sub Districts	Total Res (N)	Household equipment							Communication Tool		Vehicles		
		TV	Washing Machine	refrigerator	Gas Stove	AC	Fan	Water Pump	Telephone	HP	Bicycles	Motorcycles	Car
Non Coastal													
Batu Putu	40	33	0	1	21	0	5	0	2	20	3	27	1
Pasir Gintung	50	46	1	10	56	0	23	7	3	44	13	21	0
Sukabumi Indah	31	40	12	23	34	6	33	14	7	71	17	35	12
Sub Total	121	119	13	34	111	6	61	21	12	135	33	83	13
Coastal													
Kangkung	39	26	1	0	41	0	12	5	0	22	8	6	0
Kota Karang	56	52	1	8	57	0	32	33	1	36	20	19	1
Panjang Selatan	40	33	0	3	40	0	20	9	1	12	20	2	0
Sub Total	135	111	2	11	138	0	64	47	2	70	48	27	1
Grand Total	256	230	15	45	249	6	125	68	14	205	81	110	14

Among the means of communication, fix line phone ownership is much lower than cellular phone ownership. With the support of infrastructure and competition in cellular telecommunication industry, cellular phones become primary means of communication for residents. In Sukabumi Indah Village, in each household, there are more than 2 cellular phones. Cellular phones make communication among residents becomes easier. If a disaster hits an area, residents in other areas will be easier to obtain information regarding their relatives who might be affected by the disaster.

Other equipment owned by the residents is gas stove. With conversion program from kerosene to gas, gas stoves become an important equipment to have. In Batu Putu, family that do not use kerosene or gas, they use firewood.

Type of vehicles that are owned by the resident is mostly motorcycle. The use of motorcycles in non-coastal areas is more than coastal areas. This is because motorcycle is a relatively cheap interregional means of transportation, especially for regions that do not have public transportation.

F. Access to Financial Institutions

Basically low economic level communities would need short and long term financial and asset protections against disasters. But, due to their limited economic capacity, they have difficulty in gaining access to financial institutions like banks or insurance. Residents in coastal villages in Bandar Lampung have better access to financial institutions (Table 2.19).

Table 2.19:Residents Access to Banks and Insurance in Observed Sub-Districts in Bandar Lampung, 2009 (%)

Sub Districts	**Access to Bank**	**Access to Insurance**
Non Coastal		
Batu Putu	12,50	2,50
Pasir Gintung	60,00	20,00
Sukabumi Indah	48,39	25,81
Coastal		
Kangkung	71,79	25,64
Kota Karang	51,79	8,93
Panjang Selatan	82,50	32,50
Non Pesisir	41,32	15,70
Pesisir	66,67	20,74
Grand Total	54,69	18,36

There is a positive correlation between accesses to banks with access to insurance (Table 2.20). The resident with better access to banks would have better the access to insurance. The residents use the mechanism of banks to pay for instalments and savings. In average, the amount paid for instalments is IDR 353,701.33/month, for savings is IDR 208,378.38/month and for insurance is IDR 173,090.91/month (Table 2.20).

Table 2.20:. The Average Expenditure of Households For Installments, Savings, and Insurance in Observed Sub-Districts in Bandar Lampung, 2009 (IDR/ month)

Sub Districts	Total Res (N)	The Average Expenditure of Households For Installments, Savings, and Insurance					
		Installments	% N	Saving	% N	Insurance	% N
Non Coastal	121	428.128,97	34,71%	250.625,00	13,22%	217.000,00	4,13%
Batu Putu	40	156.800,00	25,00%	32.666,67	7,50%		
Pasir Gintung	50	350.611,11	36,00%	372.750,00	16,00%	200.000,00	2,00%
Sukabumi Indah	31	721.601,19	45,16%	186.000,00	16,13%	221.250,00	12,90%
Coastal	135	287.191,49	34,81%	176.190,48	15,56%	136.500,00	4,44%
Kangkung	39	366.687,50	41,03%	150.000,00	15,38%		
Kota Karang	56	263.125,00	42,86%	194.166,67	21,43%	245.000,00	3,57%
Panjang Selatan	40	188.000,00	17,50%	156.666,67	7,50%	82.250,00	10,00%
Grand Total	256	353.701,31	34,77%	208.378,38	14,45%	173.090,91	4,30%

.

Chapter 3 CLIMATE HISTORY AND FUTURES IN BANDAR LAMPUNG

3.1 Extreme Climate and Weather Events

3.1.1 The influences of ENSO and IOD on rainfall variability over the Bandar Lampung

Extreme climate events in Indonesia are strongly related to large-scale climate phenomena such as El Nino-Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) (e.g. Boer & Faqih 2004; Faqih 2004; Haylock & McBride 2001; Hendon 2003; Kirono et al. 1999; Saji et al. 1999). This study analyze their impact on rainfall variability over Bandar Lampung. The relationships of both phenomena with seasonal rainfall over the city are shown in Table 3.1. It is shown that the correlations of both ENSO and IOD indices with rainfall are significant during dry seasons (JJA) and transition period (SON). This suggests some possibilities of prolonged dry seasons and delays on monsoon onsets impacting the region during warm ENSO episodes (El Nino). In addition, the El Nino impact will be stronger if accompanied by positive IOD event.

Table 3.1 Correlations between seasonal rainfall over Bandar Lampung with DMI and Nino3.4 SST anomaly

	DJF	MAM	JJA	SON
DMI	-0.16	0.02	-0.33	-0.58
Nino 3.4	0.09	0.02	-0.27	-0.47

This study suggests that the seasonal rainfall during both seasons is more affected by the variability of IOD than ENSO. These are indicated by larger correlation results between rainfall and DMI. Stronger influence of IOD than ENSO to the rainfall variability in Bandar Lampung is due to its location along in the Sumatera Island. Several studies have indicated the low influence of ENSO on rainfall over Sumatra. Of particular reasons of this weak relationship is due to mountainous landscape on the west side of Sumatra dominating the local influence, as well as due to the cross-equatorial flow affecting rainfall variability in this region that is different from ENSO connected circulation (Chang et al. 2004). On the other hands, other studies found strong effect of IOD on rainfall variability in the western Indonesia including Sumatra (e.g. Saji et al. 1999).

Although the correlation between rainfall and ENSO indices (Nino 3.4 SSTa) is lower than IOD, for a certain condition, the impact of ENSO could be considerable on rainfall variability in Lampung. This, for example, can be seen in 1996, where the La Nina event caused significant increase on rainfall amount over the region. This is associated to increased probability of floods over the region. On the other hand, the El Nino occurrence during 1982-83, 91-92 and 97-98 contributed to less rainfall over the region, associated with droughts.

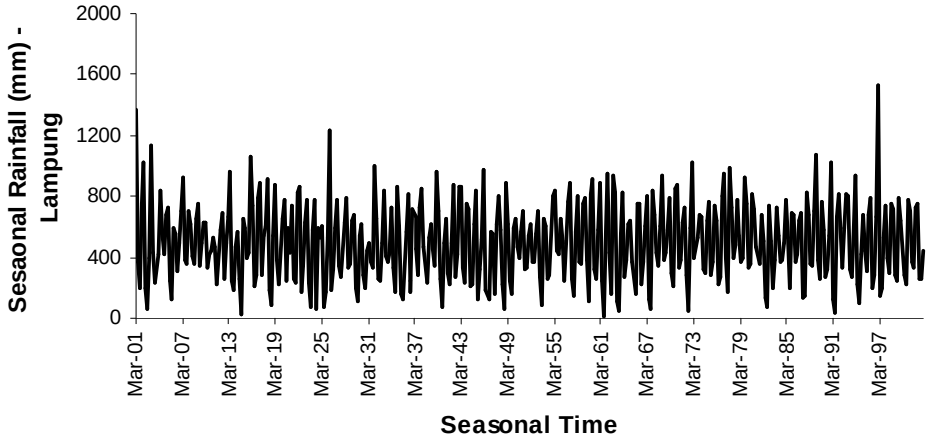


Figure 3.1:.Series of seasonal rainfall over Bandar Lampung.

3.1.2 Extreme wind

Extreme weather conditions could cause severe problems in the affected region. Here we try to identify the extreme weather condition caused by extreme wind speeds in Bandar Lampung. A daily record of one weather station in Teluk Betung is used for investigating the historical wind condition (Figure 3.2). Based on the daily wind speed record in that station from 1 January 1994 to 31 December 1999, we did not find extreme wind speed exceeding 60 km/hour threshold. Of course, this is not enough for describing the condition of overall Bandar Lampung region, since the recorded wind condition tend to occur locally and could be extremely different between one station measures to another.

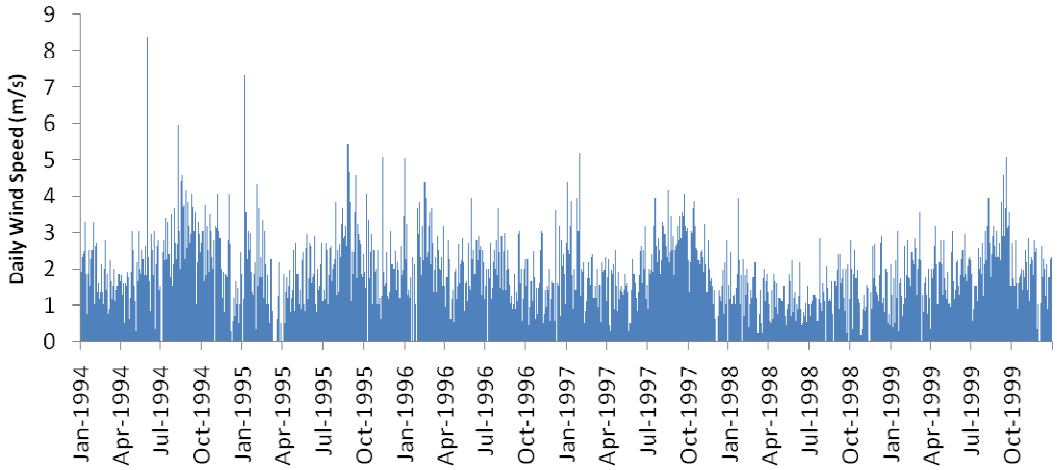


Figure 3.2:..A daily record of one weather station data in Teluk Betung

3.2 Trends of Historical Climate in Bandar Lampung

3.2.1 Rainfall

Previous study suggested that the observed rainfall in Indonesia experienced decreasing trends after 1970s globally (IPCC 2007). Nevertheless, the trends could vary locally across different region. Here we investigate the spatial trends of rainfall in Bandar Lampung city as respectively shown in Figure 3.3. In addition, we also use a longer rainfall data of Climate Research Unit (CRU), namely CRU TS2.0 (Mithcell and Jones 2005). Since the selection of different ranges of data will affect the trend and the result of statistical test, it is crucial to analyse the long-term data in order to confirm the consistency of rainfall trend in the region especially related to climate change studies. The CRU TS2.0 dataset has 0.5x0.5 degrees grid resolution covering global land area for a period of 1901-2002. In order to analysis the rainfall data over Bandar Lampung, a spatially averaged data within the city (110.25E-110.51E, 7.12S-6.95S) is extracted from the datasets (Figure 2.2).

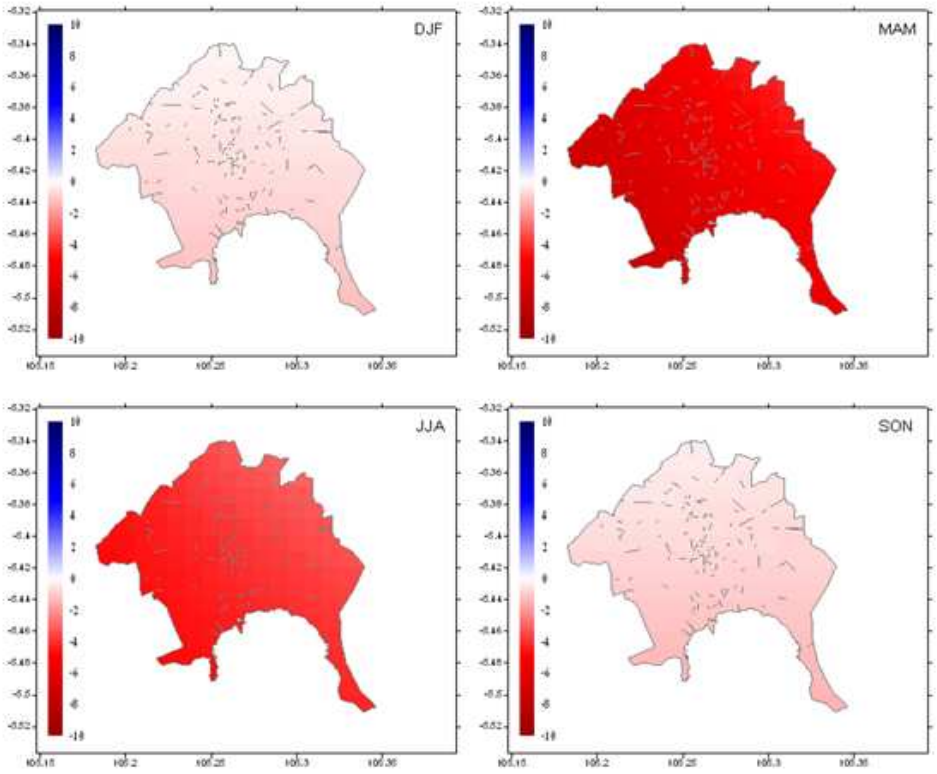


Figure 3.3:.Spatial patterns of seasonal rainfall trends over Bandar Lampung.

Trend analysis for Bandar Lampung city is conducted using short observations, which is then compared with relatively long CRU TS2.0 records. The spatial patterns of seasonal rainfall trends based on short observations are performed in Figure 3.3. It is shown that the city is experiencing downward trends at all seasons with rapid decreases occur in MAM and JJA, while slow decreases are found during wet seasons (SON and DJF). This informs that during the late 20th century (after 1970), there is a significant decrease of rainfall during dry seasons (MAM and JJA) that leads to an increase probability of drought disasters within the city. However, the

decreasing trend found during this short period is unlikely caused by global warming. Instead, the trend is more likely due to the oscillations of low-frequency climate phenomenon occurred in the Pacific that is associated with more frequents El Nino occurrences. The low-frequency oscillations in seasonal rainfall data can be seen from the filtered data using a simple moving average as shown in Figure 3.6. This low-frequency components is possibly related to the low-frequency of Indo-Pacific climate drivers such as Interdecadal Pacific Oscillation (IPO) (Folland et al. 1999) or Pacific inter-Decadal Oscillation (PDO) (Mantua & Hare 2002 ; Mantua et al. 1997). This study suggest that the trends obtained from longer time periods of data as shown in Figure 3.4 is more reliable for describing the effect of climate change in Bandar Lampung.

In Figure 3.4, we find a very rapid increase of rainfall trend during DJF and a slow increase of rainfall during MAM. In contrast, the rainfall trends during JJA and SON show slowly decreasing trends during 20th century. This suggests that the wet season rainfall tend to shift into MAM season while the dry season tends to extend into SON season. However, by referring to Figure 3.5 that describes the trends of wet days frequency in the city, the slow decreasing trends found during SON season is not supported by the downward trend of wet days frequency. Instead, the trend of wet days frequency during SON is found to be positive. This indicates that increasing wet days frequency is not followed by increasing rainfall intensity.

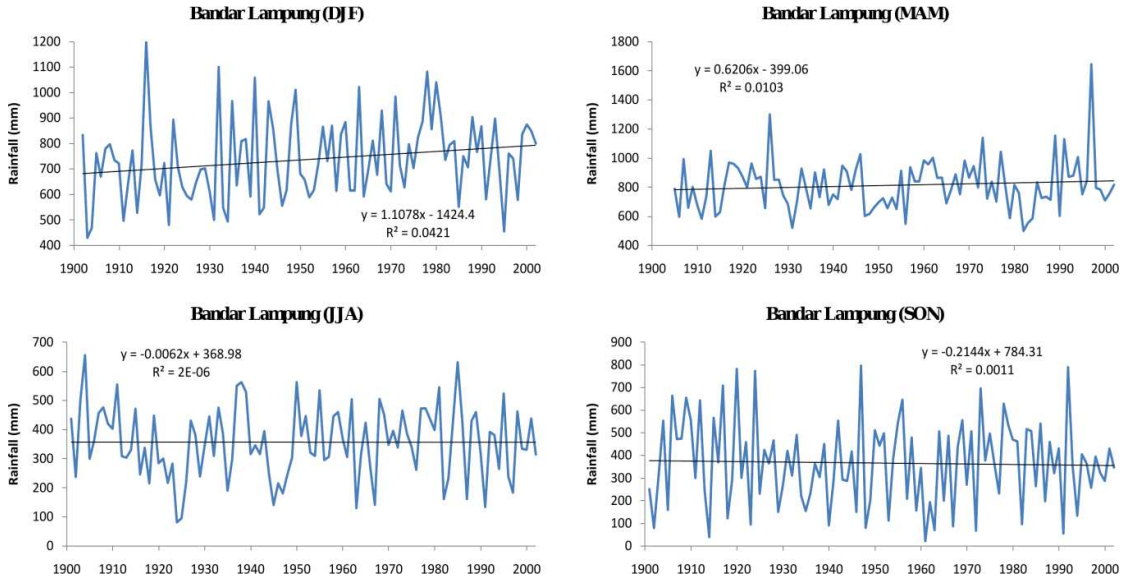


Figure 3.4:.Trends of seasonal rainfall in Bandar Lampung city (105.15E-105.34E, 5.51S-5.34S) extracted from CRU TS2.0 dataset.

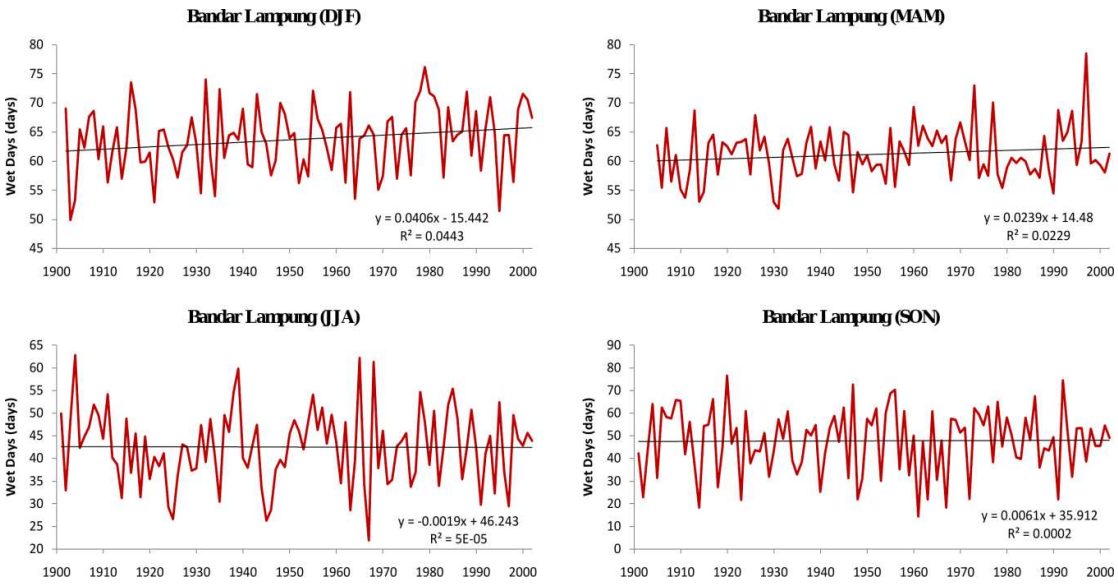


Figure 3.5:.Trends of seasonal wet days frequency in Bandar Lampung city (105.15E-105.34E, 5.51S-5.34S) extracted from CRU TS2.0 dataset.

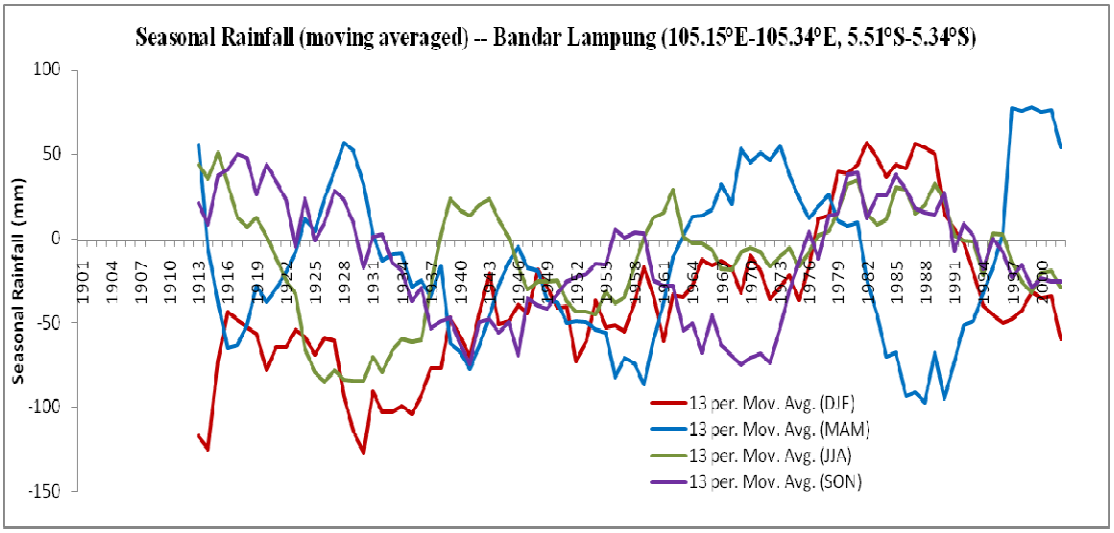


Figure 3.6:..Low-frequency component of seasonal rainfall in Bandar Lampung defined by a simple 13-year moving average

3.2.2 Temperature

The long-term CRU TS2.0 data extracted for Bandar Lampung shows significant upward trends of temperature in each season (Figure 3.7). The increasing trends are also associated with the upward trends in daily maximum (Figure 3.8) temperatures. Nevertheless, since the daily minimum temperatures are increasing faster than the maximum, the trends of their departure stated as daily temperature range (DTR) are decreasing (Figure 3.9).

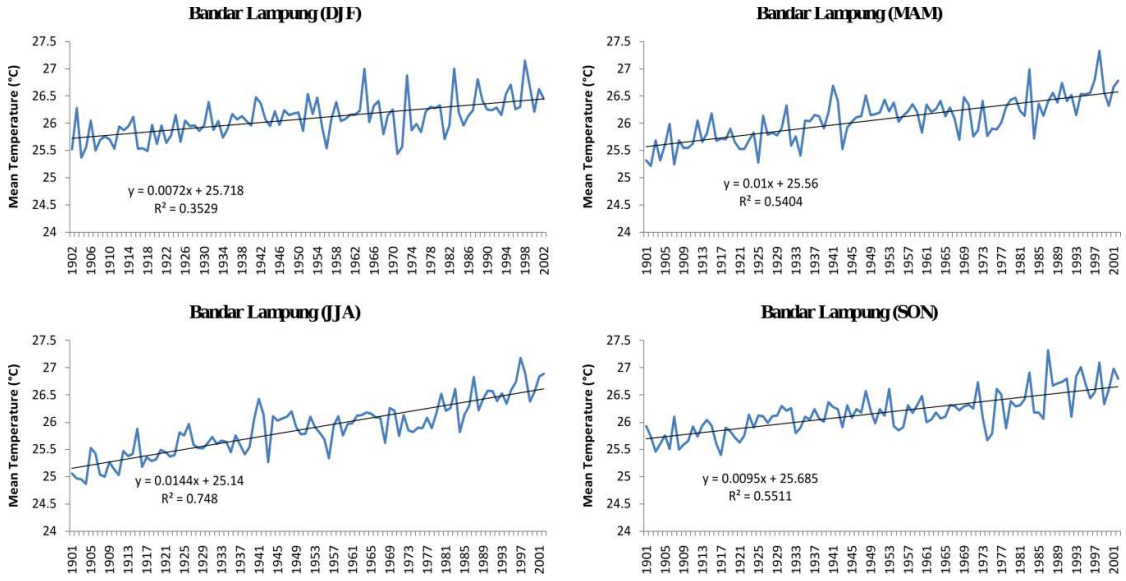


Figure 3.7:..Trends of seasonal mean temperature in Bandar Lampung city (105.15E-105.34E, 5.51S-5.34S) extracted from CRU TS2.0 dataset.

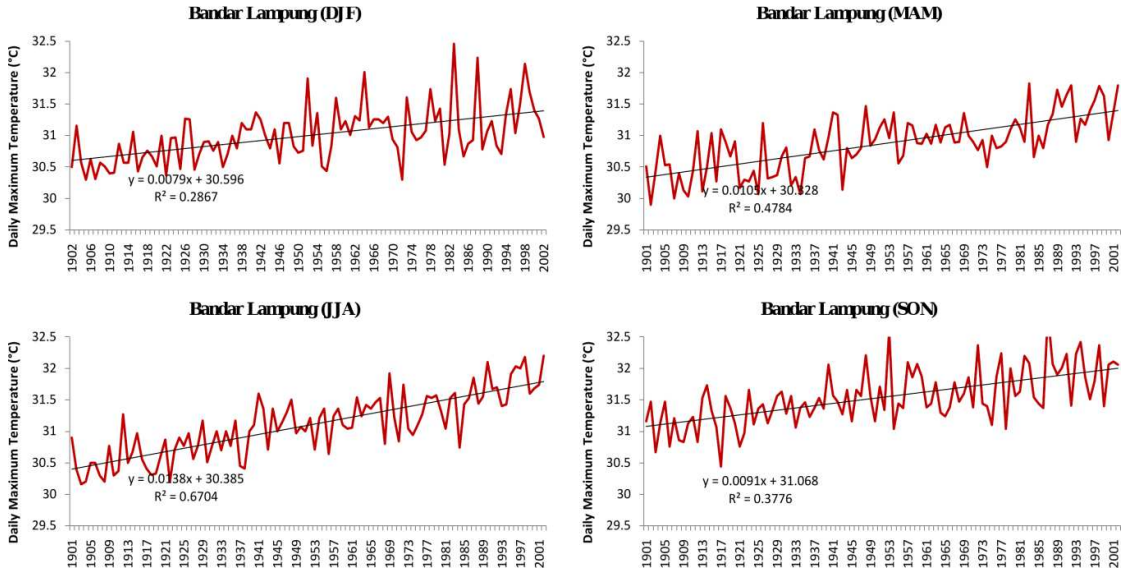


Figure 3.8:.Trends of seasonal daily maximum temperature in Bandar Lampung city (105.15E-105.34E, 5.51S-5.34S) extracted from CRU TS2.0 dataset.

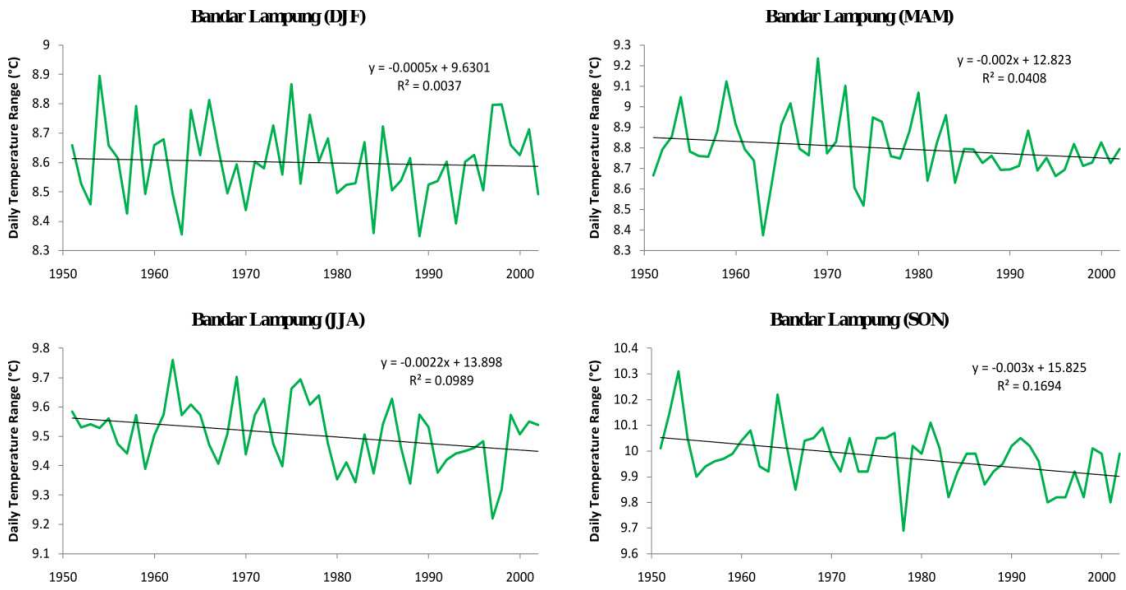


Figure 3.9:.Trends of seasonal daily temperature range in Bandar Lampung city (105.15E-105.34E, 5.51S-5.34S) extracted from CRU TS2.0 dataset..

3.3 Climate Change Projections

Projection of climate to future was developed using REGional Climate Model version 3 (RegCM3) model and 14 GCMs. The 14 GCMs include (i) bccr_bcm2_0, (ii) cccma_cgcm3_1, (iii) cnrm_cm3, (iv) gfdl_cm2_0, (v) gfdl_cm2_1, (vi) giss_model_e_r, (vii) inmcm3_0, (viii) ipsl_cm4, (ix) miroc3_2_medres, (x) miub_echo_g, (xi) mpi_echam5, (xii) mri_cgcm2_3_2a, (xiii) ukmo_hadcm3, and (xiv) ukmo_hadgem1. These GCM outputs were provided by NIES (National Institute for Environmental Studies Japan; Masutomi, 2009) . The resolution is 1 degree and the climate variables are precipitation and temperature with 2021 -2030, 2051-2060, and 2081-2085.

The RegCM3 was used to generate high resolution of historical rainfall data from 1958-2001. Since the RegCM3 model output shows systematic error compared to observations (CRU data), we corrected the historical data from RegCM3 using rescaling factor. The rescaled RegCM3 for grid-i, year-t and month-b (*rRegCM3(i,t,b)*) is defined as

$$r\,\mathrm{Re}\,gCM3(i,t,b) = \mathrm{Re}\,gCM3(i,t,b) * R(i,t,b)$$

Where the scaling factor was determined using the following formula

$$R(i,t,b) = \frac{CRU(i,t,b)}{m\,\mathrm{Re}\,gCM3(i,t,b)}$$

Where O(i,t,b) is observation data of station-i near the four Grid of RegCM3 at year-t and month-b, while *mRegCM3(i,t,b)* is the mean of rainfall of the four grids of RegCM3 near the station. The current (baseline) climate in grid-i for month-n is represented (rRegCM3(i,b)) by calculating the mean of the rRegCM3 from 1958-2001:

$$r\,\mathrm{Re}\,gCM3(i,b) = mean\{r\,\mathrm{Re}\,gCM3(t,i,b)\}_{t=1958}^{2001}$$

The future climate under different GCM is predicted using the following formula:

$$pF(s,m,i,t,b) = r\,\mathrm{Re}\,gCM3(i,b) * \left(1 + \frac{F(s,m,i,t,b) - B(s,m,i,b)}{B(s,m,i,b)}\right)$$

Where $pF(s,m,i,t,b)$ is the projected rainfall under emission scenario-s, model-m, grid-i, year-t and month-b, $F(s,m,i,t,b)$ is future climate from the GCM under scenario-s, model-m, grid i, year-t and month-b, and $B(s,m,i,b)$ is baseline climate from GCM under scenario-s, model-m, grid-i, and month-b. Since we have 14 GCMs and each GCM has two set of future climate (t1=2021-2030 and t2=2051-2060), overall we will have 140 rainfall data for each period of time. Using data we develop distribution of future climate for the two periods.

The emission scenarios selected for this study are SRESA2 and SRESB1. These two scenarios were selected as they reflect current understanding and knowledge about underlying uncertainties in the emissions. SRESA2 describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing global population. Economic development is primarily regionally oriented and per capita economic growth and technological change are more fragmented and slow. SRESB1 describes a convergent world with the same global population that peaks in mid-century and declines thereafter, rapid change in economic structures toward a service and information economy, with reduction in material intensity, and the introduction of clean and resource-efficient technology (IPCC, 2000). With these characteristics, the SRESA2 will lead to higher future GHG emissions while SRESB1 leads to lower future GHG emissions. Thus SRESB1 was defined as a policy scenario, while SRESA2 as a reference scenario.

Based on the two scenarios described above, in the next 100 years, concentrations of CO_2 in the atmosphere under the reference emission scenario would be more than double, while under the policy emission scenario only 1.5 times the current condition. Similarly for other gases (CH_4 and N_2O; Table 3.2). Concentration of SO_2, which counters the effect of greenhouse gases, would not change significantly (Table 3.3).

Under increased GHG conditions, it was estimated that global temperature will consistently increase by about 0.027 ^{0}C per year, while sea level increased by about 0.6 cm per year (Table 3.3). Historical records show that over the last 100 years the global sea level has increased between 0.10-0.25 cm per year (Warrick *et al.*, 1996).

Table 3.2 Gas Concentrations (ppmv)

	2000	2025	2050	2100
CO_2: SRESA2: Best guess	370	440	535	825
: Range	370	430-450	515-555	760-890
SRESB1: Best guess	370	420	460	550
: Range	370	410-430	450-470	510-590
CH_4: SRESA2: Best guess	1600	2250	2850	4300
: Range	1600	2200-2300	2700-3000	3800-4800
SRESB1: Best guess	1600	2050	2250	2200
: Range	1600	2000-2100	2150-2350	2100-2300
N_2O: SRESA2: Best guess	316	344	375	452
SRESB1: Best guess	316	340	360	395

Table 3.3 Temperature (^{o}C) and Sea Level Rise (cm), with reference to 1990

	2000	2025	2050	2100
Temperature: SRESA2: Best guess	0.2	0.5	1.2	2.9
: Range	0.15-0.25	0.3-0.7	0.8-1.6	2.0-4.1
SRESB1: Best guess	0.2	0.7	1.1	1.9
: Range	0.15-0.25	0.5-0.9	0.7-1.6	1.2-2.7
Sea Level: SRESA2: Best guess	2	10	21	60
: Range	0-4.0	4.0-20	9.0-41	25-112
SRESB1: Best guess	2	10	21	48
: Range	0-4.0	4.0-22	9.0-42	18-85

In this study we assess the potential risk of the Bandar Lampung city to be exposed to extreme rainfall under current and future climate. The extreme rainfall is defined as rainfall where its intensity is more than the critical threshold. It is also compared by using climate hazards data (flood and drought). For wet season (DJF), if the intensity is more than critical threshold, Bandar Lampung city is very likely to be exposed to flood hazard. While for dry season (JJA), if the intensity is less than the critical threshold, the city is very likely to be exposed to drought hazard. Methodology for defining the critical threshold is described in Chapter 6.

Figure 3.10 shows that the probability to have rainfall more than Q3 in wet season (DJF) in area located in coastal area might increase slightly in the future. While during the dry season, the probability to have rainfall less than Q3 may slightly decrease in the future in the coastal area, and the decrease may be more considerable in the area that is far from the coastal region. Further analysis using improved methodology may be required to assess future climate trend in the Bandar Lampung city. This can be supported by the use of more advance downscaling techniques (statistical or dynamical) with better predictive skill for the region.

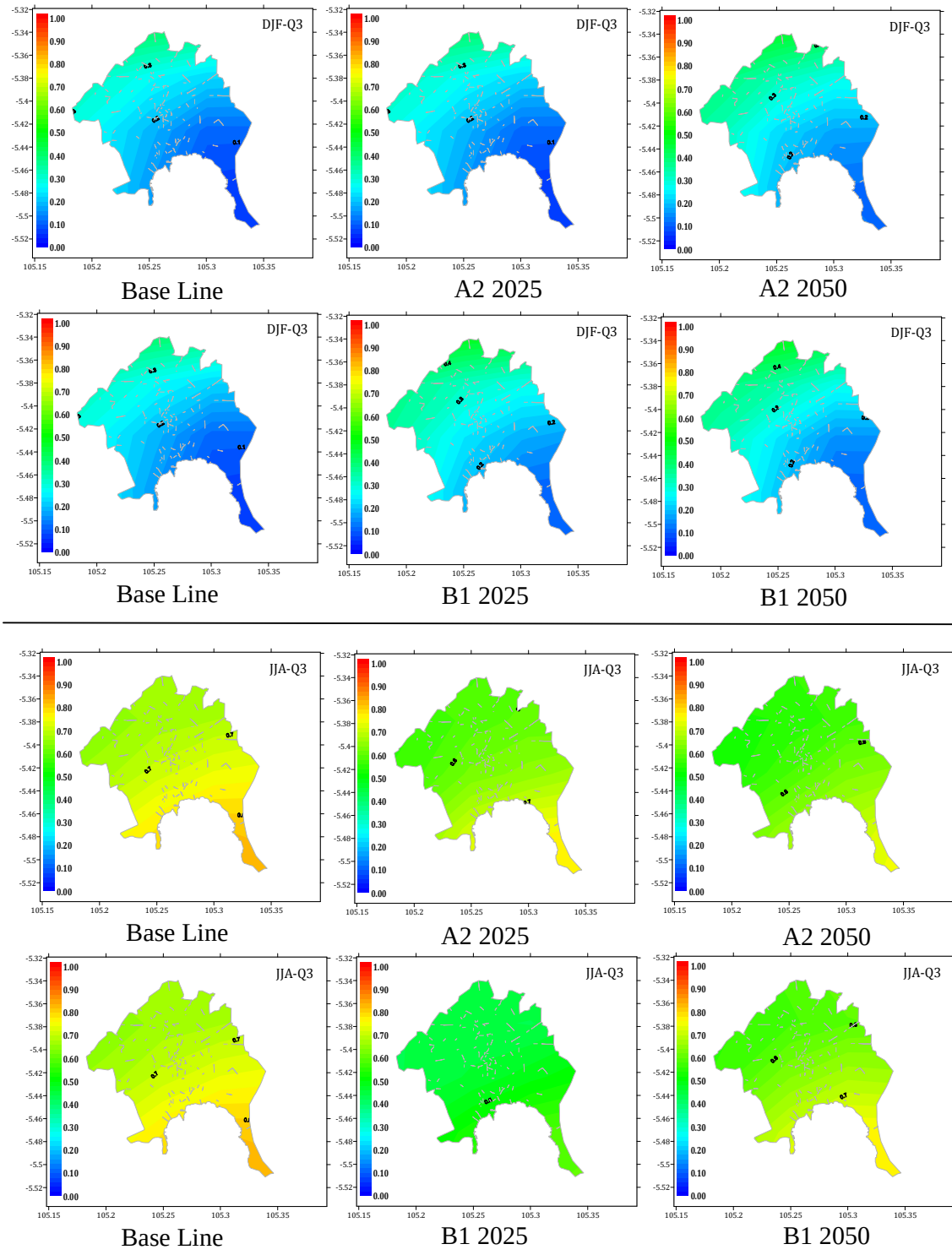


Figure 3.10:.Probability to have rainfall more than Q3 in wet season (DJF) and less than Q3 in dry season (JJA) under two emission scenarios

Chapter 4 IMPACT OF EXTREME CLIMATE EVENTS

4.1 Biophysical Impact of Extreme Climate Events

Bandar Lampung has wet tropical climate influenced by monsoon winds (Asian Monsoon). The average maximum temperature is 30.57^{o}C and the minimum temperature is 25.34^{o}C. The average maximum humidity is 89.3% and the minimum is 72.3%. The average wind speen is 2.34 km/hour with average evaporation rate of 3.95 mm/day. Rainfall varies from 67.2 mm in September to 277.8 mm in January with total rainfall of 2.257 - 2.454 mm/year and total rainy days of 76-166 days/year. High rainfall (>100 mm/month) happens for 7 months from November to May and dry season (CH < 100 mm/month) happens for 5 months from June to October (Bandar Lampung Regional Development Planning Agency, 2009).

Climate variations may occur due to the ENSO/El Nino/La Nina phenomenon, which is categorized as extreme climate events that happen every 3-6 years. Seasonally, high rainfalls in rainy seasons may cause flood, erosion, and landslides. Long dry seasons may cause drought.

In the report "Disaster Mitigation Study of Bandar Lampung 2008" (Bandar Lampung Regional Development Planning Agency, 2009), disaster potential in Bandar Lampung has been reviewed. Those disasters are classified into main groups, namely: (1) natural disasters (such as floods, earthquakes, volcanic eruptions, land movements, tsunamis, hurricanes, and drought) and (2) man-made disasters (such as technology failures, forest and land fires, epidemics, plagues, and social unrest).

Bandar Lampung as a city located between Lampung Gulf and foot of Mount Betung is a disaster-prone area in Lampung Province. The disaster-prone areas in Bandar Lampung are affected by geological and soil structures, geographic locations, landscape conditions, buildings and settlements density, ethnic diversities, hydrological conditions, and others (Bandar Lampung Regional Development Planning Agency, 2009). Types of disaster-prone identified by Bandar Lampung Regional Development Planning Agency (2009) are flood-prone, high tide-prone, tsunami-prone, earthquake-prone and drought-prone. Based on the study, there are 42 flood-prone areas in Bandar Lampung. The flood is caused by overflowing of river, tremendous flood, rob, and local flood which is related to many aspects namely: low topography, backflow of tide during high water flow, narrowing and shallowing of drainage, and low capacity of drainage.

From those various disasters, the ones that can be categorized as impact of extreme climate events are floods, droughts, landslides, and hurricanes, as well as other disasters such as abrasion, erosion and sedimentation. Disaster-prone location tabulation that has been reported in details is shown in Table 4.1.

Table 4.1. Disaster Prone Locations in Kota Bandar Lampung

No	Disaster	District	Sub District
1	Flood	Rajabasa	Rajabasa Raya, Rajabasa
		Tanjung Senang	Labuhan Dalam, Tanjung Senang, Way Kandis, Perumnas Way Kandis
		Telukbetung Utara	Kupang Teba, Kupang Raya, Gunung Mas, Gulak Galik, Sumur Putri, Batu Putu
		Telukbetung Selatan	Bumiwaras, Pesawahan, Pecoh Jaya, Kangkung, Sukaraja
		Telukbetung Barat	Kuripan, Bakung, Perwata, Sukamaju, Kota Karang, Keteguhan, N. Olok Gading
		Panjang	Karang Maritim, Way Gubak, Way Laga, Panjang Selatan, Pidada, Panjang Utara, Srengsem
		Kemiling	Kemiling Permai, Beringin Raya
		Tanjungkarang Pusat	Kaliawi, Gotong Royong, Pasir Gintung, Palapa, Kelapa Tiga, Penengahan, Tanjung Karang, Durianpayung
		Tanjungkarang Timur	Campang Raya, Kedamaian
		Tanjungkarang Barat	Segalamider, Sukajawa, Susunanbaru, Sukadanaham
		Kedaton	Perum Way Halim
		Sukarame	Sukarame
		Sukabumi	T. Baru
2	Abrasion	Panjang	Serengsem
		Telukbetung Selatan	
		Telukbetung Barat	Sukamaju
3	Hurricanes	Tanjung Senang	Way Kandis
		Telukbetung Selatan	
		Kedaton	
4	Landslides	Panjang	Pidada

Source: Strategic Plan document and the Regional Action Plan for Disaster Mitigation _ Bandar Lampung City, Year 2009-2013

Based on the result of survey on disaster impact on life sectors, flood disasters give the greatest impact on the health sector, and then on drinking water sector, housing, fisheries, and public works (the destruction of drainage facilities and other infrastructures). As for drought disaster, the sectors most affected by it are drinking water, health and agriculture. Drinking water shortage increases during long dry season (43% of the residents) or during flood disaster (19% of the residents). Sources of drinking water are regional water company/PDAM (53% of the residents), ground water or wells (38% of the residents), surface water/river water (8% of the residents) and rainwater (1% of the residents). The number of illnesses increases during disasters, especially during flood (34% of the residents) and dry season (22% of the residents).

4.2 General Impact of Extreme Climate Events

Impacts suffered as a result of disaster are not the same. The impacts are also influenced by the location where the disaster strikes. Coastal and non-coastal areas will suffer different impacts. General impacts of disaster are:

a. Coastal areas

In coastal areas, the greatest disaster potential is flood due to high tide (*rob*) and abrasion. Big flood does not happen anymore, but high tide still happens frequently. The tide only reaches the house foundation. It does not enter the residents' houses.

Residents claim that they are not bothered by the tide. During the tide residents can still do their activities. During the tide, residents claim that there is no problem with electricity, electricity is still on and can be used. Transportation is not bothered as well. Roads around residents' housing are slightly flooded but they are still passable. The only problem is if one does not walk carefully he will slip and fall. There are also no problems in education activities. Students still attend school. But there is a slight change in habit. Usually they wear their shoes from home, but as the roads are flooded, they bring their shoes and wear them when they reach unflooded roads. If the flood is quite high, they usually fold their pants so that it will not get wet. Residents are familiar with these problems, so they do not feel bothered.

Both in Kota Karang and South Panjang, floods and tides cause the garbage to pile up around the residents' settlements. Therefore in order that the garbage pile does not cause bad smell and illnesses, each resident cleans up their house and neighbourhood. While to anticipate abrasion, based on the results of in depth interview, residents need mangrove seeds. Besides that residents also expect the government to build road foundation connecting residents' houses.

Both in normal and post-disaster conditions, clean water is still obtained from drilled wells and by buying it from water sellers. Clean water availability is not hindered. It is still the same as in normal condition, where residents usually buy galloned water to fulfil their drinking needs. For washing and bathing, residents use drilled well water while for cooking they use jerry can water.

b. Non-Coastal Area

Disaster that often happens in Pasir Gintung is flood due to rain. This happens because of its location that is near river and market. Garbage and market waste are often dumped into rivers, which cause shallowing of rivers and bad drainage. The worst flood happens in 2008. It happened because one of the drainage systems was being repaired. The flood reached one meter high even in some low areas, the flood reached the roofs. The flood only lasted for one day so it did not trouble the residents much.

During floods, electricity is turned off to prevent electrocution. Clean water is provided by PDAM for free. Meanwhile, roads are not passable when flooded, but after the water recedes, the roads are passable. After the flood, usually garbage will lie around, therefore, usually the residents will work together to clean it up. Men and women work side by side to clean their houses.The men's task is heavier than the women's.

In Batu Putuk sub-district, disasters that commonly happen are drought and strong winds. Drought happening in this area according to the residents is caused by some water companies operating in that area. Their drilling operation causes reduce of water in this area, although the quality of water is still the same. This drought also affects agricultural harvest. Compared to previous conditions, cocoa and durian

harvest declines. This is due to changes in condition of nature, in this case water availability in Batu Putuk.

As a result of the drought, water availability begins to decline, but still sufficient for the residents' needs, although they must save the water. Based on FGD results of Batu Putuk residents, it is known that residents try to overcome water shortage by finding or creating new springs. Another method is by getting ready to build water reservoir or to get water from mosques. If this condition is prolonged, drought can trigger illnesses.

Meanwhile, strong winds usually occur in December. Almost every year, strong winds occur in this area. Based on the community's knowledge, signs of this disaster are rumbling sounds. If residents hear that sound, they prepare to go out of their houses and find an open location so they are safe from objects falling due to this strong wind.

When strong wind occurs, usually many trees topple and roof tiles fall. Besides that, the impact of strong winds towards agricultural plants is the fruits fall off before harvesting time. However, one of the advantages of this disaster is that there is much firewood from the falling branches.

Both drought and strong winds do not distract the residents' activities of Batu Putuk. In this condition, residents admit that the electricity is undisturbed; it is still on and can be used. The same goes with transportation, it is also undisturbed. Roads around the residents' settlements are only obstructed by fallen trees and branches, but still passable. Usually after strong wind occurs, residents clean up their neighbourhood with their own means so that their activities can run normally again. Educational activities are also undisturbed. Children can still go to school as usual

4.3 Socio-Economic Impacts of Extreme Climate

4.3.1 Social impact

The occurrence of extreme climate events that causes floods or drought indirectly has the potential to change the order of the community's social values. This can be seen from residents' mutual cooperation or kinship in handling problems that occur in the community, work relationships, production transactions patterns and other social values. Patron-client work relationship describes the relationship between parties, where an individual with higher socio-economic status (patrons) provides benefits based on his/her resources for someone with lower status (client).

Based on the survey results, it can be seen that residents' mutual cooperation and kinship in observed sub-districts still runs well. This is reflected in the residents' opinion regarding assistance given by relatives and other community members when disaster occurs. Relatives and other community members referred here are those who are not affected by the disaster. With their various social statuses, they can provide assistance to disaster victims.

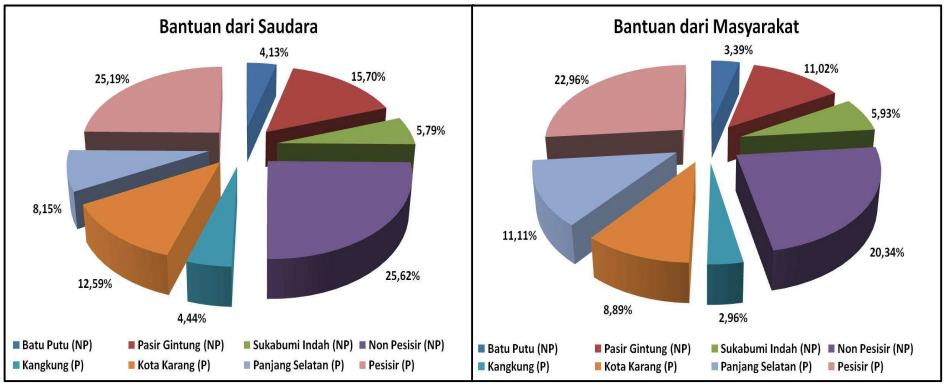


Figure 4.1.Assistance From Relatives and Other Community Members During Disasters in Observed Sub-Districts in Bandar Lampung, 2009

If we compare the amount of assistance from relatives to the amount of assistance from the community, the assistance received from relatives is relatively larger than the assistance received from the community. For example, in coastal areas, assistance from relatives is 25.19% (from the total of coastal residents), while assistance from community is 22.96%. The same pattern can be seen in non-coastal areas. From the data, it can be seen that assistance from the community is larger in coastal areas than in non-coastal areas. This fact is supported by FGD results in Kota Karang and South Panjang sub-districts. The residents stated that when disaster occurs, the first thing they will do is contact their neighbours. Neighbours live nearby, so it is hoped that they can provide assistance in a relatively short time.

From the above information it was revealed that disaster did not cause the community's mutual assistance to be weakened, even in some observed sub-districts, it became stronger. This is because basically the community's economic condition is relatively equal, so when affected by disaster they suffer equally. In South Panjang sub-district, the first effort done by the community when disaster occurs is having a discussion with family and neighbours to find solutions for the existing problems. After that, they report it to the local RT. Using their own means, residents will try to overcome their problems together. For example, working together cleaning their area after flood occurs.

In non-coastal areas there is a sub-district that has a relatively high level of community's assistance compared to two other sub-districts. This sub-district is Pasir Gintung. From the interview with the chairman of the local environment it was revealed that the large amount of community assistance was due to the many community groups in this area. With these community groups, the level of mutual cooperation and kinship becomes high, especially during disasters. A disaster that often occurs in Pasir Gintung is flood. This mutual cooperation and kinship behaviour does not only arise during flood disasters, the community also gives mutual assistance during local disasters, such as deaths, collapsed houses or other disasters. FGD results state that residents in all sub-districts have a monthly contribution of IDR 1,500.00 – 2,000,00/month for death calamity. Besides during disasters, residents' mutual assistance also occurs during parties, like wedding parties.

Based on the above description, it can be concluded that areas having a relatively high social cohesiveness in times of disaster are Pasir Gintung, South Panjang, and Kota Karang sub-districts. Residents in these three areas consider that the assistance from relatives and the community in times of disaster is relatively higher compared to other areas.

The existence of the community's social values can also be seen from the existence of patron-client work relationship that used to be part of the coastal communities social lives. In Kota Karang sub-district current patron-client work relationships are described as follows:

"....around the 80's being a fisherman was promising. At that time many residents became fishing boat owners. The fishing boat owners had many subordinates (fishermen). Almost all small time fishermen joined groups led by a fishing boat owner. They paid the fishermen to go fishing. Back then from just one fishing trip, the fish caught could reach hundred kilograms, especially from trap net. But now, being a fisherman is not promising anymore. The number of fishing boat owners has decreased. In RT 1,2, and 3 there is only one fishing boat owner and group." (M. Zabir, 63 years old, a resident of Kota Karang Sub-District)

Now many fishermen are individual fishermen because of the disappearance of fishing boat owners. Now the life of small time individual fishermen is tough because if they want to go fishing, they must cover all operational costs by themselves. Back then small time fishermen could easily loan some money to stores or agents when wanting to go fishing. Usually they went fishing in the afternoon and returned the next day carrying lots of catch, so they could pay the money loaned. But now small time fishermen are afraid to loan money, because the creditor is more careful in giving loans, and the fishermen also realize with sea condition at present there is no guarantee they will bring home lots of catch to return the loan. The decline of fish caught is also caused by climate change, therefore climate change also takes part in the decline of patron-client relationship in the society. This condition causes the society to be more vulnerable.

The impact of disasters on the social behaviours indirectly can also be seen from increase of crime in an area. Based on the survey, climate disasters affect the occurrence of crime in the study area, where 1.6% of residents think that the number of crimes increases during flood disaster and 3.5% of residents think that the number of crimes also increases during drought in their areas. The crimes meant are pick pocketing, burglary, robbery, and theft of valuables.

Thus it can be said that climate change causing disasters is potential to change social values and behaviours in a society.

Table 4.2.. Description of Impact of Disasters on Social Values in Observed Sub-Districts in Bandar Lampung, 2009

.No	Description	Current Condition
1	Helping/kinship system	Still exist: - Social relationship that is based on neighbor or kinship relations - In difficult times, fellow residents can be asked for help, not hired
2	Mutual cooperation	There is still cooperation among many residents of the sub-districts to solve certain problems considered usefull for public interest.
3	Patron-client relations	Declining.
4	Crime rate	Crime rate increases during flood and drought in their area

4.3.2 Economic Impact of Extreme Climate Events

Because main livelihoods of residents living in the study area are in fisheries as fisherman labors and fishermen, climate disasters like robs, high tides, and strong winds are potential to cause bad catch as they cannot fish that in turn will affect their socioeconomic life. Furthermore residents who work as traders also receive the effects. This is because purchasing power of the residents from the fisheries sector who suffer from bad catch decreases. Residents who work as farmers and plantation farmers are also affected by climate disasters such as floods, droughts, and high winds. They suffer from failed harvests and decline in income. The decline in income causes decline in welfare, which in turn causes increases the number of unemployment, crime and urbanization.

To get a broader picture of how disasters affect economy, the data is based on: 1). Amount of loss based on main job, 2). amount of loss based on side jobs, 3). amount of loss based on strategic sectors, 4) impact on the prices of some commodities.

1. Amount of Loss Based on Main Job

Basically, any disaster would result in loss to society, both material and immaterial. This study shows the impact of disasters and loss of main job suffered by residents. Not all residents felt the impact of disasters on their main job. Disasters discussed here are flood and drought. Figure 4-2. illustrates the impact of floods and droughts on residents' main jobs.

From the survey it can be seen that flood causes bigger impact on main job than drought. But it affects only 16.73% of the total residents in the study area. Thus there are many residents who think flood does not affect their main job. In fact the number is smaller in non-coastal areas, which is only 7.76% of the total residents in this area. But residents in coastal areas think otherwise. Here there are relatively more residents (24.44%) who think flood affects their main job. Those residents are mostly from Kota Karang and South Panjang Sub-Districts whose residents are mostly fishermen.

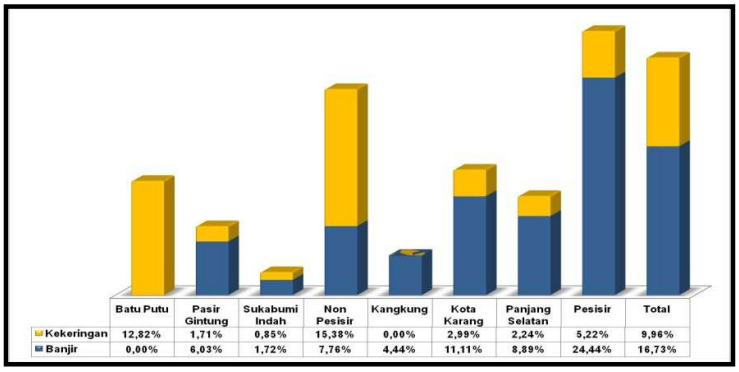


Figure 4.2. Impact of Flood and Drought on Main Job in Observed Sub-Districts in Bandar Lampung, 2009

From FGD results, actually problems faced by fishermen are quite complex. In general, several things cause the problems. First, fisherman's activities are strongly influenced by climate. Back then before 2000, a condition of low catch was usually seasonal, usually in December. At that time residents knew that from January up to May was the north wind season, which was fish season. But now the season is more difficult to predict. After 2000, people admitted that they had difficulty in predicting the timing of wind and big waves, so now fishermen do not have fixed time to go fishing. In such conditions, fishing activities become hindered, so income from fishing decreases dramatically. In such condition, residents are forced to "borrow from Peter to pay Paul". Therefore many residents are forced to choose other alternative livelihoods such as pedicab drivers, labors, and construction workers in order to finance the necessities of life. If their income is not sufficient, they admit that they are forced to go into debt to buy the necessities of life such as groceries. Another alternative is to borrow money from mobile banks. When you borrow money from mobile banks, payment can be made by instalments, but with the risk of interest charged. Usually applied interest is quite high, reaching 20 %.

The second problem is caused by lack of fishing facilities, unlike fishermen in Java whose fishing facilities, such as fishing boats, are much more advanced. This causes fishermen in observed sub-districts to have limited fishing grounds or reach. According to one participant of FGD,

"*…back then fishing can be done close to shores. Now if you want to catch fish in large numbers you have to sail further up to the open sea near the Krakatau Mountain, using a big motorized boat. But the price of such boat can reach hundreds of millions. One fishing trip may cost millions and take a week. So small time fishermen can only fish within close distance. If you go a little farther on, you will suffer from losses, but fishermen in Java can travel farther* ".

Besides that, according to residents, the number of fishermen in Lampung are many, ranging from small time fishermen to fishermen who have trawl may enter territorial waters, so small time fishermen must compete with big time fishermen.

Problems such as these cause small time fishermen to suffer from economic difficulty, so in order to survive they have to "*borrow from Peter to pay Paul*". Therefore many residents are forced to have other alternative livelihoods such as

pedicab drivers, labors, and construction workers in order to finance the necessities of life.

Unlike the flood, on average, only few residents feel the impact of drought on their main job. Drought affects only about 9.9 percent of the total residents in the observed sub-districts. Among other observed sub-districts, the majority of the residents in Batu Putuk work as farmers and agricultural labors, so for them drought brings more impact than flood. Drought has impact on decline in crop yields so the income of residents who work as farmers and traders of agricultural products tends to decline. To finance their needs they usually borrow money from neighbour's or mobile banks.

When calculated based on nominal value, the loss caused by flood and drought is as shown in Figure 4-3. The figure shows the average loss due to disasters, especially flood, felt by residents. Based on the figure, the average loss caused by disaster is IDR 662,765. Areas that experience a relatively large loss are Kangkung, Batu Putu and Pasir Gintung. The average loss suffered by Kangkung area is IDR 1,150,000,00. Meanwhile, at Batu Putu is IDR 921,071,00. Most residents in this area have main jobs as farmers in plantation, which is greatly affected by the flood. The average loss in Pasir Gintung is IDR 926,666.00.

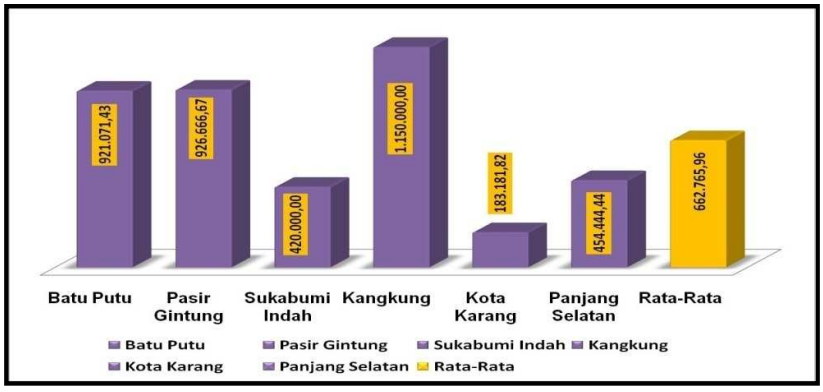


Figure 4.3.The Amount of Loss From Main Jobs Due To Dlood and Drought in Observed Sub-Districts in Bandar Lampung, 2009

2. Amout of Loss Based On Side Jobs

Besides affecting the main jobs, flood can also affect residents' side jobs, mainly side jobs as fishpond farmers. But from the data illustrated in Figure 4-4, it can be seen that the flood only affects a small portion of the total residents in the study areas. As many as 11.11% said flood had impact on their side jobs (Fishpond / Ponds).

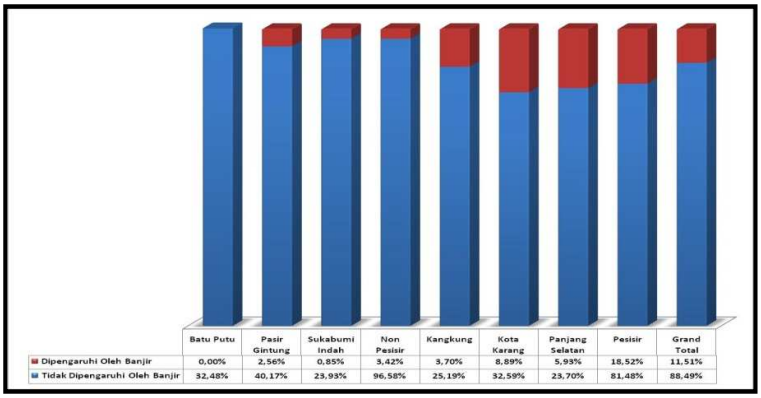


Figure 4.4.Flood Impact On Side Jobs As Fishpond Farmers in Observed Sub-Districts In Bandar Lampung, 2009

Loss suffered by fishpond farmers is shown in Figure 4-5. The average loss of side job as fishpond farmers caused by flood is IDR 583,000.00/person. However, if viewed in detail, the distribution is not equal. The biggest loss is experienced by residents in Kangkung with the average loss of IDR 2,350,000.00/person. This is because many residents' side jobs are as fishpond farmers.

Figure 4.5.Amount of Loss Of Side Job As Fishpond Farmers in Observed Sub-Districts in Bandar Lampung, 2009

3. Amount of Loss Based on Strategic Sectors

Besides affecting the livelihoods of residents, loss caused by disaster can also be calculated based on the sectors. Figure 4-6, provides an illustration of losses due to floods in Lampung. Based on the figure, there are 2 sectors that suffer a relatively large amount of loss, namely health sector with amount of loss of IDR 104,355,000.00 and fisheries sector with amount of loss IDR 76,320,000.00. Impacts of flood perceived by residents on other sectors are relatively small, for example, infrastructure sector with amount of loss of IDR 10,000,000.00, residential sector with amount of loss of IDR 8,745,000.00. In general, this loss is relatively small. This can be caused by the residents' limited knowledge in estimating the amount of loss. Besides that, many residents cannot assess losses on various sectors.

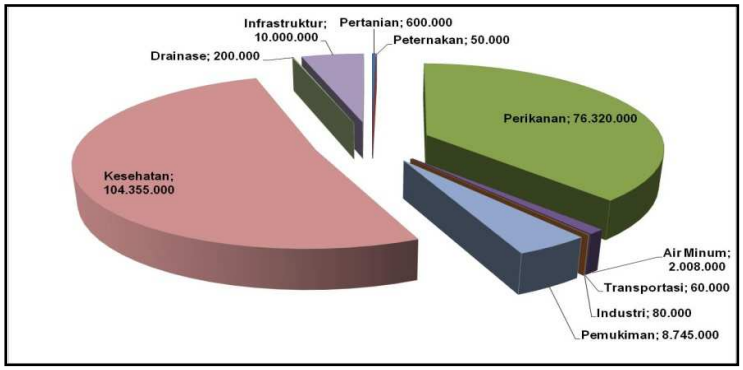


Figure 4.6. Loss Caused By Floods Based on Sectors in Bandar Lampung Bandar Lampung, 2009

This is in contrast to the losses occurring when drought strikes. Based on Figure 4-7, it can be seen several sectors that are allegedly affected by drought. From the value, the amount of loss due to drought is smaller than the amount of loss due to flood. Although the amount is relatively small, however this fact gives assumption regarding sectors prone to disasters. Based on this description, sectors that are prone to drought are agriculture, fisheries, health and drinking water. Loss in agricultural sector caused by drought lead to production decline. In fact, in extreme cases it can lead to crop failure (puso). Loss in the fisheries sector is caused by decline in water supply. The impact is the water quality decreases so many fish die. Loss in the health sector occurs because drought causes decline in environmental quality, many diseases such as diarrhoea, cough, sore throat and so forth. Loss in the drinking water sector is caused by shortage of water supply.

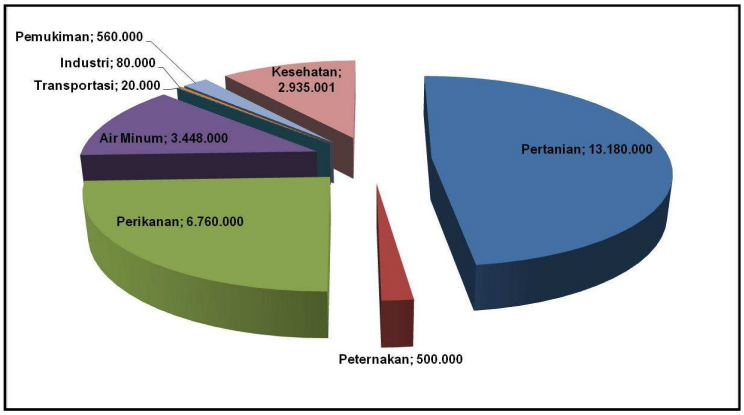
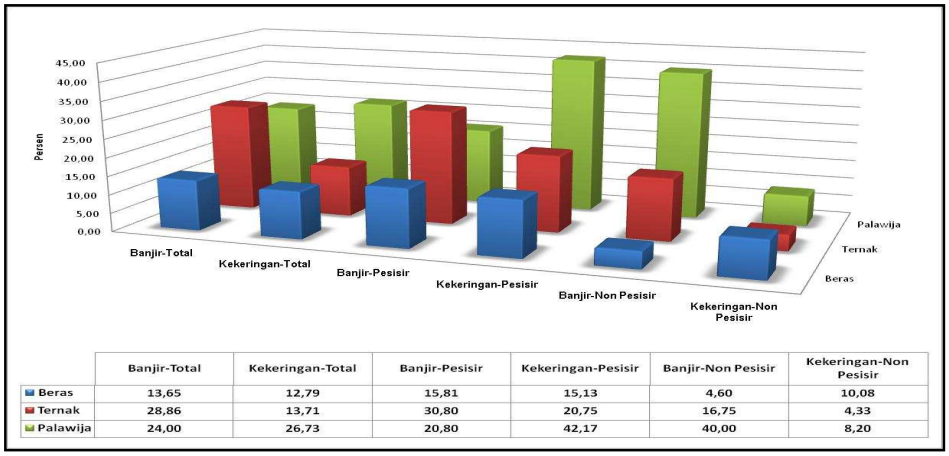


Figure 4.7. Loss Caused By Drought Based On Sector in Bandar Lampung, Tahun 2009

4. Impacts On Some Commodity Prices

Besides affecting residents' income and some strategic sectors, floods and droughts also affect prices in general. Presented below is data on price increase in several agricultural products like rice/paddy, non-staple crops, and fish/poultry. In general, price of rice/paddy increases during flood and drought. The average increase during flood is 13.65%, while during drought the increase is around 12.79%. For fish/poultry, the increase in price during flood is relatively much higher than the

increase in price during drought, and this phenomenon occurs consistently in both coastal and non-coastal areas. This happens because during flood fishing activities are disrupted so fish supply decreases. As for non-staple crops, the increase in price is different from the increase in price in rice/paddy and fish/poultry. Price increase during drought is higher than during flood.



	Banjir-Total	Kekeringan-Total	Banjir-Pesisir	Kekeringan-Pesisir	Banjir-Non Pesisir	Kekeringan-Non Pesisir
Beras	13,65	12,79	15,81	15,13	4,60	10,08
Ternak	28,86	13,71	30,80	20,75	16,75	4,33
Palawija	24,00	26,73	20,80	42,17	40,00	8,20

Figure 4.8.Price Increase in Some Agricultural Commodities in Observed Sub-Districts in Bandar Lampung, 2009

4.3.3 Impact on Health

Health facilities in Bandar Lampung include health facilities ranging from the smallest level of service like Auxiliary Public Health Centre, Medical Centre, doctor practices, to hospitals. The number of health facilities in Bandar Lampung according to *Bandar Lampung Dalam Angka (2007)* reaches 157 units consisting of 11 hospital units, 22 units of Main Health Centre, 57 units of Auxiliary Public Health Centre, and 67 units of Medical Centre. The largest number of health facility is in Tanjung Karang with 11 unit Medical Centres.

Table 4.3 shows disease outbreaks that are common during flood. Not many residents respond to the phenomenon of disease outbreaks during flood. It is recorded only 35.94 % of total residents. From the residents who provide assessment, it can be seen that types of diseases that are often suffered by the residents are Malaria (28.26%) and cough/flu/colds (27.17%). The disease that is considered relatively rarely suffered is Dengue Fever (DBD) (10.87%). From the data, it can be seen that the number of non-coastal residents who consider cough/flu/colds, DBD, and itching as illnesses occurring in rainy season is greater than coastal residents. It is the opposite for diarrhoea and malaria. This could form assumption that the spread of cough/flu/colds, DBD, and itching tends to occur in non-coastal areas, while malaria and diarrhoea occur in coastal areas.

Table 4.3. Illnesses Occurring During Flood in Observed Sub-Districts in Bandar Lampung, 2009

Sub Districts	Res Total (N)	Res Answer (n)	n/N (%)	Illnesses Occurring During Flood					Grand Total
				Cough/ Flu/Colds	DBD	Diarrhoea	Itching	Malaria	
Non Coastal									
Batu Putu	40	2	5,00	100,00	0,00	0,00	0,00	0,00	100,00
Pasir Gintung	50	19	38,00	26,32	0,00	5,26	63,16	5,26	100,00
Sukabumi Indah	31	6	19,35	33,33	50,00	0,00	0,00	16,67	100,00
Sub Total	121	27	22,31	33,33	11,11	3,70	44,44	7,41	100,00
Coastal									
Kangkung	39	19	48,72	26,32	26,32	21,05	10,53	15,79	100,00
Kota Karang	56	27	48,21	29,63	7,41	18,52	0,00	44,44	100,00
Panjang Selatan	40	19	47,50	15,79	0,00	31,58	5,26	47,37	100,00
Sub Total	135	65	48,15	24,62	10,77	23,08	4,62	36,92	100,00
Grand Total	256	92	35,94	27,17	10,87	17,39	16,30	28,26	100,00

Table 4.4 shows diseases that often emerge in the event of drought. In non-coastal and coastal areas, diseases that are often suffered by residents are cough/flu/colds and malaria. Seen from the types of illness, the difference between drought and flood is the emergence of skin diseases.

Table 4.4.. Illnesses Occurring During Drought in Observed Sub-Districts in Bandar Lampung, 2009

Area/ Sub Districts	Res total (N)	Res Answer (n)	n/N (%)	Illnesses Occurring During Drought						Grand Total
				Cough/ Flu/Colds	DBD	Itching	Skin diseases	Malaria	Diarrhoea	
Non Coastal										
Batu Putu	40	11	27,50	90,91	0,00	0,00	0,00	9,09	0,00	100,00
Pasir Gintung	50	12	24,00	75,00	8,33	8,33	0,00	8,33	0,00	100,00
Sukabumi Indah	31	8	25,81	25,00	50,00	0,00	0,00	25,00	0,00	100,00
Sub Total	121	31	25,62	67,74	16,13	3,23	0,00	12,90	0,00	100,00
Coastal										
Kangkung	39	10	25,64	80,00	0,00	0,00	10,00	10,00	0,00	100,00
Kota Karang	56	9	16,07	55,56	11,11	0,00	0,00	22,22	11,11	100,00
Panjang Selatan	40	12	30,00	33,33	8,33	0,0	0,00	41,67	16,67	100,00
Sub Total	135	31	22,96	54,84	6,45	0,00	3,23	25,81	9,68	100,00
Grand Total	256	62	24,22	61,29	11,29	1,61	1,61	19,35	4,84	100,00

Survey results in the study area show that there is no optimal access, affordability, and quality of health services. This is partly because the health-care facilities are not fully accessible to the residents, especially related to cost, location, and services provided. The number of residents who have free health cards is as many as 43.75%. However, service systems, medicine, and referral are still considered unable to run optimally yet.

At the time of the disaster, only 27.7% of the residents claim to receive assistance from the government, 14.8% of the residents spend their own money for medical expenses, and the remaining 57.5% of residents do not know because they never noted the costs spent for medical treatments. The amount of costs spent by 14.8% of the residents for treatment during a climate disaster can be seen in the figure below.

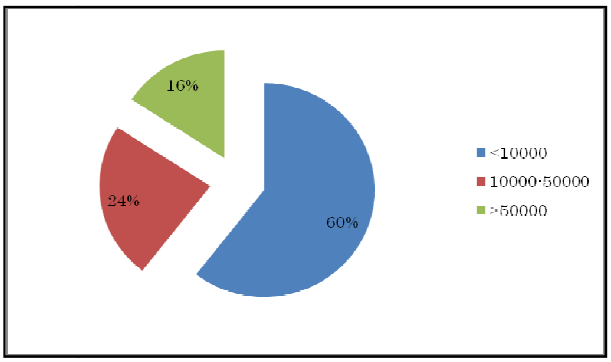


Figure 4.9.The Amount of Cost Paid By Residents (in IDR)

Actually, the health facilities provided by the health service are good enough. For residents who have public health insurance (Jamkesmas/first Askes), when sick they can directly come to the health centre. If the condition of residents requires further care, the health centre will provide referrals to the hospital. Residents who are given a letter of Jamkesmas are poor, which is decided by judging from the work of the head of the family.

For residents who do not have a letter of Jamkesmas, they can use Jamkesda facilities. But unlike Jamkesmas, the process that must be passed by them to obtain Jamkesda facilities is long. Besides there must be a letter from the head of RT, their house must be monitored/ surveyed by the health centre, and this usually takes 2 days. Then if they should be referred to the hospital, residents must first pay the hospital fees as collateral. The money is returned if all of the documents are complete. Such conditions cause perception that there is no optimal access, affordability, and quality of health services

4.4 Government and Residents' Response to Disaster Due to Extreme Climate Events

4.4.1 *Residents' Response to the Presence of Disaster Handling Institutions*

Early warning is intended to continually inform the level of observation result activity in an area prone to disaster so that early preparation can be done to anticipate disaster at any time. Early warning is disseminated to the public through local governments with the aim of providing public awareness in avoiding disaster. The

forms of early warning and results of disaster-prone areas monitoring are technical advice that include the transfer of road (temporarily or permanently), evacuation and/or relocation, and others. The important things that local government or residents must know are how to live in harmony with nature in the disaster area, what needs to be done and avoided in the disaster-prone areas, and how to save themselves in case of disaster.

Training regarding evacuation and rescue procedures in case of disaster is also needed. The training emphasises more on the flow of information and technical field staff officers, SATKORLAK PB, SATLAK PB, and the community to the level of evacuation and rescue of disaster victims. With this training a high awareness in facing disaster will be formed.

From the survey results in the six study areas, residents feel unsatisfied with the disaster handling institutions in their area. 90% of the residents stated that there was no disaster handling institutions in their area. Those 90% admitted they have never got any information about the climate or early warning from the government, EWS (Early Warning System), or other related institutions. Only 10% of the residents said there was a disaster handling institution in their area. They are called Tagana (Disaster Response). Residents admitted that Tagana functions effectively in providing climate information or early warning. Other institutions are local ward, RT, RW.

4.4.2 Residents' Respond To Disaster Information

Most of the residents in the six study areas obtain information on climate forecasts traditionally from traditional leaders and the community leaders in the respective area. In addition to that, residents also receive forecast information from BMKG. Interview results show that approximately 58% of the residents obtain BMKG forecast information through the medium of television. 4% of the residents obtain the forecast through newspapers. 2% of the residents obtain the forecast through radios. And 6% of the residents obtain the forecast from local village officials, 2% of the residents obtain the forecast from government agencies, and the remaining 28% of the residents did not respond (Figure 4-10).

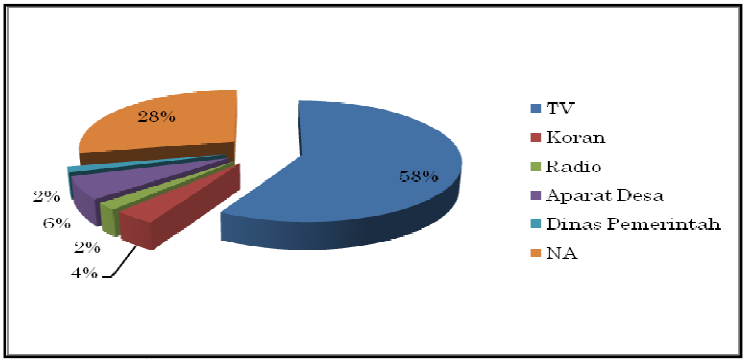


Figure 4.10.The Percentage of Medium Used to Provide Forecast Information

One of the government's roles in reducing disaster impacts and losses is to provide disaster-related information such as disaster warning, disaster management, climate change and the impacts of climate change. This information can be conveyed through

the medium of television, radio, newspapers, magazines, and direct meetings between residents and government apparatus from central to regional. Table 4.5 illustrates the perception of residents on various disaster-related information. In this table the disaster-related information is seen from the perspective of usability and availability. In general, there is a gap between the utility and availability. This indicates that many efforts in disseminating information regarding disaster are still needed. From the data, it can be seen that residents think that information regarding disaster warning is a lot more useful than other information.

Based on some types of disaster-related information, it turns out that information on disaster warning is more useful than other information. Residents' lack of knowledge regarding information on disaster handling, climate change and impacts of climate change can be seen from residents low participation in giving opinion on the information. For example, only 56.25% of the residents think that the information on disaster handling is useful, whereas 37, 89% think that climate change information is useful, and 35.94% think that impact of climate change information is useful. This is a sign that the awareness of residents on the importance of disaster-related information is still low, and this supports the previous information that the government's role in providing information to the public is still relatively low. This is shown from the perception of the residents on low availability of disaster-related information in Bandar Lampung. The highest availability of information is disaster warning (50.78%), while the availability of information on disaster handling, climate change, and the impacts of climate change is still low less than 35% (Table 4.5).

Table 4.5. Residents' Perception On Various Disaster Related Information in Bandar Lampung, 2009 (%)

Sub Districts	Disaster Warning		Disaster Handling		Climate Change		Impacts of Climate Change	
	Usability	**availability**	**Usability**	**availability**	**Usability**	**availability**	**Usability**	**availability**
Non Coastal	72,73	47,93	55,37	30,58	37,19	23,14	34,71	19,83
Batu Putu	70,00	55,00	45,00	27,50	27,50	25,00	22,50	20,00
Pasir Gintung	76,00	36,00	60,00	22,00	36,00	8,00	36,00	6,00
Sukabumi Indah	70,97	58,06	61,29	48,39	51,61	45,16	48,39	41,94
Coastal	74,07	53,33	57,04	34,07	38,52	17,78	37,04	16,30
Kangkung	76,92	38,46	56,41	17,95	38,46	10,26	33,33	7,69
Kota Karang	85,71	62,50	62,50	41,07	44,64	19,64	44,64	19,64
Panjang Selatan	55,00	55,00	50,00	40,00	30,00	22,50	30,00	20,00
Grand Total	73,44	50,78	56,25	32,42	37,89	20,31	35,94	17,97

4.4.3 Response On Relocation Issue

Because of the recurrence potential of extreme climate events that can cause disasters in the future; dense public housing condition with relatively indecent environment; and the government's plans to build *water front city* in coastal areas, residents are asked about their opinions and expectations on the project and on the government's plan to relocate them. The residents' opinions and expectations are as follows:

Coastal Area

If there is a huge disaster and the government advice them to relocate, male residents claimed that they felt reluctant to move. But if the locations of current residence are not liveable any longer, they are willing to move as long as they're given facilities and decent houses and the relocation area is not far from the sea, so they can still do

their current job (fishermen). The decision to move must be decided together with all family members. As for the possibility to change the type of work permanently, the fishermen claim it is difficult (unwilling) because it is related to their skills. However, if the government provided training to develop their skills, they would be willing to join the training. The form of assistance expected by the residents in coastal areas is housing and capital, capital to start a new business or new skills.

Female residents are willing to be relocated, to change their livelihood, and to join training programs and community empowerment. The trainings expected are trainings on farming, sewing and fishery product processing. However, it is still based on their husbands' approval.

Non-coastal Areas

In areas experiencing drought like Batu Putuk sub district, disaster is considered something normal, so they do not consider being resettled to other areas. They feel reluctant because they are concerned about the availability of jobs. However, if the disaster is severe and forces them to relocate, they expect the government to provide housing and new jobs. Besides that, they expect to be given skills to survive.

Women admitted willing to join training programs and community empowerment. Training expected is training on how to produce emping. They also expect to be given equipment to make emping. This is especially interesting for young mothers, while the elderly are not because they feel that job is too difficult for them.

In areas where flood often happens like in Pasir Gintung, the flood is often caused by overflowing river water. Therefore, the expected activity to prevent the flood is dredging of river filled with market waste. For that residents need to be given awareness on healthy living habits, like not throwing garbage in the river, by way of healthy living campaigns. Another activity that the residents expect is environmental control, for example, zone regulation or safe boundaries between settlements and rivers.

In conditions where there are no other options, the residents of Pasar Gintung are willing to relocate, provided that the new areas are more decent than their current settlement. Residents are willing if there is training to improve their skills, such as salted egg production training, or mobile phone services, provided that the management is well run.

4.4.4 Identification of Adaptation Activities That Have Been Conducted by The Residents

Adaptation activities to face disasters conducted by residents are generally structural (physical) such as widening/deepening drainages, raising house floor level or building two-story houses, relocating, strengthening house constructions, and creating dikes when facing flood, and buying or creating drilled wells or deepening well when facing drought. Non-structural activities through residents' initiatives are still very low. Most non-structural activities such as community empowerment, institutional strengthening and others come from government programs.

Table 4.6. Non-structural government activities in developing disaster handling abilities and residents' response

NO	GOVERNMENT ACTIVITIES	RESIDENTS' RESPONSE
1	Interactive communication through radio and television about disaster mitigation	Conducting with many limitations
2	Socialization of early warning communication systems and family based emergency response	Not yet fully reaches the public, especially in slums
3	Forming and strengthening of Sub-District Level Disaster Preparedness (SIBAD) in 13 districts	Residents have not felt the presence and function of SIBAD
4	Socialization of the signs of disaster through meetings of community groups, sub-districts, etc.	Joining meetings and starting to prepare
5	Making or reproducing and distributing bulletins of early warning systems	Not totally reaches the residents
6	Economic empowerment of the poor in disaster-prone areas	Only lasted for 1 month
7	Regularly/periodically conducting Coast and Sea Cleaning Movement with the residents	Monthly participation
8	Regularly/periodically conducting River and Drainage Cleaning Movement with the residents	Monthly participation
9	Prohibiting fishermen to fish in the sea during high tide	Some obedient, some disobedient
10	Making drilled wells for public facilities	Nor effective due to bad water quality

4.4.5 Identification of Residents' Adaptation

A. Flood

Adaptation performed by residents during floods are diverse, ranging from staying at home, relocating to unflooded areas, making embankments, deepening water channels, raising the floor level, adding food and fuel supplies. Types of adaptation is strongly influenced by the environment of the respective area. For instance, adaptation performed in non-coastal areas will be different from adaptation in coastal areas. Figure 4-11 shows the differences.

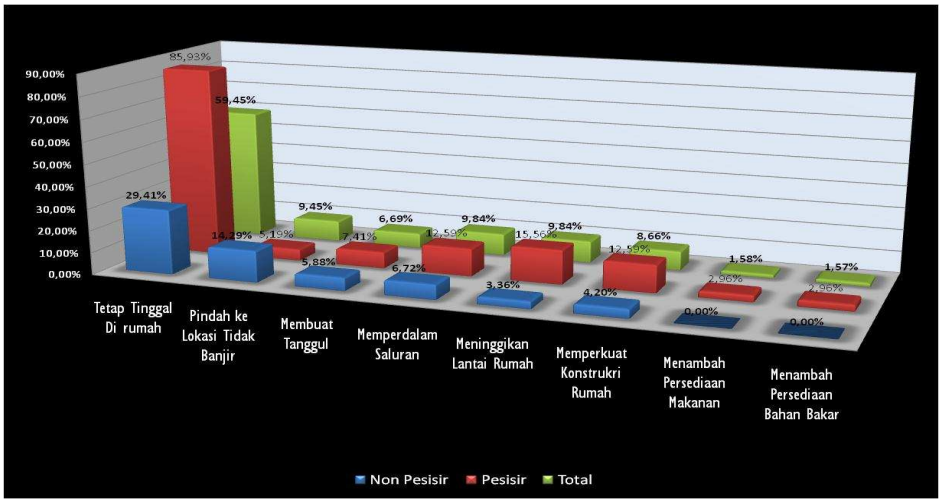


Figure 4.11.Adaptation Occurring in Coastal and Non-coastal Areas During Flood in Lampung

Based on the figure, residents' behaviors during disaster are as follows:

- Remaining in their house during flood.

This behavior shows the residents' response whether to remain at home or leave for a while, during floods. In general, as many as 59.46% of the total residents state that they remain at home during floods, so it means that 40.54% leave their houses during floods. If seen by region, the phenomenon of many residents leaving their houses happens in non-coastal areas, since in this area only 29.41% of the residents remain at home. Whereas in coastal areas, only a small number of residents leaves their house. The majority (85.93%) remains at home during flood. This is due to the different types of flood. Flood occurring in coastal areas is rob. Since most residents have raised their houses, so when rob comes, almost all residents remain. Rob is relatively able to be anticipated by the residents. Unlike the case of flood occurring in non-coastal areas, which can not be predicted. As described previously, in this area almost all residents leave their house when the flood comes. It is like what happens in Pasir Gintung. Pasir Gintung residents who leave their houses during flood is as many as 82%. While in Sukabumi Indah, the number of people who remain at home are more than those who leave their homes. Based on FGD results, this is because residents claim they do not want to relocate as fear of unemployment. However, if the disaster is severe and forces them to relocate, they expect the government to provide housing and new jobs. As an anticipation, residents provide a ready means of transportation in facing floods, such as *pedicab*. The aim is to move to a higher location.

- Relocating to non-flooded areas.

This behavior describes the residents' response in finding temporary residence during flood. Location of the temporary residence is usually relatives' house who are not by affected flood. In general, of all the residents in observed sub-districts, only 9.45% of residents move to unflooded locations. Therefore, most of the residents remain at home. If seen from the area, relocating to unflooded areas is mostly done by residents in non-coastal areas than in coastal areas. In non-coastal areas, as many as 14.78% of the residents relocate to unflooded areas. Whereas, in coastal areas, there are only 5.18%. If seen in details, in non-coastal areas, the behaviour of relocating only occurs in Pasir Gintung, whereas, it does not exist in the other two areas. From all residents in Pasir Gintung, 34% of the relocate. The rest remain at home. In coastal areas, the number of residents who relocate in each sub-district is relatively small. For example, in Kangkung, only 7.69% of the total residents relocate, while in Kota Karang and South Panjang, the number is 3.57% and 5% of the total residents in each sub-district. Factors affecting whether residents relocate or not are influenced by (1) The presence of relatives in non-flooded area who can help them; (2) house condition; (3) security reasons.

- Other adaptations besides the ones mentioned above are making embankments, deepening water channels and raising floor levels, and these are mostly done by coastal area residents.

- From those adaptations, it can be seen that flood does not affect residents to pile up food and fuel supplies.

B. Drought

Drought usually happens from June to August. Loss impact of drought are (a) decline in production, as crops fail to grow properly even most of them die, and (b) decrease of family and environment sanitation. So in order to survive, residents must adapt to minimize the loss due to drought. Drought adaptation maybe in the forms of: (1) buying water for daily needs, (2) reducing water consumption, (3) pumping water from the closest source, (4) move to other locations and (5) holding a ritual to ask for rain.

Based on Figure 4-12, in general there are three forms of adaptations that are mostly done by residents namely, buying water, reducing water consumption, and pumping water from the closest source. Those are done in order to provide and maintain the availability of water so that it can fullfil daily needs. The phenomenon of prolonged drought happening in certain areas causes the residents to perform a ritual of asking for rain. This happens in coastal areas. For more details, the followings explain the residents adaptation to drought:

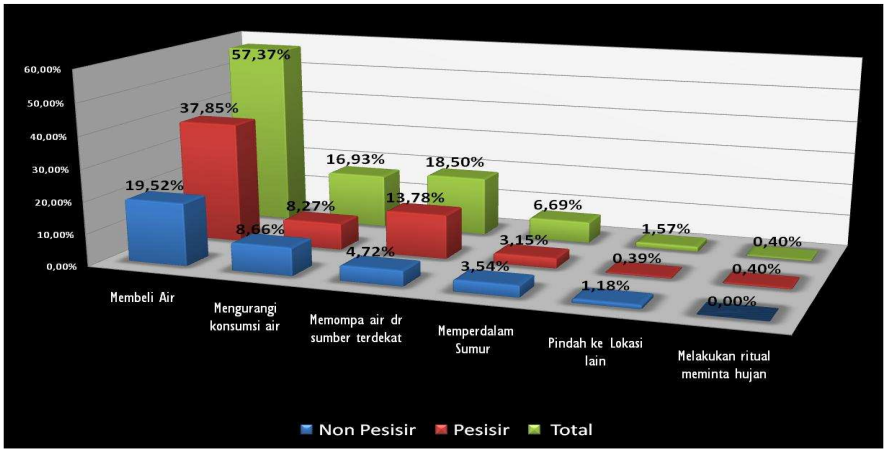


Figure 4.12.Residents Adaptation to Drought in Observed Sub-Districts in Bandar Lampung

Buying water.

Response to drought by buying water is primarily for bathing, shitting and culinary purposes. This response to buy water, is mostly done by residents in coastal areas. Based on the data, the number of residents in coastal areas who purchase water during drought is as many as 37.85% of the total residents of Lampung, while in non-coastal areas, the number is as many as 19.52% of the total residents of Lampung. If seen in detail in every sub-district, every resident in Batu Putu does not purchase water while drought. This is possible because water supply in this area is relatively more available than other areas, despite drought in Bandar Lampung. Moreover, it may be due to no water sellers in the area, due to geographical condition that does not allow people to sell water. So residents in this area rely on available water sources. In contrast to residents in Pasir Gintung and Sukabumi Indah, buying water is a common thing to do during flood because these two sub-districts are located near the city. Of all the residents in Pasir Gintung, only 58 % purchase water during drought. While in Sukabumi Indah the number is 68.97%. This is what occurs

in coastal areas. Residents in coastal area that buy water are from Kangkung sub-district. As many as 82.05% of the residents in this area buy water. It is the same in the two other areas, in Kota Karang the number is 67.86%, while in South Panjang the number is 62.50%.

Reducing water consumption.

The first response when drought strikes is to reduce water consumption. In this situation residents automatically save water, especially for bathing and washing activities. But there are not many residents who do this. There are only 8.66% in non-coastal areas and 8.27% in coastal areas of the total residents who perform the reduction of water consumption. If seen from the proportion in each area/sub-district, there are two areas in which its residents reduce water consumption more than residents in other areas, namely Sukabumi Indah (27.59% of the total residents in Sukabumi Indah) and South Panjang (27.50% of the total residents in South Panjang).

Pumping water from the closest source.

For residents who do not buy water, water availability is obtained by pumping water from nearby sources. In each area there is usually a well as a source of communal water. This adaptation is done mostly by residents in coastal areas. If seen in detail, the percentage of residents pumping water from nearby sources in coastal areas is larger than in non-coastal areas. There are only 20% of the residents in Pasir Gintung who pump water from nearby sources. This proportion is larger than other villages in coastal areas. Meanwhile, the proportion of residents in coastal areas is relatively equal with a range of 22-30.7% of the total residents in each area. Thus, areas such as Pasir Gintung, Kangkung, Kota Karang and South Panjang, have water sources that can be relied upon when drought strikes.

C. Income Strategy

There are three income strategies which are common in the community: (1) agriculture intensification and extensification; (2) double income pattern (income diversity); and (3) migration or permanent relocation. Based on survey and FGD results in observed sub-districts, it can be concluded that income strategies that are done by the residents of observed villages in Bandar Lampung are agriculture intensification and double pattern income.

Agriculture intensification is conducted by the residents of Batu Putuk by diversifying crops. Usually in one lot of land, they plant various types of plantation crops, so when a crop price falls, it can be helped selling other crops whose price is relatively more stable. In addition to plantation crops, they also make use of their land to grow horticultural crops, such as vegetables and fruits. These horticultural crops have a shorter cycle than the plantation crops. This way, while waiting to harvest the plantation crops, daily needs can be fulfilled from the harvest of vegetables and fruits. Sometimes plantation crops that is fruitful, fail to be harvested due to the typhoon that causes the fruit to fall off. In such conditions, horticultural crops can help the difficult economic problems.

The second income strategy is double pattern income. This pattern is done in two ways, first by income diversity, which is a combination of livelihoods, on farm and off farm owned by a person. Off farm activities are side jobs besides main jobs. The second is by empowering members of the family, such as wives and children who have grown up. Double income pattern strategy is done in almost every observed village, both in coastal and non-coastal areas. This strategy also applies both to residents having working in on-farm and off-farm sectors.

Summary of the magnitude of disaster impact and the efforts done by the residents to handle problems that may arise can be seen in Table 4.7 and Table 4.8. When compared between flood and drought disasters, flood causes greater impact on the economy of the residents in Bandar Lampung.

Table 4.7.. Disaster Impact Befalling on Residents of Observed Villages in Bandar Lampung, 2009

Problems	Panjang Selatan		Pasir Gintung		Kota Karang		Batu Putuk		Sukabumi Indah		Kangkung	
	Flood (%)	Drought (%)	Flood (%)	Drought (%)	Flood (%)	Drought (%)	Flood (%)	Drought (%)	Flood (%)	Drought (%)	Flood (%)	Drought (%)
Food	10	10	6	2	8,9	3,6	-	10	-	3,2	7,7	5,1
Drinking Water	35	47,5	18	40	23,2	39,3	-	32,5	12,9	54,8	-	23,1
Houses damaged	22,5	5	48	2	8,9	-	-	2,5	6,5	-	5,1	2,6
Asset damaged	10	2,5	44	2	12,5	-	-	-	6,5	-	7,7	2,6
Reduced employment	27,5	10	4	4	12,5	10,7	2,5	35	3,2	-	17,9	15,4
Indebted	17,5	12,5	18	6	19,6	17,9	5	32,5	3,2	3,2	23,1	23,1
Disease	42,5	25	40	14	48,2	25	-	7,5	22,6	35,5	41	30,8
The decline in agricultural production / livestock / fish	22,5	7,5	2	-	21,4	10,7	5	40	-	-	17,9	7,7
Crime	7,5	5	-	-	3,6	7,1	-	-	6,5	3,2	5,1	5,1
Waste	17,5	7,5	12	-	23,2	5,4	-	-	3,3	-	28,2	28,2

Table 4.8 it is known that partially the impact of flood and drought in Bandar Lampung are relatively small. The size of the impact is obtained from residents perception towards the size of disaster impact that they feel in various aspects of economy. In reality, disaster rarely happens in Bandar Lampung, it happens locally with a relatively smaller scale than disater in other areas. But if the potential of extereme climate events increases in the future, the size of impact will also be larger.

Table 4.8.. Summary of Residents Perception in Bandar Lampung Towards the Size of Disaster Impact and Handling Efforts Done

No	Problems	Distribution / Magnitude	Handling Efforts
1	Disruption of the main livelihood: lower income	16,73 % residents said the main livelihood disruption during flood; 9,96% residents said the main livelihood disruption during drought	Looking for other livelihood alternatives, debt
2	Number of unemployed	11,3% residents said it was hard to find another job during the flood disasters; 10,9% residents said it was hard to find another job during the drought disasters	
3	Food Scarcity	5,9% residents said there are food shortages occurred during the flood disaster; 5,5% residents said there are food shortages occurred during the drought disaster	Take potluck, ask for help, and debt
4	Prices for some commodities	When a flood occurs, the price of rice: rose 13.65 percent, fish: 28.86 per cent, crops: 24 percent; When a drought occurs, the price of rice: rose 12,79 percent, fish: 13,71 per cent, crops: 26,73 percent	Take potluck, ask for help, and debt
5	Scarcity of drinking water	19,1% residents said there is scarcity of drinking water during floods; 43,4% residents said there is scarcity of drinking water during drought	Looking for other sources, buying gallons of water, save water consumption, taking water in mosque
6	Damaged Houses	16,4% residents said the house was damaged after flooding events; post-event drought only 2% of the state were damaged house	Improve housing.
7	Damaged Assets	14,8% residents claimed were damaged post-flood assets; post-event drought only 1.2% of residents claimed were damaged assets	Improved
8	Debt / borrowing money	15.2% of residents admitted into debt during the flood disaster; 16% of residents admitted into debt during the drought.	mortgage goods
9	The emergence of various diseases	34% of residents expressed a variety of diseases arising during flood events; 22.3% of residents expressed a variety of diseases arising during drought events	Treatment and maintain cleanliness
10	The decline in agricultural production / fish.	12.1% of residents complained about it at the time of the flood disaster; 10.9% of residents complaining about it at the time drought events	cultivated plants, diversification of crops, look for another job debt
11	Evacuation / refuge	9% of residents stated displaced during floods but not in the drought	
12	Waste	14.1% of residents complained at the time of the flood disaster 6.6% of residents also complained about the same thing at the time of drought	cleaned and recycled

Chapter 5 VULNERABILITY AND ADAPTIVE CAPACITY MAPPING

5.1 Methodology for Vulnerability and Adaptive Capacity Mapping

For defining capacity and vulnerability indices, we used 2005 socio-economic survey data by '*kelurahan*' (villages) from National Bureau of Statistics (BPS) while for some of biophysical data were obtained from related sector or generated based on satellite interpretation with GIS techniques (Table 5.1). All the data were weighted according to their relative importance in shaping vulnerability (V) and capacity (C) to adapt.

Table 5.1. Indicators used for defining Vulnerability and Capacity and the corresponding weights

A	**Capacity**	**Weights**	**B**	**Vulnerability**	**Weights**
A1	Electricity Facility	0.05	B1	Number of household living in River Bank	0.05
A2	Education of Working People Age	0.25	B2	Number of Building in River Bank	0.05
A21	*Nursery School*	*0.07*	B3	Drinking Water Services **	0.10
A22	*Elementary School*	*0.13*	B4	Population density	0.10
A23	*Junior High School*	*0.20*	B5	Poverty	0.20
A24	*Senior High School*	*0.27*	B6	Fraction of Coastal***	0.10
A25	*University*	*0.30*	B7	Fraction of River***	0.10
A3	Main Source of Income	0.30	B8	Drainage Facility	0.20
A4	Health facility*	0.20	B9	Non-Green Open Area	0.10
A41	*Puskesmas*	*0.20*			
A42	*Polyclinic*	*0.30*			
A43	*Posyandu*	*0.20*			
A44	*Midwifes Clinic*	*0.10*			
A45	*Med. Doctor Clinic*	0.20			
A5	Road Infrastructure	0.20			

Note: *In term of facility, Polyclinic is better than Puskesmas as it is managed and operated by Private company, but the cost of health services is much higher than the government's one (Puskesmas). ** Data obtained from the Lampung Drinking Water State Company (PDAM Office) and divide by population. *** Data were generated from Satellite and topographic map.

To measure relative position of *Kelurahan* in term of their vulnerability and capacity to adapt, we develop capacity (CI) and vulnerability indices (VI). The Capacity Index (CI) is developed using five main indicators (A1, …, A5). Each indicator is

scored. The scoring value of Indicator A1 is the percentage of household in the *Kelurahan* that uses electricity facility. This indicator represents the level of wealth of communities of the *Kelurahan* s. Indicator A2 is education which may represent the capacity of community in the *Kelurahan* s in managing the risk. The higher the education is the better their capacity in managing the risk is. This indicator consists of five sub-indicators namely number of Nursery (N), elementary (E), and junior high schools (J) at *Kelurahan* level, senior high school at Sub-District level (H) and University at District Level (U). The scoring value of I_{A2} in each *Kelurahan* was calculated using the following formula:

$$I_{A2i}= 1/P_i * (0.07*N_i+0.13*E_i+0.20*J_i) + 1/P_{ij}*(0.27*S_j)+1/P_{ik}*(0.33*U_k)$$

Where P_i, P_{ij}, and P_{ik} are the population size of *Kelurahan -i*, Sub-District-*j* of *Kelurahan -i*, and district-*k* of *Kelurahan -i* respectively. Since the scoring value of this indicator is very small, all the values were normalized with the highest score in order to get scoring values of the indicator ranging from 0 to 1. Indicator A3 is main income source of community in the village. For *Kelurahan* s where main source of income of the community is strongly influenced by climate variability will have low capacity score. The values of the indicator by main source of incomes are presented in Table 5.2. In this case for example, *Kelurahan* in which agriculture is the main source of income of the community, the scoring value will be 0.25.

Table 5.2. Indicator value according to types of main income source of community in the Kelurahan

No	Main source of income	Score (Indicator value)
1	Agriculture	0.25
2	Mining and processing industries	0.50
3	Trading, transportation and communication business etc	0.75
4	Services	1.00

Indicator A4 is health facility which represents access of community to health facilities. The better the health facility in the *Kelurahan* is the higher the capacity of the *Kelurahan* is. This indicator is further divided into 5 sub-indicators namely number of Polyclinic (Pl), Child Community Services (*Posyandu, Ps*), Health Community Services (*Puskesmas, Pk*), Midwifes Clinic (B) and Doctor Clinics (D). All the values of the sub-indicators were normalized by population size of the corresponding *Kelurahan* . The scoring value of I_{A4} in each *Kelurahan* was calculated using the following formula:

$$I_{A4i}= 1/P_i * (0.3*Pl_i+0.2*Ps_i+0.2*P_{ki}+0.1*B_i+ 0.2*D_i)$$

Since the scoring value of this indicator is very small, all the values were divided with the highest score in order to get scoring values of the indicator ranging from 0 to 1. Indicator 5 is dominant type of road infrastructure. For this data we define *Kelurahan* where the dominant road infrastructure is made from aspalt will have value 1 while for those with non-aspalt will have value 0. The formula to calculate the CI is the following:

$$CI_i = \sum_{j=1}^{5} w_{ij} * I_{Aij}$$

Where subscript-i^{th} represents *Kelurahan* -i^{th} and w_{ij} is weight value for indicator A-j^{th} of *Kelurahan* -i^{th}. The selection of the weight values was subjective, based on understanding and knowledge of experts on relative important of the indicators in determining the level of capacity. With this formula, the higher the capacity index value is, the higher the capacity of the *Kelurahan* is.

Similar with the Capacity Index (CI), the vulnerability index was also developed using the same approach. There nine main indicators (B1, …, B8) as defined in Table 4. Indicators B1 is percent of household in the *Kelurahan* living in the river bank. As the value of this indicator will be very small, to have values of the indicators ranging from 0 to 1, all the values in this indicator were divided by its maximum value (the highest score). Indicator B2 is number of building situated in the river banks. All the values of this indicator were normalized by maximum number of building situated in the river banks. Indicator B3 is production capacity of Drinking Water Company in supplying water to the *Kelurahan* . *Kelurahan* where most of the community gets drinking water from Drinking Water State Company (PDAM) will be less vulnerable to drought impact as the PDAM normally still can supply enough drinking water irrespective of season (dry or wet). The values of this indicator were normalized by population size of the corresponding *Kelurahan* . Since the scoring value of this indicator is very small, all the values were normalized again with its maximum value (the highest score) in order to get scoring values of the indicator ranging from 0 to 1. The scoring value of this indicator will be one minus the normalized value.

Indicator B4 is population density in which the higher the population density the higher level of the exposure of the people to hazard. This puts the *Kelurahan* into more vulnerable *Kelurahan* . To get values of the indicators ranging from 0 to 1, all the values in this indicator were divided by its maximum value. Indicator B5 is number of poor household. Values of this indicator are normalized with population size of the *Kelurahan.* Indicator B6 is fraction of coastal area in the *Kelurahan* . The *Kelurahan* s with high fraction of coastal area will be more vulnerable than the *Kelurahan* with have less fraction of coastal area, as the level of exposure of these *Kelurahan* s to the impact of sea level rise will be higher than those situated in the inland. Coastal fraction is determined by dividing area being affected by tide+100 m in each *Kelurahan* with total area of the corresponding *Kelurahan* (Figure 5.1). This inundation due to high tide is usually used as an indicator of *rob* as a result of temporary sea level rise, while the addition of a distance of 100 meters is used to anticipate extreme tide.

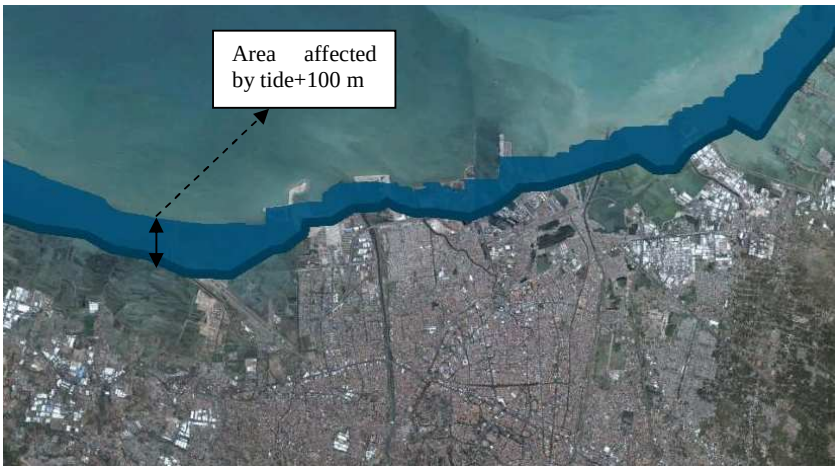


Figure 5.1. Coastal area which is affected by tide + 100 m

Indicator B7 is fraction of river which was determined based on river order. The river order is determined using Strahler's method (1986). In this method, the river's network is notated as a number based on its (order) level. The upper stream of the river is given notation number equal to 1, thus, it is called as order-1. The segment of the river where we can find the confluence between order-1 is defined as the 2nd order of the river, and the confluence between the 2nd orders represents the 3rd order. Based on these rules, part of the river that is formed as a result of the confluence between a particular order-level is considered as the next level of this order. However, in the case where two orders with different levels meets at a particular segment, this can be referred to the highest level of the orders. Figure 5.2A illustrates the highest order of the river indicated by the red line. In this case, the river has 4-order as the highest level. This highest order is usually represented by the location of the accumulation of surface flow, which very often becomes the target of flooding. In this study, the wide of targeted flooding area as shown in Figure 5.2B is assumed to be as far as 100 meters to the left and right sides of that segment. Indicator B8, non-drainage facility, indicates the fraction of *Kelurahan* that has no drainage facility. Indicator B9, non-green opened area, indicates fraction of villages that with non-green opened area. The higher these value the more vulnerable these *Kelurahan* .

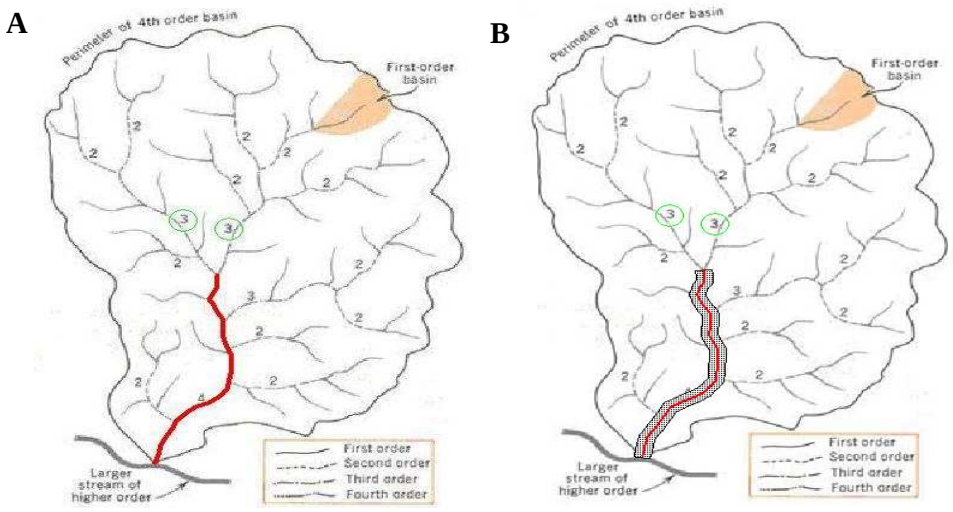


Figure 5.2. Determination of the highest order stream (A) & estimation of the wide of its water surge (B)

The formula to calculate the VI is the following:

$$VI_i = \sum_{j=1}^{5} w_{ij} * I_{Bij}$$

Where subscript-i^{th} represents *Kelurahan* -i^{th} and w_{ij} is weight value for indicator B-j^{th} of *Kelurahan* -i^{th}. The selection of the weight values was subjective, based on understanding and knowledge of experts on relative important of the indicators in determining the level of capacity. With this formula, the higher the index, the more vulnerable the *Kelurahan* is..

5.2 Classification of *Kelurahan* (Villages) Based on Vulnerability and Capacity

To classify the villages based on their vulnerability and capacity level, all VI and CI values of all *Kelurahan* were subtracted by 0.5. As the VI and CI values range from 0 to 1, by subtracting the index values with 0.5, the VI and CI will range from -0.5 to +0.5. The relative position of *Kelurahan* according to their VI and CI is determined based on their position in the five Quadrants as shown in Figure 5.3. *Kelurahan* s situated in Quadrant 5 will have high VI and Low CI. Whereas *Kelurahan* s situated in Quadrant 1 will have low VI and high CI. Using this classification system, if *Kelurahan* s situated in Quadrant 5 are exposed to certain hazards, the impact would be more severe compare to *Kelurahan* s Situated in Quadrant 1.

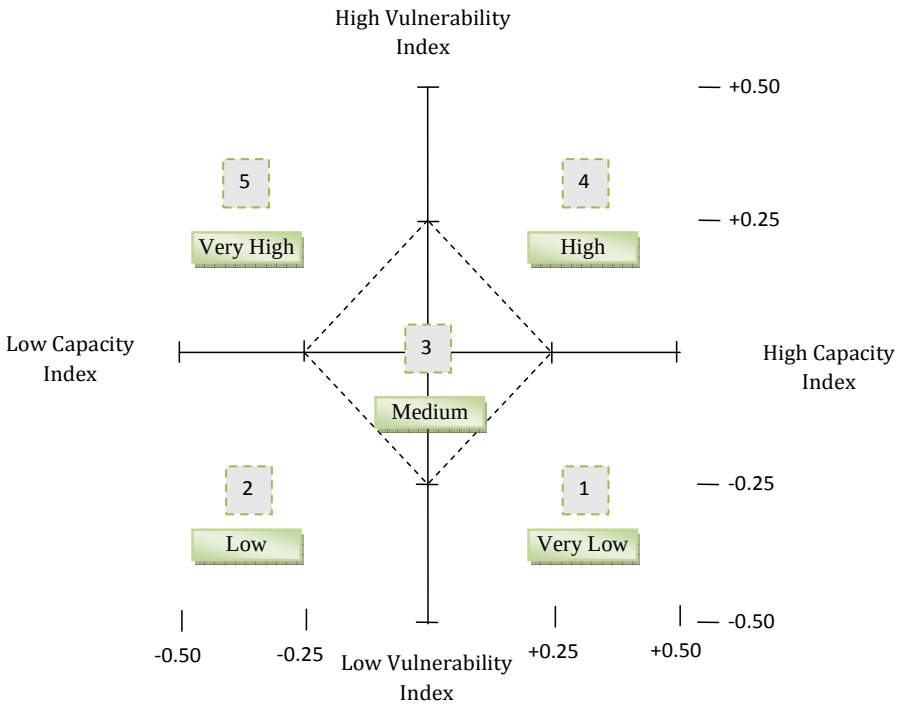
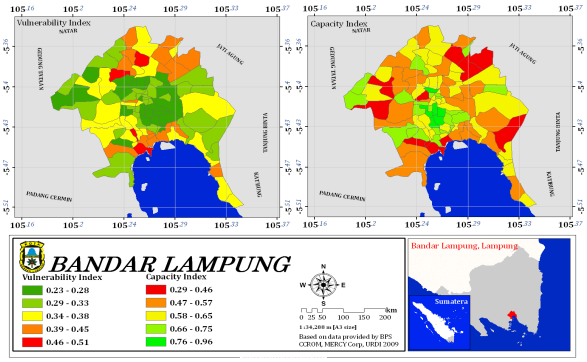
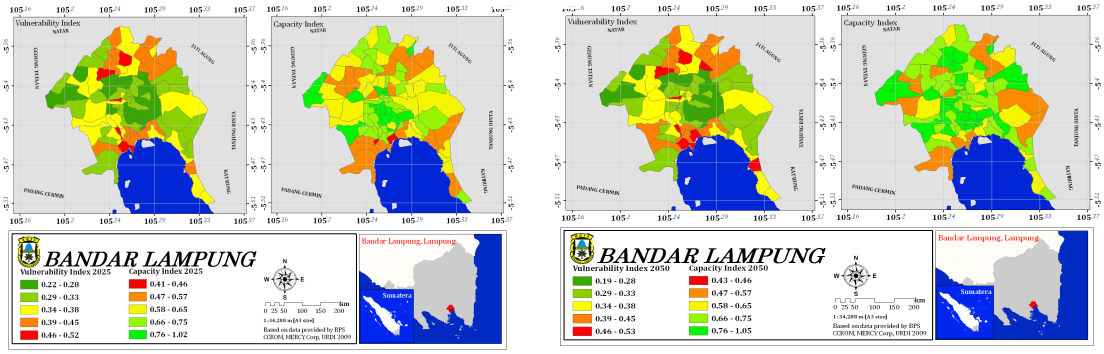


Figure 5.3.Splitting the villages based in their vulnerability and capacity indices



(A)

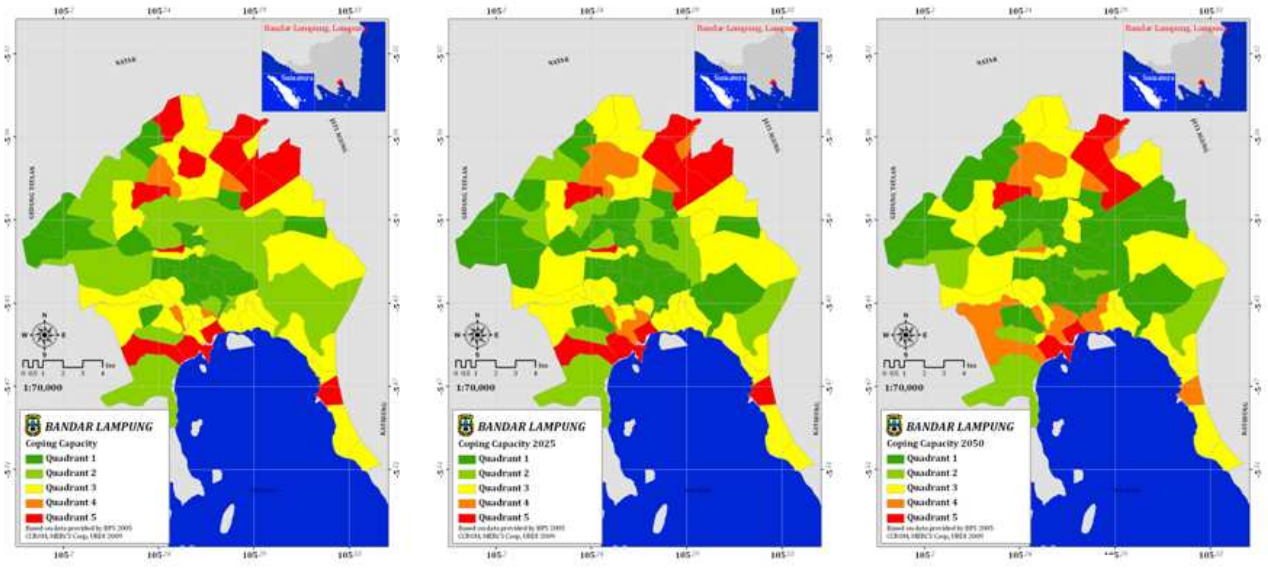


(B) (C)

Figure 5.4. Vulnerability and capacity indices of Kelurahan Baseline, (B) 2025, (C) 2050

To assess the change of V and C in the future, we only consider the change of population density (based on government projection), non-green opened area, and education (based on spatial planning or RTRW) since other data is not available. Factors used for normalizing the score of these corresponding indicators in 2025 and 2050 were the same as those of the baseline year 2005.

Figure 5.4 shows the index value for the vulnerability and capacity for each village in Bandar Lampung. In the baseline condition, Vulnerability Index ranged from 0.23 to 0.51, in 2025 VI ranged between 0.22-0.52, while the projection for 2050 VI ranged from 0.19 to 0.53. These results show that the level of vulnerability slightly broaden, yet still be considered stable, given the results obtained by analysis of future projections (2050) is almost the same as conditions in 2005. This analysis indicates that at the same environmental conditions the ability to adapt has increased. The condition is also indicated by increasing index value CI. In 2005, CI values varied in the range of 0.29-0.96, but the projection for the year 2025 showed a significant improvement 0.41-1.02, and the projection in 2050 showed an index value of 0.43-1.05. Based on this projection results, it show that the ability or capacity of community adaptation in Bandar Lampung is good enough.



(A) (B) (C)

Figure 5.5. Coping capacity index of Kelurahan of Lampung City

(A) *Baseline, (B) 2025, (C) 2050 (See Appendix 1 for detail)*

Condition of vulnerability and capacity are shown starting from quadrant 1 (green) to quadrant 5 (red). Figure 5.5 shows that in 2005 baseline conditions and projected conditions in 2025 and 2050 does not show significant changes. However, the picture in 2050 shows that in some areas which had been shown in red (very high) becomes orange (high) and in some other areas of yellow (medium) becomes green (very low). There is also a small part of the original area of yellow (medium) becomes orange (high), indicating a decrease in VI or increase in CI; and a small part of the original area of yellow (medium) becomes orange (high), indicating an increase VI or decrease CI..

Chapter 6 CLIMATE RISK ANALYSIS

6.1 Methodology for Climate Risk Mapping

To assess current and future climate risks, we adopt definition of climate risk as suggested by Beer and Ziolkowski (1995) and Jones et al. (2004). The risk is defined as a function of the probability of unexpected climate event to occur and the consequence of the unexpected climate events if it occurs. Thus the risk can be presented in the form of risk matrix (Table 6.1). From Table 6.1, we can define the climate risk will be very high if the likelihood of unexpected event to occur is very likely and the consequence of the events is catastrophic.

Table 6.1.. Matrix of risk as a function of probability of unexpected event to occur and the consequences if the unexpected events occur.

Likelihood / Consequences	The probability of unexpected event to occur		
	Very Likely	Likely	Unlikely
Catastrophic	*Very High*	*High*	*Medium*
Critical	*High*	*Medium*	*Low*
Marginal	*Medium*	*Low*	*Very Low*

The consequence of the events will depend on the coping range which is shaped by a range of biophysical, social and economic factors. Coping range is the interval of tolerance of a system to climate variability. If the climatic conditions through this tolerance interval, the system will be damaged or sustainability of the system will be disrupted (Boer, 2007). In this context, the coping range can be represented by the vulnerability and capacity indices. Thus if the unexpected event occurred in *Kelurahan* with high vulnerability and low capacity index, the consequence of that event is expected to be high. If it occurred in *Kelurahan* with low vulnerability and high capacity, the impact is expected to be low. In this study, we adopted five level of coping capacity index as shown in Figure 5.4. To allow multiple climate hazards being accommodated in the matrix of climate risk, we modify the likelihood of unexpected event defined in Table 2 as an index, called composite climate hazard index (CCHI).

The Climate Hazard Index (CHI) is calculated as the following:

$$CCHI_i = \sum_{j=1}^{n} w_{ij} * CHI_{ij}$$

Where $CCHI_i$ is composite climate hazard index of *Kelurahan -i*, w_{ij} is the weight of climate hazard-*j* at *Kelurahan -i* and CHI_{ij} is index of climate hazard-*j* of *Kelurahan -i*. Types of climate hazard being analysed in this study are flood, drought, land slide and sea level rise (robs). Strong wind is very rarely in the city therefore we exclude

this in the analysis. The weight and the formula used to calculate the index the climate hazard is given in Table 6.2. The adjusted matrix of climate risk is presented in Table 6.3.

Table 6.2.. Weight and formula for calculating climate hazards index

Type of hazard	Weight*	Formula
Flood	1.25	Probability of having monthly rainfall of more than 339 mm multiplied by average of area of *Kelurahan* being impacted by flood. In order to get the index value of between 0 and 1, the calculated value is normalized by the maximum value
Drought	1.50	Probability of having dry month with length of more than 6 month multiplied by number of dry month above the 6 month (DM_{6+}). Dry month is defined as month with rainfall of less than 129 mm. If total length of dry month is 8 month, the DM_{6+} = 2 months. In order to get the index value of between 0 and 1, the calculated value is normalized by the maximum value.
Land slide	0.75	Probability of having monthly rainfall of more than Q2 multiplied by slope indicator of the corresponding *Kelurahan* . *Kelurahan* that has locations with slope of more than 45^{o}, the indicator value will be equal to 1, otherwise zero.
Sea Level Rise	1.00	Fraction of *Kelurahan* area being inundated by the sea level rise
Max CCHI	4.50	

Note: The weight is very subjective and determined based on Expert Judgement. Drought has the highest weight as its impact may be more severe than flood due its duration and extend of impacted area. Impact of flood, land slide and sea level rise is more localized than that of drought.

Table 6.3.. Matrix of Climate Risk according the coping capacity index and composite climate hazard index

Coping Capacity Index	Composite Climate Hazard Index (CCHI)		
	More than 3.5	Between 2.0 and 3.5	Less than 2.0
5	*Very High*	*High*	*Medium to High*
4	*High*	*Medium to High*	*Medium*
3	*Medium to High*	*Medium*	*Medium to Low*
2	*Medium*	*Medium to Low*	*Low*
1	*Medium to Low*	*Low*	*Very Lowe*

Methodology for defining critical rainfall causing flood and the one causing drought was based on statistical distribution of the monthly rainfall and hazard data from 7 Kelurahan s (Table 6.4). The critical rainfall threshold was determined based on the characteristics of the hazards and time of the hazards occurrence (month and year) and regional monthly rainfall intensity of the corresponding year (based on data from Masgar station, 05°10'12" S and 105°10'29.4" E).

Table 6.4.. Flood and drought hazard events in Bandar Lampung City

Type of Disasters	Name of Village	Sub-District	Lon	Lat	Date and Month	Incident Year
Flood	Panjang Selatan	Panjang	105.3231	-5.4752	Oct-Dec	1981-2007
	Sukabumi Indah	Sukabumi	105.2956	-5.3983	Jul	2008
	Pasir Gintung	Tanjung Karang Pusat	105.2571	-5.4047	18-Dec	2008
	Kota Karang	Teluk Betung Barat	105.2606	-5.4547	Aug-Oct	2008.2009
	Kangkung	Teluk Betung Selatan	105.2677	-5.4465	Jan	2006.2009
	Batu Putu	Teluk Betung Utara	105.2229	-5.4314	Rainy season	2006
Drought	Panjang Selatan	Panjang	105.3231	-5.4752	May-Aug, Jan-Mar	Every year
	Sukabumi Indah	Sukabumi	105.2957	-5.3983	May-Oct	Every year
	Pasir Gintung	Tanjung Karang Pusat	105.2571	-5.4047	Apr-Oct	Every year
	Kota Karang	Teluk Betung Barat	105.2606	-5.4547	Feb-Sept	Every year
	Kangkung	Teluk Betung Selatan	105.2677	-5.4465	Every month	Every year
	Batu Putu	Teluk Betung Utara	105.2229	-5.4314	May-Oct	Every year

Source: Bappeda Lampung (2006)

Based on Boxplot of monthly rainfall data of dry season and wet season (Figure 6.1), we found the rainfall which separate the two monthly rainfall distributions was 129 mm. This value was taken as the critical rainfall causing drought since drought occurred every year (Table 6.4). This means that if rainfall is below 129 mm, drought will occur. For flood, we adopt the critical value of 339 mm (quartile 3 of the distribution) since floods did not occur every year as the drought. Thus, if rainfall in wet season is above this value, flood will occur.

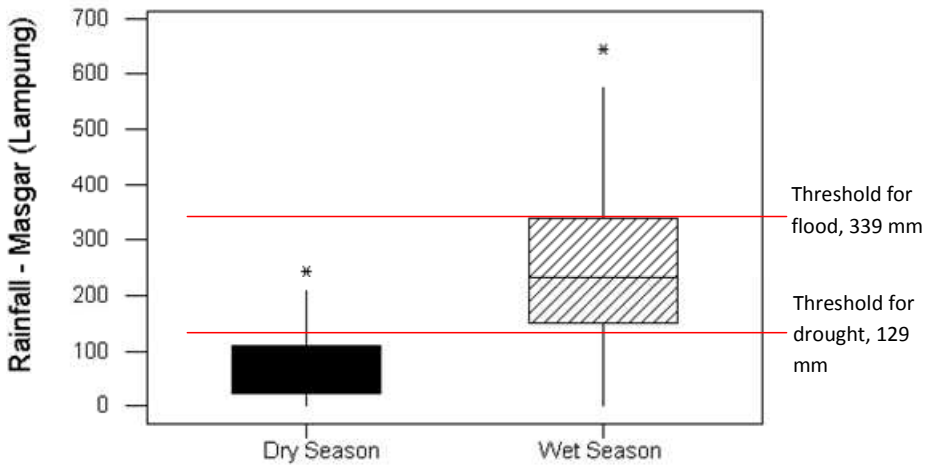


Figure 6.1.Box plot of monthly rainfall in dry and wet season during hazard and no-hazards years.

6.2 Classification of Kelurahan (Villages) Based on Level of Their Exposure to Climate Risk

Figure 6.2 shows Composite Climate Hazard Index baseline 2005, and the Climate Hazard A2 scenario in 2025, A2 in 2050, B1 in 2025 and B1 in 2050. The analysis shown that the most areas are in the range of index < 1.5 (shown in green and yellow in the figure), and only a small portion that > 1.5 (shown in red on the scenarios A2 and B1), namely at the southern part of Panjang subdistrict. In the A2 scenario, the area that has index > 1.5 is slightly wider (Figure 6.2 B and C) than the baseline or scenario B, which is indicated by a part of Teluk Betung Barat subdistrict. Baseline Climate Hazard in 2005, when projected with the A2 and B1 scenarios in 2025 and 2050, in many areas does not change. This shows good adaptability. Adaptability will determine the width or narrowness of the coping range (tolerance interval). The higher ability of adaptation will have a wider interval of tolerance (coping range) from the system.

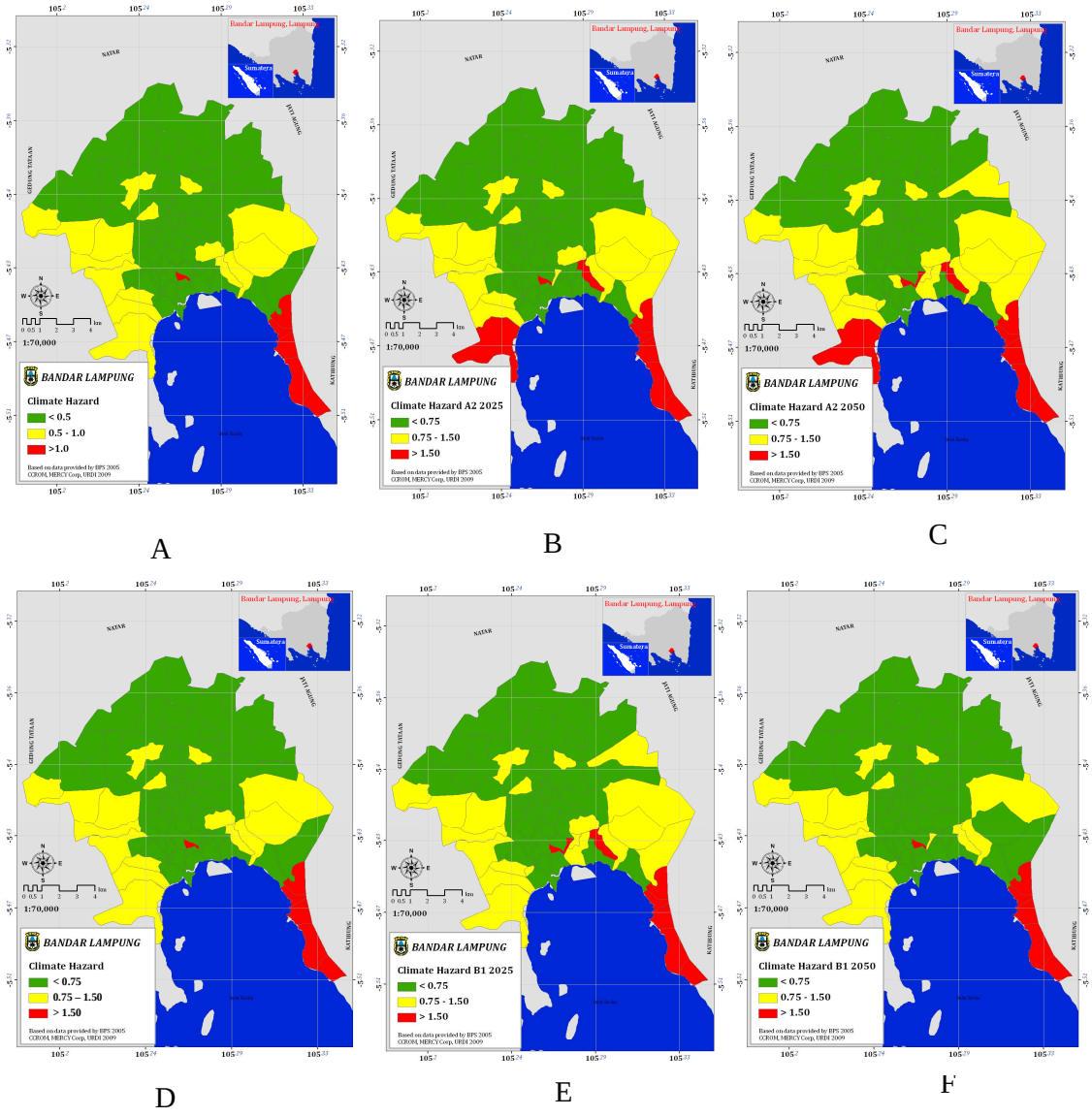


Figure 6.2.. Composite Climate Hazard Index of Bandar Lampung. Note: (A) & (D) Climate Hazard Baseline, (B) Climate Hazard A2 2025, (C) Climate Hazard A2 2050, (E) Climate Hazard B1 2025, (F) Climate Hazard B1 2050. Note: Green (<0.75), Yellow (1.75 – 1.50), Red (>1/50). (See appendix 1 for detail)

Classification of Kelurahan based on the level of exposure to climate risks is shown in Figure 6.3. It was shown that there are no Kelurahan with Very High (VH) Climate Risk Category at present (baseline conditions). The highest category is only Medium to High (M-H). There are about 14 Kelurahans (14.2%) with M-H risk category. These include Kota Karang and Perwata (Teluk Betung Barat Sub-district), *Kelurahan* Gunung Terang (Tanjung Karang Barat Sub-district), *Kelurahan* Tanjung Senang and Way Kandis (Tanjung Senang Sub-district), *Kelurahan* Waydadi (Sukarame Sub-district), *Kelurahan* Sepang Jaya and Kedaton (Kedaton Sub-district), *Kelurahan* Kangkung, Bumi Waras, kankung and Teluk Betung (Teluk Betung Selatan Sub-district) and *Kelurahan* Panjang Selatan and Srangsem (Panjang Sub-district). The remaining are 5 Kelurahans (5.1%) as M (Medium) risk,

36 Kelurahans (36.7%) as L-M (Low to Medium) risk, 22 Kelurahans (22.4%) as L (Low) risk and 21 (21.4%) Kelurahans as VL (Very Low) risk. In the future (2025 and 2050), more Kelurahans will be exposed to higher climate risk, particularly under scenario SRESB1 (Figure 6.4). There would be two Kelurahans would move from M-H to High climate risk category, namely kelurahan Gunung Mas at kecamatan teluk Betung Utara dan kelurahan Garuntang at kecamatan Teluk betung selatan. While many of Kelurahans with L-M risk category would move to Medium risk category (Figure 6.4).

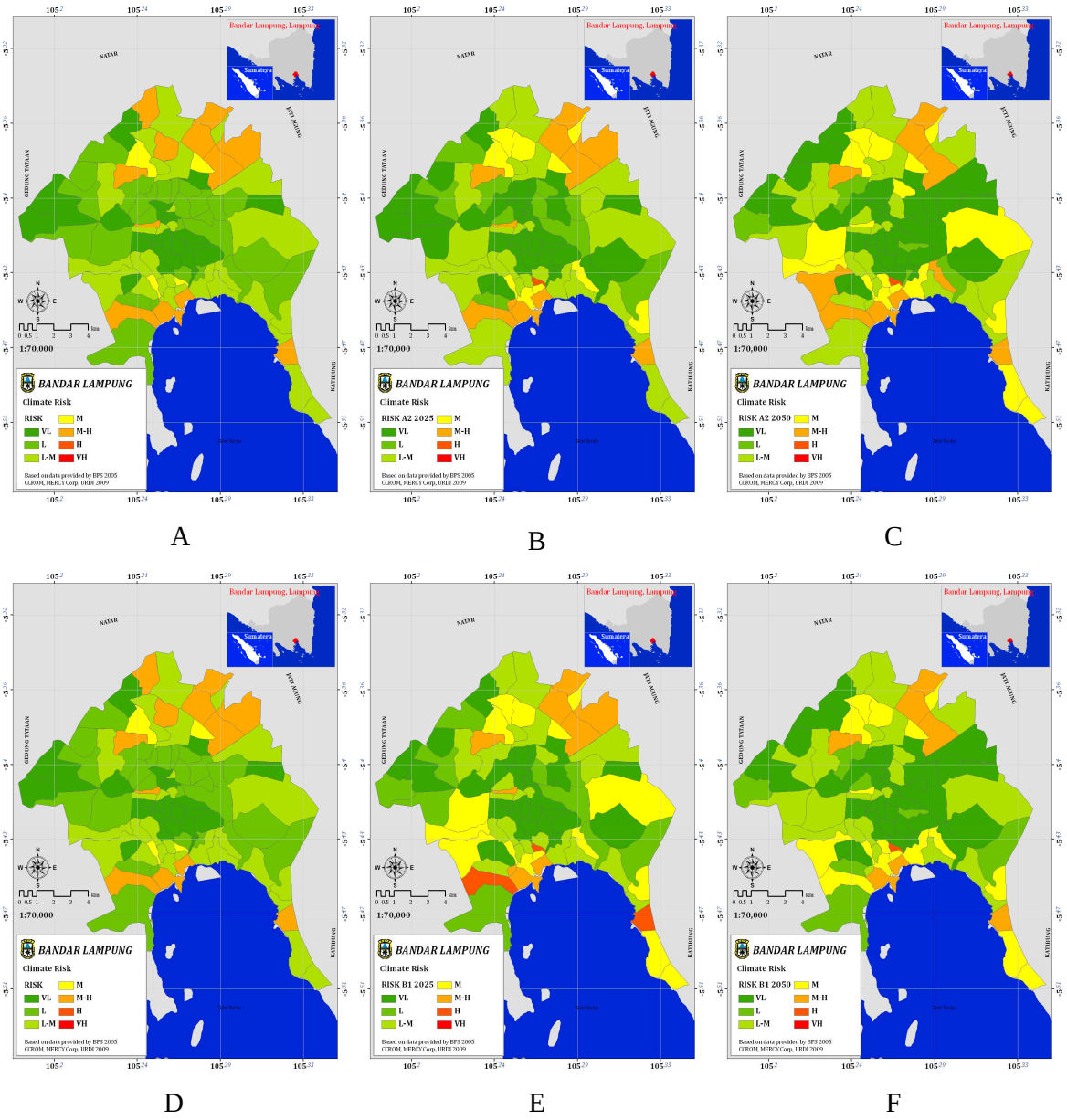


Figure 6.3. Classification of Kelurahan based on their level of their exposure to climate risk (A)& (D) Climate risk baseline, (B) Climate risk A2 2025, (C) Climate risk A2 2050, (E) Climate risk B1 2025, (F) Climate risk B1 2050 (See appendix 1 for detail)

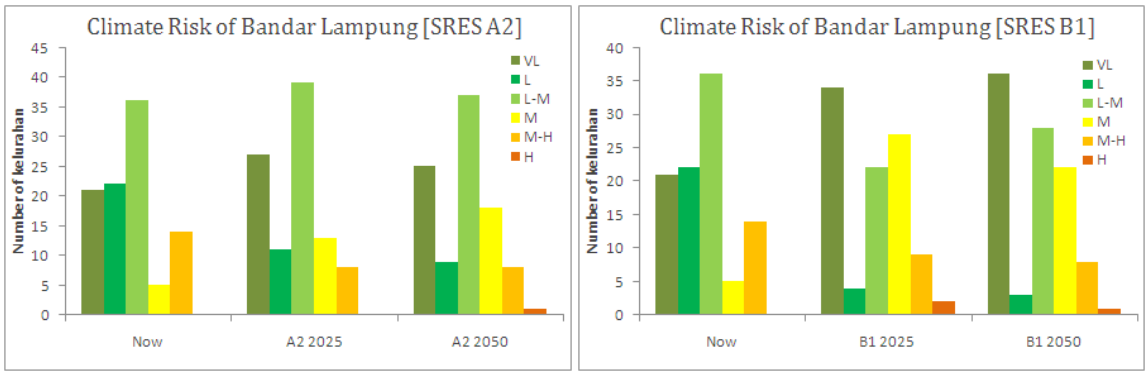


Figure 6.4. Number of Kelurahan by climate risk index category

The above analysis demonstrated that how change in socio-economic and biophysical conditions will change coping capacity of the Kelurahans. Adaptation programs should be prioritized in Kelurahan with high vulnerability index and low capacity index and being exposed or potentially exposed to high climate hazard index. To reduce the level of risk of Kelurahan to the impact of climate change, the infrastructure and community development programs should be directed to improve socio-economic and biophysical indicators shaping the vulnerability and adaptive capacity of the Kelurahans.

Chapter 7 GOVERNENCE AND INSTITUTIONAL SYSTEM

Governance and institutional analysis consists of three main analysis including the stakeholder analysis, assessment of effectiveness of current initiatives and programs (short and long term) cope with future climate risks and assessment of local government capacity and institutional to integrate climate change into development planning.

7.1 Roles of Stakeholders and Existing Programs in Delivery and Management of Key Climate-Affected Sectors

Stakeholder mapping and analysis conducts through some steps as follow: (i) to identify stakeholder that has both direct and indirect relationship with climate change sector, (ii) to analyse roles, responsibility and contribution of each stakeholders to climate change, (iii) to map stakeholder interest and strength in providing and managing sectors that related to climate change.er

Stakeholder can be classified into several categories namely: central government (line ministry/department and non-departmental government institution), provincial government, city/district government, private sector, non-government organisation (NGO), university, multilateral/bilateral organization, community based organisation (CBO), association, etc. Stakeholder can also be classified based on its scope/position, which are internal stakeholders from inside Bandar Lampung City such as local government, NGO's, local universities, private sector etc and external stakeholders from outside the city such as central government, provincial government, international donor agencies, etc.

In this section, stakeholder analysis will be specifically undertaken for climate-change related problems facing by Bandar Lampung which are flooding and water-sanitation.

7.1.1 Role of stakeholder in flood management

Even though Bandar Lampung is located 100 metre above sea level but the city often have flood problem. In 2008, the city suffered from big flood which caused a lot of material lost. Flood in Bandar Lampung is caused by a lot of factors such as high rain fall, poor drainage system, poor community attitude and reducing of green area. Another factor that significantly cause the flood in the city is narrowing river width along Teluk Betung and Panjang due to increased high densely populated settlements. The narrowing river width and sedimentation lead river to be unable to keep the water which lead to flood at the surrounding area.

At the same time, deforestation at hilly area of Bandar Lampung also contributes to flood in the city. City government is unable to control land use changes in hilly area belong to private land-owners. As consequence, land owners could do anything on their land without considering the impact. Beside flooding, uncontrolled land-use changes could triggered to landslide in surrounding areas.

In order to solve these problems, Bandar Lampung city government has conducted several programs and activities such as clean river program (program Kali Bersih), improved drainage system, tight-permit system and other-related programs to reduce flood and to increase community awareness.

Table 7.1. Stakeholders that related to Flood and water-sanitation

Stakeholders	**Sector related to climate change**	
	Flood	**Water and Sanitation**
Central Government		
• Directorate General of Water Resources	V	
• Directorate General Human Settlements		V
Internasional Donor		
• Asian Development Bank	V	V
City of Bandar Lampung		
▪ Local Planning Board	V	V
▪ Environment Board	V	V
▪ Health Agency		V
▪ Cleaning and Park Agency	V	
▪ Coastal and Animal Husbandary Agency	V	
▪ Public Work	V	V
▪ Agriculture Agency	V	
▪ Fire and Disaster Agency	V	
Non Government Agency		
▪ Mitra bentala	V	
▪ Pusbik	V	V
▪ Walhi	V	
▪ Sahabat lingkungan	V	
University		
▪ University of Lampung	V	V

7.1.2 Role of stakeholder in water and sanitation

Like other cities in Indonesia, the main source of drinking water provided by local water enterprise known as PDAM Way Rilau in Bandar Lampung. It is local-own water enterprise which has mission to provide water for all. In 2002, the water enterprise could serve almost 66.1 percent of total household in Bandar Lampung (HDI Report, 2004). This percentage is relatively high for urban area. However, the water enterprise could not serve consumer for 24 hours services due to limited water debit. Many middle to low income people still do not have access to healthy drinking water provided by water enterprise. With regard for this, water entreprise will build a partnership with private sector to increase water debit so that the enterprise could increase its coverage and serve low income people at affordable price.

Poor sanitation services in urban areas affect economic loss and decrease people quality of life. Bandar Lampung has also sanitation problem like other cities in

Indonesia. It is stated that the coverage of sanitation service was about 69.32 percent in 2008. There is about 30 percent of population still do not have access to sanitation. With regard to this, since 2008 Bandar Lampung city government has been implementing the community based sanitation program (Sanimas) which aimed to develop community based sanitation. Hopefully, this effort become alternative strategy to improve sanitation at community level. In line with sanimas program, there are follow-up activities supported by health agency such as healthy family program and healthy life campaign in order to increase the benefit of the program..

7.1.3 Stakeholder analysis

Stakeholder analysis is aimed to identify roles and responsibilities of each stakeholder and its potential contribution in managing climate change related sector..

Table 7.2. Stakeholder Roles and Contributions for Climate Change

Stakeholders	**Roles, Task and Responsibility**	**Potential Contribution to manage Climate Change Sector**
Pemerintah Pusat		
Directorate General of Water Resources	Formulating and implementing policy and technical standard on water resources through: formulating technical policy, programming and budgeting, policy implementation, water resources management, supervision and technical assistance, investment pattern and financing system development, formulating norm, standard, guideline and manual on water resource and administrative matters.	• Formulating national policy and strategy on water resources and flood management. • Coordinating and facilitating assistance and partnership on flood management. • Providing technical assistance on flood management through national budget.
Directorate General of Human Settlements	Formulating and implementing policy and technical standard on human settlements through formulating policy, programming and budgeting and performance evaluation, technical supervisiom and formulating norm, standard, guideline and manual, facilitating infrastructure development and management, developing investment pattern and financing system, technical assistance and infrastructure monitoring in human settlements sector such as vertical housing, slum and fisherman settlement, water and sanitation, building and	• Formulating national policy and strategy on human settlements sector • Coordinating and facilitating assistance and partnership in livable settlement provision, water and sanitation, building inspection. • Providing technical assistance on settlement development, water and sanitation and building management

Stakeholders	Roles, Task and Responsibility	Potential Contribution to manage Climate Change Sector
	disaster management.	
Bandar Lampung City Government		
Local Development Planning Board	Formulating and implementing local policy on development planning through : formulating technical policy, coordinating planning formulation, supervision and other tasks	▪ Formulating and coordinating planning and programming accross sector and accross region (climate change related sectors) ▪ Facilitating the integration of climate change related issue into development planning ▪ Coordinating and mobilizing financial resources for climate change related program and activities ▪ Monitoring and evaluation of climate change related programs and activities
Environmental Protection Agency	Formulating and implementing local policy on environmental issue through: formulating technical policy, providing assistance on technology development and environmental control, supervision and other task related to environmental issue.	▪ Formulating environmental policy and regulation ▪ Controlling and law enforcement on spatial planning and land use ▪ Implementing environmentl improvement program and activities ▪ Promoting the open green area (30 percent of city area) ▪ Supervision and monitoring on housing and commercial development.
Cleaning and Park Agency	Conducting local government task on cleaning and park sector through formulating technical policy, task administration, supervision and other task related to cleaning and park issue.	▪ Promoting the 3R campaign (*reduce, reuse and recycle)* and public campaign on waste management ▪ Supervision the task force (youth program) for disaster management ▪ Maintaining open green space and coastal management
Health Agency	Conducting local government policy and program in health sector through: policy formulation and program implementation as well as other health program such as community health service, prevent, protect and promote community and family health	▪ Fomulating community health policy and program ▪ Contributing to climate change issue especially on health promotion program ▪ Providing emergency unit and mobile health center closer to community. ▪ Human resources development program

Stakeholders	Roles, Task and Responsibility	Potential Contribution to manage Climate Change Sector
Forestry and Poultry Agency	Conducting local government task on forest and poultry sector through formulating technical policy, task administration, supervision and other task related to forestry and poultry issue.	▪ Formulating program and policy on forestry and poultry ▪ Forestry protection and management
Public Works	Conducting local government policy and program in public works sector through formulating technical policy, task administration, supervision and other task related to public works.	▪ Formulating program and policy for flood management and water supply and sanitation ▪ Developing the appropriate technology to control flooding ▪ Promoting green infrastucture development
Agriculture Agency	Conducting local government policy and program in agriculture sector through formulating technical policy, task administration, supervision and other task related to agriculture.	▪ Formulating program and policy on agriculture-resilience ▪ Rehabilitating water resource system (irrigation for paddy field and water pump) • Mapping vulnerable area
Non Government Organisations		
Mitra Bentala	Providing advocacy to community and developing partnership with local government to promote environmental-oriented development	▪ Providing advocacy on environmental-related policy and program (mangrove, coral reefs) ▪ Increasing community awareness on environmental management. ▪ Promoting local wisdom and action to reduce flooding
Pusbik	Conducting study, research and advisory services to local government on environmental management and providing advocacy to community to increase their awareness on environmental issue	▪ Environmental management at hilly area. ▪ Increasing community awareness on environmental issue ▪ Empowering small scale enterprise to improve economic condition.
Walhi (Wahana Lingkungan Hidup)	Walhi is an NGO that has concern to environmental protection and conservation to support sustainable development. Some focus areas among others are: clean production and	▪ Providing advocacy to local government on environmental issues ▪ Ensuring law enforcement on environmental issue. ▪ Environmental education program to community. ▪ Community-based solid

Stakeholders	Roles, Task and Responsibility	Potential Contribution to manage Climate Change Sector
	liquid and solid waste management, environment education, land conservation and environmental tourism	waste management
Sahabat Lingkungan (Friend of Environment)	Conducting study, research and advocacy to local government and community on environmental conservation.	▪ Providing consultancy and advocacy to local government on environmental-friendly of coastal management. ▪ Increasing community awareness on environmental issues. ▪ Campaign on environmental issues
University		
University of Lampung	Developing partnership with local government to conduct research and development on climate change related issue Providing community services Increasing education for community	▪ Conducting research and policy analysis on climate change program and policy ▪ Providing input to increase community resilience of climate change.

The management of climate change related sector in Bandar Lampung involved various stakeholders with their own roles and contribution. Bandar Lampung city government plays the major roles in managing climate change issue both for financial support and program impementation. Central government provide regulatory framework, program coordination and financial support to local government in managing environmental and climate change issies. Some local NGOS's actively contributed in providing advocacy and program implementation on environmental issues. However, the existing roles and contributions of stakeholder have been partially implemented without any coordination among them. In order to increase program effectiveness, it is needed to improve coordination among stakeholder. Partnership among stakeholder is a requirement to create successful community resilience on climate change.

7.2 Assessment of effectiveness of current initiatives and programs (short and long term) cope with future climate risks

Longterm and Medium Term Development Planning

The planning process at local level are strongly influenced by existing national laws and regulations, it is therefore important to briefly look into the laws and regulations.

- Law No. 17/2003 on State Finance regulates stages in the district-level budgeting process. It said that district budget should be based on district annual work plan (RKPD).

- Law No. 25/2004 on the National Development Planning System primarily provides the legal basis for the interconnected planning system which includes long-term, medium-term and annual development plans, at the national as well as at the local levels, sectoral (per department/ministry at the national level and per SKPD at the local level). The main aim of this development planning system is to ensure that all development efforts in the country are conducted efficiently, effectively and leading toward the realization of stated development targets. The law also affirms that the Government Work Plan at the national level and the Local Government work plan (RKPD) should respectively become the reference for the national annual budget and local budget.

- Law No. 32/2005 on Local Government has the intention to integrate planning and budgeting processes into one low. This law reaffirms the various types of development plans, which include long term plan with a 20 year period, medium term with a 5-year period and the annual plan (RKPD).

The connection between Law No. 17/2003, Law 25/2004 and Law 32/2004 can be theoretically illustrated in the Figure 7.1.

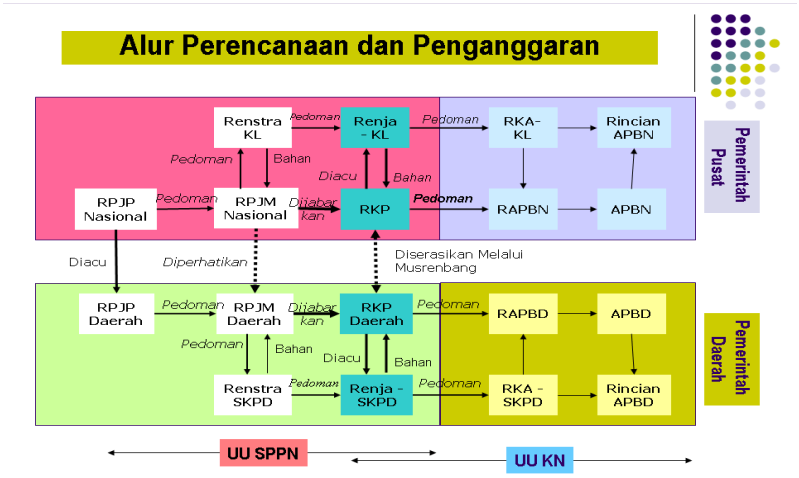


Figure 7.1:Integrated System of Planning and Budgeting at National and Regional/Local Levels

Beside those local development planning and budgeting laws, there are other laws related with spatial management and disaster management which should also to be considered in climate change adaptation planning.

- Law No. 24/2007 on Disaster Management regulates steps need to be taken in disaster management including pre-disaster, emergency response and post-disaster management. The main substances of Law 24/2007 are consisting these following aspects: (i) roles and responsibilities of national and regional/local government in each disaster management stages; (ii) institutionalization at national and regional/local level in disaster

management, (iii) the right of community in disaster management, (iv) the involvement of international organization and business sector, (v) controlling mechanism on disaster management, (vi) sanction mechanism.

- Law No. 26/2007 on Spatial Planning provides policy and strategy to integrate the use of natural resources and man-made resources as well as to protect spatial function and negative impacts on natural environment. The implementation strategy of spatial planning consist of: (i) application of consistent zoning regulation as part of detail spatial plan, (ii) systemic spatial utilization control mechanism through zoning regulation, permit system, incentive and disincentive;, (iii) consistent law enforcement.

On the Bandar Lampung Medium Term Development Plan 2005-2010, the city vision is to achieve the Bandar Lampung community which has a welfare, just, safe and democratic to support good public service. In order to achieve the vision, it is agreed to formulate 9 (nine) missions as follows:

1. To achieve good quality and affordable education based on their strong beliefs;
2. To achive religion life harmony;
3. To improve community health level;
4. To improve good quality infrastructures in line with spatial planning;
5. To create city safe and order and to alleviate social problems;
6. To improve economic development and maintaining community basic needs;
7. To manage sustainable and responsible natural resources;
8. To achieve clean, responsible and participatory governance;
9. To strengthen law supremacy based on democratic justice.

Based on its vision and mission, it was stated five main issues in urban development namely: education, health, people economic, environment, infrastructure and law enforcement and social protection.

In response to disaster management, the Bandar Lampung City Government has formulated a disaster mitigation study in year 2008. The study aimed (i) to map vulnerable areas on disaster, (ii) to analyse natural hazard risk and man-made hazard, (iii) to formulate program and action plan in reducing hazard risk. Beside the action plan, Bandar Lampung city government has established a Local Disaster Management Board in November 2009. The Board has responsibility in preparing disaster management as well as to anticipate the problems related to disaster. Through the existence of this board, it is expected to have quick response in dealing with disaster management.

Some problems and identified strategies on disaster management in Bandar Lampung can be seen in this following table.

Table 7.3.. Problems and alternative strategy in related to development planning and disaster management in Bandar Lampung

Problem	Alternative Strategy
• Less quality and quantity of urban infrasturcture • Uneven distribution of urban infrastructure • Lack of financial capacity on infrastructure maintenance and development • Ineffective spatial planning • High damage of water sheed areas • Uncontrolled mining • Increase surfece water pollution • Lack of law enforcement on environmental damage • Lack of community awareness on managing environment • Lack of solid waste management • There are disaster hazard (landslide, flooding, earthquake, tsunami)	• Improved quality and quantity of urban infrastructure • Improve quality and quantity of public building • Improve urban fringe area infrastructure • Improve transportation infrastructure • Improve controlling on urban spatial utilization • Rehabilitate natural resource and environmental protection • Improve pollution control and environmental damage • Increase community acces in empowering and natural resource empowerment • Improve natural resource protection • Rehabilitate damaged environemnt • Improve solid waste management •

Programs and Activities that related with Climate Change

a. Programs and Activities from Local Budget

Climate change involves various sector and activities. The assessment of climate change program and initiatives at local level is based on sectoral data. There are several sectoral which can be classified as climate change related sector in Bandar Lampung such as health, environment, public works, planning and fishery and marine. Some programs and activities related to climate sector for each sector are as follows:

Table 7.4. Programs and activities related to climate for each sector

Health sector	Health promotion and community empowerment, healthy environment, access for poor people, prevention transmitted diseases, etct
Environment	Pollution control and environmental improvement, natural resources protection and conservation, solid waste management, green open space management, etc
Public works	Drainage system improvement, flood control, control over spatial planning, regional development and natural resource improvement, etc
Fishery and marine	Coastal area mitigation
Forestry	Forest and land rehabilitation

In 2008, Bandar Lampung city government allocated IDR 11 Billion (equivalent to USD 1.2 Million) for climate change related activities in five sector. Compare to total local budget, both for routine and development expenditure, the percentage of the budget that allocated by local government for climate change related activities was only about 1 percent of total budget. Public works sector allocated about IDR 8.8 Billion (9 percent of its budget) for some programs and activities related with climate change. Then health sector allocated almost IDR 3.2 Billion, and environmental sector is about IDR 2.2 Billion. For forestry sector, there was central government fund provided throuh task assistance in 2008 which amount of IDR 1.5 Billion especially for forest and land rehabilitation.

Table 7.5. Budget Related to Climate Change 2008

Sector	# Budget Realization (in IDR Billion)		%
	Total budget	# Related to CC	
Health	21.9	3.2	15
Public Work	99.7	8.8	9
Environment	3.3	2.2	66
Planning	4.5	0.1	2
Fishery*	5.6	1.5	27

*Source of budget from central government technical assistance

b. Program and Activity from Central Government

Central government also contributed to the improvement of environment in Bandar Lampung. Some programs have been implemented in the City such as NUSSP and PNPM Urban. The implementation of these program need contribution from local government.

As the central city of Lampung Province, City of Bandar Lampung became a magnet for community surrounding the area to come to the city. Rapid urbanisation without appropriapte service provision support has created problem to the city including the growth of slum areas.

In order to address the problem, city government has been participated in the *Neighbourhood Upgrading and Shelter Sector Project* (NUSSP), funded by *Asian Development Bank* (ADB), The project is aimed to assist local government in reducing the number of urban poverty through partnership development among government, private sector and community. The NUSSP has built neighbourhood infrastructures and facilities such as local road construction, solid waste management, water supply, drainage system, community toilets and street lighting. In total, there were 142 hectares of slum areas have been upgraded with the number of beneficiaries reached 12.000 household.

Project financing has been done through cost sharing from ADB loan and local government budget (60:40). The cost sharing is based on local government capacity. Table below show the cost sharing between two parties:

Table 7.6.. Cost Sharing in NUSSP Project (in IDR Billion)

	2006		2007		2008	
	ADB	LG	ADB	LG	ADB	LG
	4.38	3.2	2.6	1.7	5.9	2.5
Total	7.6		4.3		8.4	

Another program that contributes to infrastructure improvement in Bandar Lampung is Program PNPM Mandiri Urban. The involvement of the city in this program is to improve urban infrastructure in the city. In 2010, PNPM Mandiri Urban is implementing in 13 locations with total budget allocation is about IDR 18.5 Billion (or equivalent to USD 2 Million). The fund is coming from central government (IDR 15.5 Billion) and local government (IDR 3.17).

7.3 Assessment of Local Government Capacity and Institutional to Integrate Climate Change into Development Planning

Although, local government is the main actor in managing city-climate hazard, but the role of other stakeholders are also important. It is important also to know the capacity of local government and its institution to integrate the climate-change issue into development planning. There are at least 6 (six) aspects will be analysed including the role of stakeholder, existing laws and policies, the availability of planning document, institutional capacity, financial capacity and program implementation. This following table is summarized the analysis result.

Table 7.7: Assessment of Local Government and Institutional Capacity to Integrate Climate Change into Development Planning

Component	**Strenght**	**Weakness**
The Role of Stakeholder	• There is stakeholder involvement • There are national program supported by international donors (such as PNPM dan NUSSP)	The roles and contributions of stakeholder are still partial and not yet integrated into policy
Existing laws and policies	▪ There is a law required the local government to formulate planning document which considering disater mitigation and adaptation and climate changes	Lack of understanding on how to formulate operational strategy in order to elaborate the required-aspect of the law into planning document
The availability of planning document	• The next mid-term plan will be formulated and also the draft of spatial plan is on-going revision – this is an opportunity to integrate climate-change issues as well as disaster management into planning documents • There are disaster mitigation	- Not all stakeholders understand and have capacity to formulate disaster adaptation and mitigation and climate change resilience planning - Disaster management

Component	Strenght	Weakness
	studies	action plan is not yet formulated (so that there is no legal document for disaster management)
Institutional Support	• Establishment of City Team for ACCCRN project • Local disaster management board has established	Disaster management board is not effective yet
Budget capacity	• There is commitment to support for climate change program. • Budget-support from central government through decocentration and task-assistance • International donor support	• Limited budget allocation for climate-change related activities (1% of total budget) • Lack of coordination among agencies lead to program duplication and overlapping
Program implementation	• Program and activity has done and implementing by stakeholder	Lack of coordination accross sector and accros-region

In terms of stakeholder involvement, there were some donors supported project have been implemented in Bandar Lampung such as NUSSP and PNPM Mandiri Urban. These projects have been provided benefits for local people in improving urban infrastructures and facilities. It is also shown local government commitment to finance a partnership project.

Related with law and regulation, it is clearly mentioned that the planning document should consider disaster mitigation and adaptation and climate-change issue. The problems is local government doesn't have capacity to elaborate the aspects into planning document. It needs the technical assistance and capacity building program to improve the understanding and capability of local government officers.

In 2010, the Bandar Lampung City Government will formulate a new medium term development plan as resulted from the direct election which will be taken in June 2010. This is a good opportunity to integrate the climate change aspect into the document, so that it can be legally-binding. It needs political commitment and comprehensive understanding from the City Team to introduce the issues.

Related with institutional capacity of local government, there are some strengths related with the establishment of city team, central government and donor support on financing opportunities and some project implementation done by stakeholders. While in the weakness are mostly related with the need to have better coordination across sectors and across regions in order to reduce the ineffectiveness project implementation. It is also pointed out the need to strengthening the City Team as champion to introduce and to integrate climate-changes issue into local planning document.

Based on facts mentioned in previous section, there are some findings which can be conclude as follows:

- In relation to spatial planning and disaster management
  - RTRW Kota Bandarlampung is now on going revision and there are rooms to provide inputs on climate change issues
  - Some normative subtance on Public Greean Areas and disaster mitigation.
  - Local Disaster Management Board has been established in November 2009, although the board is not yet effective on program implementation.
  - There are some infrastructure program response to climate change (such as PNPM Kota Bandar Lampung), construcion of irrigation network, etc
  - The spatial planning formulation mentions the need of green open space (30%);
  - There are community based program on environemnt (PLBK)
  - There are non governmental organization involvement in environmental management

In order to improve the urban resilience planning related to climate change, there are some steps need to taken as follows:

- Strengthen capacity of local government in integrating climate change into long-term development planning. Strong scientific works on climate change scenarios and climate change impacts in Semarang City will be required to assist local government in developing horizon plan of adaptation[5] to climate change. Technical assistance and capacity building program for local government officers is required to enable them in developing horizon plan of adaptation.
- Integrate climate change adaptation framework into City of Bandarlamung planning and spatial planning document
  - ✓ Set up methodology and substance for developing and revision of City Spatial Planning RTRW) with climate change issues and impacts
  - ✓ Set up methodology and substance for Medium Term Planning (RPJMD) of City of Bandarlampung related to climate change issues and impacts
- Increase stakeholders (government, community and private) understanding and concern about climate change through shared learning, communication strategy and capacity building program;
- Increase community resilience on climate change through finding and developing several efforts and local wisdom through climate change adaptation pilot project

[5] Horizon plan of adaptation relates to the lifetime of decision-making associated with a particular activity – how far into the future is it planned. Thus it is the period of time over which a particular adaptation program is planned to be implemented (Jones et al., 2004).

CHAPTER 8: ADAPTATION ACTION PLANNING

Adaptation is a quality that enables oneself to change or to change one's surroundings in order to become better suited for survival. It is a key component of resilience, the more adaptive a person or people the more they are able to cope with changes which may happen to them. From the Community Based Vulnerability Assessment, we look at not only existing adaptations that communities and individuals have developed, but also at the potential for future adaptation in times of stress. Again this is a speculative study but one can discern a capacity for adaptation by seeking to identify those qualities and capacities people may have to adapt.

Survival in the urban world of developing countries is not for the weak. Considering that many who move there may have been born in countryside surroundings, more used to natural cycles, plentiful agricultural production and ages old activities which may require little or no schooling, moving to the city presents a wholly different set of challenges. Thus for migrants to the city life is fraught with adaptation and survival strategies, to a market economy, to constantly shifting opportunities, to unpredictable events that are out of one's immediate control. The urban poor demonstrate that they are amongst the most adept at developing adaptation strategies as they seek to consolidate themselves in an often hostile urban context that many are unfamiliar with and initially unequipped to thrive in. It is thus necessary to challenge our notions about who and what is adaptive since we are not simply discussing vulnerability, but the capacity to adapt in times of challenge. The simple existence of such large numbers of poor, finding a living, housing, building communities in often the most challenging places is testament to a high adaptive quality.

Adaptation strategies will be assessed through the optic of their capacity for resilience to climatic phenomena, but they are in no way merely limited to responding to physical risks such as flooding. Since adaptation cannot eliminate extreme weather risks I look at ways in which impacts are limited, either by responding to them, or preparing for, them adequately. We look initially at the multiplicity of different ways in which communities in each city have developed adaptation strategies, what they are and what contribution they make to increasing resilience. Then we seek to extract lessons and factors that may contribute to each of these strategies being viable and successful.

8.1. Adaptation Strategies

Below are described some of the different adaptation strategies that have been observed in the communities studied during the Community Based Vulnerability Assessment. While they all relate to adaptations to severe climate events they also relate to survival adaptations borne by the need to adapt and survive in the city. These two ideas are very much interlinked. Beneath the list an analysis is performed to gather lessons about what makes these adaptations viable, what are factors that may contribute to determining their success, as well as any constraints and opportunities. Another table also describes the ways in which such adaptations contribute to disaster response, preparedness and resilience.

- Progressive reclamation of land: The coastline of the Kangkung community has been progressively reclaimed along the years by the accumulation of a mixture of

earth and trash. As a result many homes once perched above the water are now on solid ground. However this process actively promotes the dumping of trash in the water and on the shore, often by creating little barriers of rocks and then filling the area within. The accumulation of trash attracts pests (rats and mosquitoes) leading to unsanitary conditions and a high incidence of malaria. This adaptation to the landscape does increase the permanence of homes by reducing the need to replace posts exposed to water and high maintenance costs, as well as improves the chances of installing local services and increasing access.

- Structural improvements and infrastructure: In some areas of Pasir Gintung local residents have taken the initiative to build structural improvements in their

communities without waiting for local government to have to build them. The residents along the riverbanks for example have erected a small wall (about two feet in height) in order to prevent water spilling into their homes during all but very high flooding conditions. Money is collected from neighbors and the labor is carried out by the residents themselves. While a piecemeal and limited infrastructure barrier it is effective and responsive to their needs.

- **Increasingly resistant housing:** In the fishing communities of Kota Karang and Kangkung there have been many incremental architectural adaptations to homes in order to make them more resistant to the destructive effects of the sea. For example in Kangkung many of the fisherman's homes that are built on wooden posts have had these posts reinforced with concrete 'jackets'. This prevents their continual exposure to seawater and thus reduces the need to replace them every six months. This can be done incrementally (not necessarily all at once) and given the financial means available to the family.

- **Living above the water:** Families that live above the water such as those in Kota Karang are adapting to the economic necessity of access to employment, markets, opportunities and services, and lack of access to land. Many of them come from different cities, even different regions of Indonesia, and their adaptation to the new city takes the form of adaption to challenging physical and environmental conditions in order to secure necessary economic conditions.

- **Gradual consolidation of neighborhoods:** Urban poor communities such as those within Kangkung (Lingkungan 2) and Pasir Gintung (Lingkungan 2) have been able to consolidate their neighborhoods and thereby reduce their vulnerability by the incremental improvements. Even without secure land tenure, sustained investment by city government or large amounts of capital over a number of years local communities have been able to progressively improve drainage systems, build retaining walls and steps, and install water pipes. This has reduced the incidence and risk of landslides, flooding and coastal erosion, although not completely eliminating these risks, but demonstrates the community's capacity to deal with climate change risks alone with modest projects and not relying on large scale ones.

- **Housing on stilts**: In some communities such as that of Kota Karang along the river banks houses are built on stilts, even although they are on dry land. This is not necessarily an adaptation to specific climate risk, it is a Bugis tradition by these Bugis migrants, but does allow for the storage of large items (such as for vending carts and construction materials). It also allows for seasonal flooding not to affect

their homes and thus helps reduce vulnerability to loss of assets given unusually high flooding. It is worth mentioning however that as some Bugis people prosper in the city they decide to adopt conventional housing models (which start at the ground level) and thus lose their adaptive architectural attributes as they acculturate to their urban surroundings.

- **Water harvesting and animal husbandry:** Families with scare water and food resources collect water run off from their roofs for cleaning activities and sometimes bring up animals (chicken, hens and even goats) to supplement their diets. These families incidentally live on houses on stilts above the sea, where space is scarce (in Kota Karang and Kangkung). Adapting to socio-economic needs, lack of services and limited space this is an alternative that helps them economize on their spending and water use while allowing them to be self sufficient. Collecting water means that they are less reliant on a government water delivery system that doesn't serve them, a reactive survival measure.

- **Ability to access cash through credit and fungible assets:** A well used survival strategy, both for every day survival as well as following extreme weather conditions and disasters is the ability to access resources. Families often need to access funds to supplement their incomes and do so by taking out credit from informal lenders or from local shops. Other ways are to sell off assets such as televisions and motorcycles to raise money in the event of an emergency or need for instant cash, or to participate in community savings groups (*Arisans*). This lets them bounce back from periodic cash flow crises by having fungible assets handy or people and informal institutions from which to access resources. These institutions are characterized for their informal nature, not involving bureaucratic processes or deposits, but do imply higher interest rates and reliance on one's reputation in the community.

- **Community collaboration projects**: Communities collaborate in order to improve their surroundings by contributing their days off to community projects such as clean ups and building retention walls. Such projects in the community of Pasir Gintung serve to clear drains that helps ensure that drainage water does not become hazardous or overflow gutters damaging homes and property. This is known as *gotong royong* and requires a consistent and coordinated collaboration between different groups and areas of an area. This can be a challenge since some areas may be more dedicated than others in their community clean ups, with a failure to clean drains in one area upstream adversely affecting other areas downstream.

8.2. Lessons Learned from the Communities

The adaptation strategies identified above offer us an insight into understanding what exactly determines viable and successful strategies. For these strategies to have been developed and implemented they must have been made possible some how, so what factors have made them possible, and why has the community chosen these ones? Although a comprehensive analysis can only realistically be made in the wake of a severe climatic event we can glean clues that allow us to identified factors which contribute to good and effective adaptation strategies. Below are some of the common qualities that seem to be present in the adaptation strategies listed above:

- **Quite simply 'they work'**: The adaptation strategies above are a very practical response to the overriding threats and realities of the populations studied. Their responses have been developed because they work for them, not because they sound like good ideas or have potential. This is a very important point to recognize, success may not necessarily be defined as having large scale impact, what is more important is that in a very practical sense these adaptations have real bearing and effect on their everyday lives.

- **They are inexpensive and work with what materials are available:** Adaptation

strategies may take time to develop, so they develop by a consistent application of time and resources, and for the urban poor resources are scarce. Evolution is almost always incremental and from inexpensive, or free, materials. Such examples include the scavenged housing materials from a nearby scrap heap, or even community savings groups that collect very minimal amounts. These are what people can afford and that make sense to them.

- **Accessible in times of need:** Adaptation strategies also have to be accessible when you need them the most, in times of distress. In order to raise capital to recover from a flood a family may sell their television, motorbike or other fungible assets, rather than go through a bureaucratic process of applications that might imply lengthy paperwork. Generally in the city people want access to resources quickly and this is a very important characteristic of adaptation strategies that work, they are easily managed and accessed.

- **They don't rely upon big government projects or interventions:** In a country in which government resources are scarce and response may be lacking urban poor communities do not wait for government to save them. They save themselves. Thus they have developed reliance upon community organization and initiatives that better respond to their needs within their own means. While government intervention is appreciated and instrumental local self-reliance seems to be a key characteristic of adaptation strategies.

- **Adaptation to severe climate events must work together with other adaptation**

strategies: Those most affected by climate change may not know or care to plan for it if it doesn't benefit other aspects of their lives. Since the urban poor have a very practical outlook those adaptations that are successful for them are those that work with other strategies that they are concerned about, such as health, housing, education and livelihoods. If something can make them safer and also deliver on making them wealthier then that is what they are likely to seek. Safety for its own sake is not a motivating factor, but when other benefits can be derived then the solution becomes workable.

- **The whole is greater than the sum of the parts:** Many of the adaptation strategies are successful because they harness the collective efforts and strengths of people. They are rarely individual efforts. There is not only a willingness to work together but an affirmation that by doing so the outcome will be better. People are concerned about each other and when this concern translates in collective action the results can be significant.

- **Leveraging government support leads to better results**: When communities are able to work together with local and city government (and vice versa) adaptation strategies seem to have been successful. For example community investments when matched or leveraged with government investments were able to make a significant and lasting impact on the neighborhood's conditions.

- **More access to information can lead to better outcomes:** Vulnerable communities have to constantly evaluate their situation, be it economic, housing or health. Adaptation strategies that can help them to have more access to information and thereby make better decisions about their situation will lead them to better outcomes. At a very simple scale the knowledge of different savings groups or different interest rates from local lenders can greatly increase their economic options and reduce their vulnerability. Urban poor communities are usually isolated and so successful adaptation strategies seem to increase access to information.

8.3. Pilot Project in Bandar Lampung as Adaptation Action Planning

Bandar Lampung are looking for pilot model to test the approach that can contribute to city resilience planning. Pilot activities test innovative and potentially replicable interventions to enhance climate resilience. During the engagement phase of this initiative that there will be significant opportunity to implement small scale projects prior to the development of multi-stakeholder city level climate change resilience action plans.

The objectives of pilot implementation are:

- To prepare for climate change impact at the city level
- To engage city level stakeholders (city government, NGOs, universities, CBOs, private sectors, community groups)
- To implement the pilot projects that test climate change resilience strategy
- To test the adaptive capacity of the community

The subject of pilot project implementation is vulnerable people who affected by climate change impact. The beneficiaries are women, children, elderly and men, both in terms of increased awareness, increase local capacity, influence local policy etc. The activities of pilot project should also meet or in line with these criteria:

1. Replicability
2. Addressing current and future risks
3. Benefit to local community
4. Innovation
5. Collaboration
6. Scalability
7. Sustainability Strategy

There are some additional criteria that should be conducted by the implementer of pilot project:

- Implementation of pilot project has to be related to the local problems at local administrative or cross border administrative communities on issues of environment, health, education, social, economy in which related to the impact of climate change.
- Implementation of pilot project directed for adaptation and response effort activities to the impact of climate change, such as: erosion, flooding, drought, landslide, and etc.

Below are the selected pilot projects in Bandar Lampung:

The 1st Pilot Project in Bandar Lampung: Participatory Design of Adaptation of Community Resilience in Kangkung and Kota Karang Sub-district, Bandar Lampung City to Climate Change by Lampung Ikhlas – Local NGO

Lampung Ikhlas is an open and independent association working on field of building solidarity between society of natural disaster victims and for humanity. Founded on 26 December 2004, Lampung Ikhlas has been actively implemented activities related to disaster emergency response, voluntary program, and etc. And as a response to the local problems in Bandar Lampung City because of the impact of climate change in sectors of environment and water availability, they have been selected as pilot project implementor in both Kangkung and Kota Karang Sub-district. Lampung Ikhlas project title is: "Participatory Design Adaptation of Community Resilience in Kangkung and Kota Karang Sub-district, Bandar Lampung City to Climate Change".

The objective of the project is "to increase understanding, awareness, and participatory involvement of the community in order to build adaptive capacity to the climate change impacts". Further, the targets of the project are:

1. Building understanding and implement program activities for society in Kangkung and Kota Karang Sub-district to the impacts of climate change (within social, economy, and sustainable living sectors).
2. Increasing community capacity to adapt with climate change.
3. Increasing awareness of community in Kangkung and Kota Karang Sub-district to climate change.
4. Help to increase community living standards in health sector, household economic resilience, environment management, and adaptation to climate change.

The subject of the program activities are vulnerable community groups that impacted from the climate change events in coastal area of the program: Kangkung and Kota Karang Sub-district. The beneficiary communities of the program are: vulnerable communities to climate change, including women, children, adult male especially from fisherman family, poor family, and others; in terms of increased revenue, improved health status, convenience, and increase knowledge. Implementer of activities is groups that already exist within society.

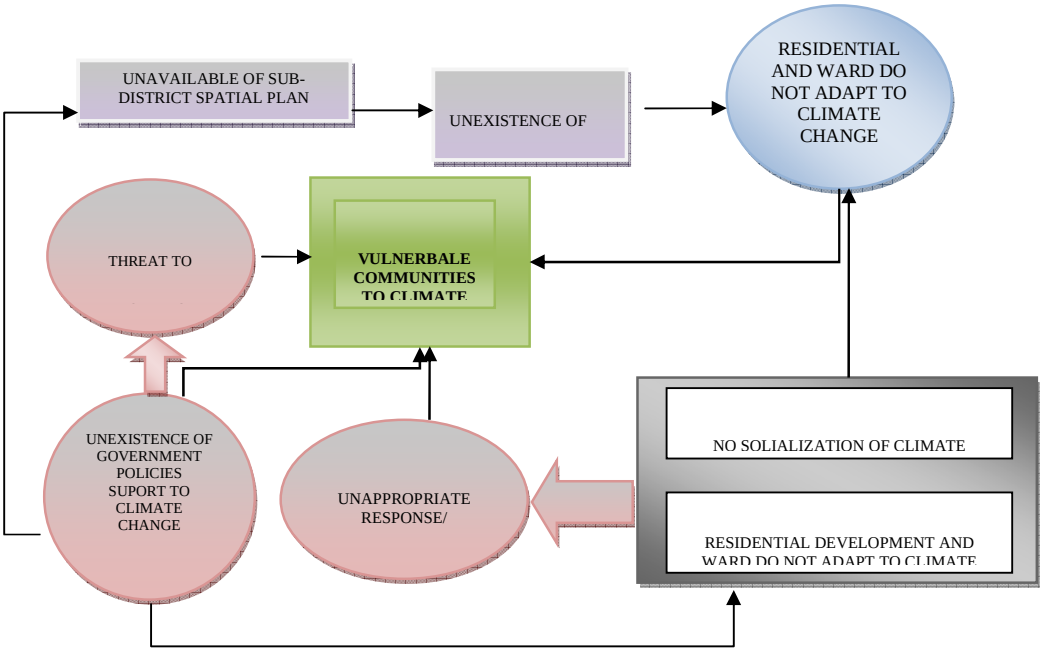


Figure 0.1:*LFA Problem Analysis*

Furthermore, the project activities are including:

1. *Program Socialization*: to build voluntary involvement motivation of local community in implementing the project;
2. *Survey*: to gather data and information of the area and problems in supporting the success of the project;
3. *Focus Group Discussion* (FGD): to build togetherness, readiness, and willingness of community in order to adapt with climate change;
4. *Waste Management*: increasing community awareness and capacity to solve the problems of health related to the climate change event impacts, and increasing income through waste recycling training, organic fertilizer training, trash painting contest, and provision of waste recycling facilities activities;
5. *Clean Water Provision for Household*: increase community capacity, solve the problems of water shortage as an impact of climate change events, and build water management groups through brackish water filtration training and creating brackish water filtration installation activities;
6. *Media Campaign*: to socialize climate change impact in order to build community resilience through the creation of leaflet, sticker, poster, calendar, and banner ; and
7. *Documentary Film Making*: to explain the stage in the project activities.

The 2nd Pilot Project in Bandar Lampung: Capacity Building of Panjang Selatan Sub-District Society to Cope With Climate Change by Mitra Bentala – Local NGO

Mitra Bentala founded on 9 April 1995 with a vision to creating "the sovereignty of coastal marine communities and small islands of Lampung in the management of resources in a democratic, equitable, and sustainable". Since established, Mitra Bentala has been involved with government, local NGO, educational institution, privat sector, and society in numerous coastal and small islands activities related. And as a response to the problems of climate change event impact in *Kelurahan* Panjang Selatan, Mitra Bentala has been selected as pilot project implementor in Panjang Selatan Sub-district. Mitra Bentala project title is: "Capacity Building of Panjang Selatan Sub-district Society to Cope with Climate Change".

The objective of the project is "as an effort to strengthen the capacity of communities in an effort to increase community resilience of Panjang Selatan sub-district to climate change".

Further, the targets of the projects are:

1. Short term period:
    - Increasing the capacity of the community through active involvement and improving knowledge of climate change adaptation efforts;
    - Build public awareness in understanding and solving problems related to climate change impacts; and
    - Adaptation efforts to climate change through waste management, provision of drinking water refill, and rehabilitation.
2. Long term period:
    - Encourage the formation of community groups in the adaptation to climate change;
    - Encouraging the creation of collective support for the implementation of adaptation to climate change in Panjang Selatan Sub-district; and build capacity adaptation to climate change.

The beneficiary communities of the program are: community in 3 wards of Panjang Selatan Sub-district along side the coastal area up to the hill, especially for vulnerable communities to climate change, including fisherman family, poor family, female headed family, and others.

Furthermore, the project activities are including:

1. *Socialization*: program socialization in sub-district level and group discussion in ward level;
2. *Waste Management*: waste management training, establishment of waste management group, and provision of waste facilities activities;
3. *Rehabilitation, Natural Resources Education, and Vigilance to Disaster*: natural resources management education, eco-feminism education, rehabilitation (tree planting), and making disaster evacuation route and maps;

4. *Installation of Drinking Water Refill*: installation of drinking water refill training and provision of drinking water installations refill;

Campaign: documentary film making and creation of poster, leaflet, and t-shirt.

THINKING FLOW OF ACTIVITIES

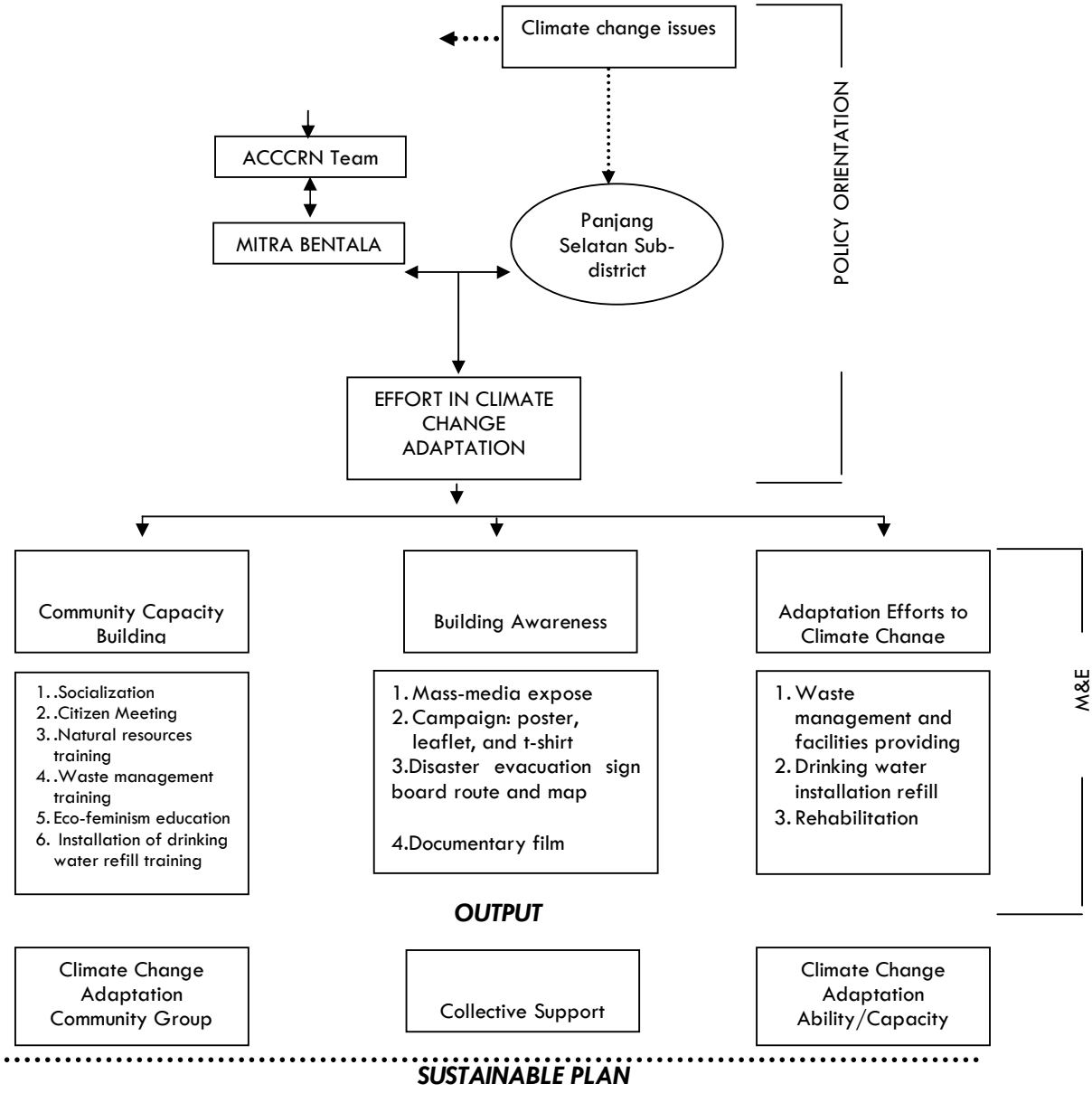


Figure 0.2: *Thinking Flow of Activity*

Pilot projects are necessary to help local government to better understand how climate change will impact communities and sectors, how current capacity has to be strengthened and spatial plan to be improved to form climate change-resilience city and how to use the good lesson learnt from pilots in designing long term policies and strategies to address climate change.

8.4. Adaptation and Resilience

The following table attempts to categorize how the abovementioned adaptations may be understood (i) as contributing to resilience, and (ii) by reducing the impact of climate events by facilitating disaster preparedness and disaster response. It is in this way that adaptation strategies can build resilience, by preparing in advance they can help reduce risk and/ or facilitate a response that allows them to bounce back and recover.

Constraints and opportunities to strengthen adaptive capacity:

Below is detailed an analysis on what the existing factors that adaptation depends upon, what are the constraints that may exist that limits it occurring and what are the opportunities that currently exist in the studied communities that can provide a basis for further progress in building resilience.

What are the factors upon which adaptation may depend upon?

Money	Lack of access to capital may limit capacity to make investments.
Capacity levels	Lack of ability to adapt to different conditions.
Understanding	Necessary to learn about adaptations and threats and how to respond.
Access to information	Information can empower by giving tools to access knowledge and resources.
Collaboration and engagement w/ local government	Marginalization from decision-making can exclude from access to information, resources and tools necessary to adapt effectively to different conditions.
Migration and growth rates	Overburdened capacity can limit the ability to be flexible and cope with change effectively.
Public service delivery	Ability to develop can hinder or stimulate development and adaptation.
Mobility	Physical access to resources, information and tools depends upon physical access

What are the constraints to developing adaptive strategies?

Information	Urban poor communities have less access to information so are not as informed about changes and opportunities in their environment.
Access (political, economic and physical)	Disadvantaged communities often suffer from isolation, physical, economic and political, which reduces their opportunities
Capital (both from local population and local government)	With adequate resources vulnerability can be greatly reduced and open up many possibilities for adaptation. Lack of local investment (by government and by the population) hinders the development of alternatives.
Community collaboration	Lack of community collaboration and cohesion can undermine collective processes and projects, and can diminish

	the voice that a community has in making claims.
Institutional + jurisdictional collaboration	An inability for local governments to coordinate their actions institutionally (between different departments) and in space (across different jurisdictions) can hinder the effective implementation of programs, projects and initiatives that could assist adaptation strategies (eg. offer quality health and water services).
Natural resources	A lack of natural resources can hinder the capacity to adapt by limiting the tools accessible to develop changes and adaptation strategies, or make it much more costly.
Dependence on outside factors that cannot be controlled	Economic futures are not determined by local dynamics and factors, they occur in different cities and far off countries. Much of the livelihoods of local population depend upon factors that are out of the control of local populations.

What are opportunities present?

Existing cases that exist and work	There are many adaptations currently being used and developed within the study sites that can be shared and their benefit spread. They have already proven useful and effective.
Possible social networks of people in similar situations with know how	Pooling of collective knowledge can help to assist adaptation strategies by opening up access to social capital, information, tools and potentially political influence.
Local level neighbourhood government	Many local governments are very keen to assist their populations, have skills and willingness to improve the conditions that can lead to adaptation. Good will should be harnessed and encouraged.
City and national government programs (e.g. PNPM)	Existing programs and policies at the city and national levels are designed to improve conditions for local residents but they often are not articulated with local initiatives. If understood and better coordinated they can assist adaptation strategies.
Materials and know-how from industries and economic activities	Existing economic activities can serve as resources and political support. Not only are many residents currently employed giving them know-how, they also use left over resources, and gain valuable financial income from them. Politically they could be a powerful ally.
Local leadership	Local study communities demonstrated strong leadership, a quality that is essential to bring about change and ensure resilience.
Community cohesion	Communities also demonstrate high levels of collaboration and cohesion making collective projects possible.
Local civil society organizations	The existence in both cities of local civil society organizations indicates that there are human resources that can contribute to social change processes that assist communities with which to collaborate with.

8.5. Specific Ideas to Strengthen Adaptive Capacity

The strategies and projects below offer a few possible ideas as to how to strengthen adaptive capacity in Bandar Lampung. A preference has been given to know-how and experiences that are already being the practiced within the study sites. Lessons can be easily learned and transferred from such cases since (i) they are already proving themselves as workable and (ii) they would be more easily introduced from communities and groups which come from a similar context rather than brought in from outside agents. Other ideas look to capitalize on the lessons learned and address specific issues related to vulnerability in the multiple dimensions in which it presents itself.

- Invisible cities, making them visible: In the case of certain hitherto unrecognized or undocumented communities, such as the newly arrived migrants of Kota Karang, a community level census and survey would help to document exactly what needs these people may have. As yet there is little appreciation or understanding of these people's needs or conditions. Local government may not feel the need to provide them with services or enter into dialogue with them since they are not aware of the scale or nature of this need. They conveniently occupy an ambiguous invisible space. By better documenting these areas local neighborhood-level government could have a better idea about what services are necessary (how many people need access to a health center, or pupils in a classroom) and as a result could receive budget corresponding allocations.

- Adaptive reuse: There are already many resources that come to local urban poor communities that can help bolster resilience but yet are not fully taken advantage of. Cases of adaptive reuse are already evident in the study sites: reusing trash to reclaim land on the coastline in Kangkung and harvesting water from the roofs of homes above the water in Kota Karang are two examples of the ways in which 'free' resources can be given additional uses. One idea would be to utilize the empty water drums (in abundance in coastal areas like Kota Karang) to harvest run off water from rooftops in Pasir Gintung. This would help to provide an alternative water source for non-consumption activities and also be a temporary sink for run off to reduce flash flooding.

- Subsidies: Given the precarious economic situation faced by urban poor communities certain social services are simply out of reach. Government could assist by subsidizing access to these services to ensure that the urban poor can benefit from them. Subsidies for education and water would help bolster resilience and reduce vulnerability in many urban poor communities. A connection subsidy would help significantly lower their costs. In the fishing community of Kangkung almost all children above twelve years are pulled from school, their parents unable to afford sending them to high school and needing them to work. If an education subsidy could secure their retention in school until they finish high school they could access a whole range of employment in the city and not rely exclusively on fishing related jobs.

- Sharing community narratives + networks: Many urban poor communities live a very isolated existence in which they are often unaware that their realities are very similar to other urban poor communities not far away, in the same city. This denies them the opportunity to share information between themselves, learn from each other

and build social networks that could build resilience. By encouraging exchange and meeting of communities could encourage the formation of social networks, sharing of information and learning.

- Low cost financing of incremental housing improvements: It is evident that urban poor residents can improve their own housing conditions and thereby significantly reduce their vulnerability to climate risks. Incremental, small scales changes help to gradually build more robust and resistant homes and stay within limited budgets. Houses on stilts in the Kota Karang community have wooden posts strengthened by concrete one by one, making them less susceptible to waves and erosion. By making accessible financing available families can purchase materials and slowly improve their homes by themselves, not waiting to rely on government projects or the accumulation of large amounts of savings. Small improvements, such as better roofing for example, can significantly reduce vulnerability in a place that is prone to cyclones and heavy winds.

- Neighborhood Vulnerability Index: A number of communities have been identified as possessing qualities that make them highly vulnerable to climate change. Through progressive investments in projects and improvements some of these qualities can be reduced over time and thereby reduce the neighborhood's vulnerability. It would be useful to see how progress is being made over time, this would allow groups to know what strategies are working and what areas needs more targeted assistance. By compiling a database which can monitor progress in time and space the neighborhood would have a gauge of how it is doing to reduce its vulnerability, and how it may compare to other areas in this regard.

- Detailed maps for local neighborhood government use: By keeping detailed maps at hand that identify assets, populations and categorize hazards they can better prepare for a climate related disaster, such as for example setting up early warning systems. Such maps would be also be a vital resource for disaster response: in the event of a landslide for example as they could provide an instant database of community assets from which to launch a rescue or reconstruction initiative. Access to information, in a clear and accessible format is essential to reducing vulnerability and strengthening resilience; maps and a community database can help provide this.

- Alternative social safety nets: At the moment there is little in the way of a consolidated policy which serves as a social safety net disaster for those families whose homes and property damaged are extreme weather event which leaves. Local government can only provide scarce resources that are generally described as insufficient. Affected communities end up relying upon private foundations and charity, or their own survival skills, such as in the case with the flooding in Pasir Gintung. However other social safety nets could be explored which may keep in store resources in reserve. A city warehouse that could collect and hold items, or a bank account that could store donations, are possible models that put away resources in a fund for future events. A city Task Force would be charged with managing such a fund and determining its use..

Table 0.1: *Adaptation and Resilience in Bandar Lampung*

Adaptation	**How does it contribute to resilience?**	**Dimensions it impacts**	**Preparedness**	**Response**
Progressive reclamation of land	Reduces the impact of waves on housing structure, lower costly housing costs, safer area to circulate and build on.	- Economic - Physical - Housing	Yes	No
Structural improvements and infrastructure	Increases access to services (water), circulation and reduces the threat of landslides, flooding and health epidemics.	- Physical - Health	Yes	No
Improving housing incrementally	Increases the durability of homes and their capacity to resist shocks, reduces economic costs, creates lasting investment.	- Economic - Physical - Housing	Yes	No
Living above water	Provides low-cost access to economic opportunities, cheap housing alternative and first rung on migrant ladder.	- Housing - Economic	No	No
Consolidation of neighborhoods	Increases social capital due to collaboration and often political mobilization due to collaboration with government.	- Social - Political	Yes	Yes
Raised housing	Allows families security from seasonal floods, gives storage space and provides refuge.	- Housing	Yes	Yes
Water harvesting	Provides additional source of water to supplement scarce water supply.	- Water - Economic	Yes	No
Access to credit and cash	Allows for purchase of goods + materials that can support survival strategies and lend economic flexibility.	- Economic	Yes	Yes
Community collaboration	Increases interconnectedness of social network and unity of neighbors can facilitate projects and action.	- Social	Yes	Yes

CHAPTER 9. CONCLUSION AND RECOMMENDATION

Based on historical data, it was clear that climate of Bandar Lampung City has changed. The most tangible evidence can be seen from the increasing trend of mean surface temperature over the last 100 years in the city. The change in seasonal rainfall was also found in the historical data, indicating a shift in the monsoon onset and a change in the frequency of extreme rainfall. Global warming due to the increase of CO_2 concentration in the atmosphere under SRESA2 and SRESB1 scenarios will change future climate of Bandar Lampung City. Wet season (DJF) rainfall may increase slightly in the future, while the dry season (JJA) rainfall might decrease. However, further studies to refine climate change scenarios in Bandar Lampung City using regional climate models and statistical downscaling is necessary.

Impact of extreme climate event were analysed in terms of four major hazards: flood, drought, landslides, and sea level rise. In general, flooding usually occurs in locations with lower elevations in coastal areas or basins, or in places with poor drainage system (non-coastal areas). While erosion and landslides occurred in the hills/mountains that has a high slope. Floods provide the greatest impact on the residential sector, transportation, and health, agriculture, fisheries, drainage and infrastructure. Meanwhile drought affects drinking water sector, health, agriculture and fisheries. Social impacts caused by floods and drought can be seen from the social relations/kinship, labour relations, production and transaction patterns of criminality.

Flood and drought are found to be two common climate hazards in Bandar Lampung City. Communities have developed their own way to adapt. Most communities in coastal areas raise the floor level and build a dike to adapt to flood. While in non-coastal areas, they build a dike, and temporarily moved to other locations which are not affected by flood. During drought season, adaptation measures undertaken by communities in coastal areas is to buy clean water, whereas in non coastal region is to reduce the amount of water consumption. Forms of adaptation can also be seen on a living strategy.

About 19 Kelurahans have high vulnerability index. Of the 19 Kelurahans, about 14 kelurahans have low adaptive capacity index and the other 5 Kelurahans have high adaptive capacity index. The impact of climate hazards that hit Kelurahans with high vulnerability index and low adaptive capacity index is expected to be more severe than in Kelurahans with high vulnerability index and high adaptive capacity index. Kelurahan with high vulnerability index and low capacity index are Bumi Waras, Garuntang, Gunung Terang, Kangkung, Kedaton, Kota Karang, Panjang Selatan, Perwata, Sepang Jaya, Srengsem, Tanjung Senang, Teluk Betung, Way Kandis, Waydadi. In 2025 and 2050, adaptive capacity index and vulnerability index of some Kelurahan will increase and some will decrease.

Bandar Lampung City is already exposed to multiple climate hazards, i.e. flood, drought, landslides, and flood due to high tide (robs). Based on composite climate hazards index (CCHI, a function of frequency and intensity of the four hazards),

most areas of Bandar Lampung have CCHI of equal or less than 1.5, and only a small portion more than 1.5, i.e. in a small part of the southern part of Panjang Sub-district. In the A2 scenario, number of Kelurahans with CCHI of more than 1.5 is increasing. Kelurahan with high vulnerability index, low capacity index, and high composite climate hazard index is considered to have Very High Climate Risk, while the one with low vulnerability index, high capacity index, and low composite climate hazard is considered to have Very Low Climate Risk. Climate Risk Index of Kelurahans at Bandar Lampung City mostly between these two categories, namely High (H), Medium to High (M-H), Medium (M), Medium to Low (M-L), Low (L) and very low (VL). Under current condition, Kelurahans with climate risk of index of between M-H include Kota Karang and Perwata (Teluk Betung Barat Sub-district), *Kelurahan* Gunung Terang (Tanjung Karang Barat Sub-district), *Kelurahan* Tanjung Senang and Way Kandis (Tanjung Senang Sub-district), *Kelurahan* Waydadi (Sukarame Sub-district), *Kelurahan* Sepang Jaya and Kedaton (Kedaton Sub-district), *Kelurahan* Kangkung, Bumi Waras, kankung and Teluk Betung (Teluk Betung Selatan Sub-district) and *Kelurahan* Panjang Selatan and Srangsem (Panjang Sub-district). Kelurahans that are in M-H risk level cover 14% of the total area of Bandar Lampung. Kelurahans with VL (Very Low) risk level cover 21% of Bandar Lampung area. While those with L (Low), L-M (Low to Medium) and M (Medium) were cover about 22%, 36% and 5% of Bandar Lampung area respectively. In the future, the climate risk level of some Kelurahan will change.

Climate change management (adaptation and mitigation) is considered as new concept and not fully understood by all stakeholders at the local level. No special policies or programs related to climate change for both middle term (5 year plan) and long term (20 year plan) are issued. Capacity of local government in integrating climate change into long-term development planning is still limited. This can be understood as climate change is a complex issue. Strong scientific works on climate change scenarios and climate change impacts in Bandar Lampung City will be required to assist local government in developing horizon plan of adaptation to climate change. Technical assistance and capacity building program for local government officers is also required to enable them to use science-based information for developing the horizon plan of adaptation.

A number of good conditions exist at Bandar Lampung City that can positively contribute the process of developing resilience city to climate change. In the existing laws and policies, it is clearly mentioned that the planning document should consider disaster mitigation and adaptation and climate-change issue. The City Government is also in the process of formulating a new medium term development plan for 2011-2014 as resulted from the direct election which will be taken in June 2010. This is a good opportunity to integrate the climate change aspect into the document, so that it can be legally-binding. Managing current and future climate risk needs political commitment. However, there may be some problems with planning and programming facing by the City Government. These problems are lack of integration, coordination and vision-mission in climate change management, lack of budget allocation to support climate change, ineffective spatial planning to mitigate and adapt the impact of climate change.

The City Team, a team represented by various stakeholders from government bodies, academia and NGOs, community leaders have been formed for formulating climate change programs for the Bandar Lampung City as part of Asian City Climate Change

Resilience Network (ACCCRN). Government of Bandar Lampung City has established Local Disaster Board in November 2009. The presence of this board is important to ensure the effective implementation of hazards and climate change programs by various stakeholders. However, the board is not yet effective on program implementation.

To have resilience city to climate change, it is important to understand how people, community, and sectors response to current climate risk and how the current capacity should be developed to strengthen the capacity in managing future climate risk. Particular pilot projects are needed to get lesson learnt how climate risk can be well managed and how to use the lesson learnt to improve the climate change adaptation plan.

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APPENDIX

No	Kecamatan	kelurahn	Coping Capacity Index			Composite Climate Hazard Index					Climate Risk Index				
			2005	2025	2050	2005	A2 2025	A2 2050	B1 2025	B1 2050	2005	A2 2025	A2 2050	B1 2025	B1 2050
21	TELUK BETUNG BARAT	SUKAMAJU	2	3	3	1.12	2.37	2.07	1.75	1.57	L	M	M	M-L	M-L
22	TELUK BETUNG BARAT	KETEGUHAN	3	3	3	1.34	1.65	2.21	2.06	1.56	M-L	M-L	M	M	M-L
34	TELUK BETUNG BARAT	KOTA KARANG	5	5	5	0.00	0.08	0.08	0.08	0.08	M-H	M-H	M-H	M-H	M-H
33	TELUK BETUNG BARAT	PERWATA	5	5	5	0.49	0.88	1.71	1.20	1.03	M-H	M-H	M-H	M-H	M-H
23	TELUK BETUNG BARAT	BAKUNG	2	3	3	1.39	1.72	2.35	2.16	1.64	L	M-L	M	M	M-L
20	TELUK BETUNG BARAT	KURIPAN	3	4	4	1.43	1.80	2.50	2.27	1.73	M-L	M	M-H	M-H	M
24	TELUK BETUNG BARAT	N O GADING	3	3	3	0.00	0.00	0.00	0.00	0.00	M-L	M-L	M-L	M-L	M-L
14	TELUK BETUNG BARAT	SUKARAME II	2	2	3	1.34	1.65	2.21	2.06	1.56	L	L	M	M-L	M-L
25	TELUK BETUNG SELATAN	GEDONG PAKUON	4	4	4	0.00	0.00	0.00	0.00	0.00	M	M	M	M	M
29	TELUK BETUNG SELATAN	TALANG	3	3	3	0.00	0.00	0.00	0.00	0.00	M-L	M-L	M-L	M-L	M-L
35	TELUK BETUNG SELATAN	PESAWAHAN	4	4	4	0.00	0.01	0.01	0.01	0.01	M	M	M	M	M
32	TELUK BETUNG SELATAN	TELUK BETUNG	5	4	4	0.13	0.35	0.64	0.54	0.34	M-H	M	M	M	M
36	TELUK BETUNG SELATAN	KANGKUNG	5	5	5	0.03	0.12	0.19	0.17	0.13	M-H	M-H	M-H	M-H	M-H
40	TELUK BETUNG SELATAN	BUMI WARAS	5	5	4	0.24	0.65	1.18	1.00	0.64	M-H	M-H	M	M-H	M
39	TELUK BETUNG SELATAN	PECOH RAYA	3	3	3	0.25	0.69	1.25	1.05	0.67	M-L	M-L	M-L	M-L	M-L
84	TELUK BETUNG SELATAN	SUKARAJA	3	3	3	0.10	0.38	0.61	0.53	0.38	M-L	M-L	M-L	M-L	M-L
85	TELUK BETUNG SELATAN	GARUNTANG	5	3	4	1.47	2.69	3.63	3.42	2.31	M-H	M	H	M	M-H
90	TELUK BETUNG SELATAN	WAY LUNIK	3	3	3	0.11	0.29	0.53	0.45	0.29	M-L	M-L	M-L	M-L	M-L
86	TELUK BETUNG SELATAN	KETAPANG	3	3	4	1.15	1.84	2.08	2.11	1.48	M-L	M-L	M-H	M	M
97	PANJANG	SRENGSEM	5	5	3	1.78	1.94	2.59	2.20	2.05	M-H	M-H	M	H	M
94	PANJANG	PANJANG SELATAN	5	3	4	1.78	1.91	2.56	2.17	2.02	M-H	M-L	M-H	M	M-H
93	PANJANG	PANJANG UTARA	3	3	3	1.11	1.33	1.61	1.42	1.32	M-L	M-L	M-L	M-L	M-L
92	PANJANG	PIDADA	3	3	3	1.81	2.02	2.77	2.32	2.12	M-L	M	M	M	M
91	PANJANG	WAY LAGA	2	3	3	1.00	1.54	2.23	1.81	1.49	L	M-L	M	M-L	M-L
89	PANJANG	WAY GUBAK	3	3	3	1.10	1.69	1.82	1.88	1.33	M-L	M-L	M-L	M-L	M-L
98	PANJANG	KARANG MARITIM	3	3	3	1.78	1.99	2.64	2.25	2.10	M-L	M-L	M	M	M
49	TANJUNG KARANG TIMUR	RAWA LAUT	1	1	1	0.00	0.00	0.00	0.00	0.00	VL	VL	VL	VL	VL
55	TANJUNG KARANG TIMUR	KOTA BARU	3	3	3	0.00	0.00	0.00	0.00	0.00	M-L	M-L	M-L	M-L	M-L
64	TANJUNG KARANG TIMUR	TANJUNG AGUNG	3	3	3	0.00	0.00	0.00	0.00	0.00	M-L	M-L	M-L	M-L	M-L
54	TANJUNG KARANG TIMUR	KEBONJERUK	3	3	4	0.00	0.00	0.00	0.00	0.00	M-L	M-L	M	M-L	M
57	TANJUNG KARANG TIMUR	SAWAH LAMA	3	3	4	0.00	0.00	0.00	0.00	0.00	M-L	M-L	M	M-L	M
58	TANJUNG KARANG TIMUR	SAWAH BREBES	3	3	3	0.00	0.00	0.00	0.00	0.00	M-L	M-L	M-L	M-L	M-L
61	TANJUNG KARANG TIMUR	JAGA BAYA I	3	4	4	0.00	0.00	0.00	0.00	0.00	M-L	M	M	M	M
83	TANJUNG KARANG TIMUR	KEDAMAIAN	2	2	1	0.00	0.00	0.00	0.00	0.00	L	L	VL	L	VL
52	TANJUNG KARANG TIMUR	TANJUNG RAYA	3	1	3	0.00	0.00	0.00	0.00	0.00	M-L	VL	M-L	VL	M-L
53	TANJUNG KARANG TIMUR	TANJUNG GADING	1	1	1	1.10	1.69	1.82	1.88	1.33	VL	VL	VL	VL	VL
88	TANJUNG KARANG TIMUR	CAMPANG RAYA	3	3	3	1.29	1.89	2.56	2.16	1.91	M-L	M-L	M	M	M-L
30	TELUK BETUNG UTARA	KUPANG KOTA	3	3	1	0.27	0.49	0.95	0.67	0.57	M-L	M-L	VL	M-L	VL
31	TELUK BETUNG UTARA	GUNUNG MAS	3	1	4	1.50	4.13	7.49	6.33	4.04	M-L	M-L	H	M-L	H
37	TELUK BETUNG UTARA	KUPANG TEBA	2	1	1	0.13	0.37	0.67	0.57	0.36	L	VL	VL	VL	VL
38	TELUK BETUNG UTARA	KUPANG RAYA	1	1	1	0.44	1.22	2.21	1.87	1.19	VL	VL	L	VL	VL
51	TELUK BETUNG UTARA	PAHOMAN	1	1	1	0.00	0.00	0.00	0.00	0.00	VL	VL	VL	VL	VL
50	TELUK BETUNG UTARA	SUMUR BATU	1	1	1	0.03	0.06	0.09	0.09	0.06	VL	VL	VL	VL	VL
28	TELUK BETUNG UTARA	GULAK GALIK	1	1	1	0.04	0.08	0.15	0.10	0.09	VL	VL	VL	VL	VL
27	TELUK BETUNG UTARA	PENGAJARAN	3	3	1	0.00	0.00	0.00	0.00	0.00	M-L	M-L	VL	M-L	VL
26	TELUK BETUNG UTARA	SUMUR PUTRI	3	3	1	0.00	0.00	0.00	0.00	0.00	M-L	M-L	VL	M-L	VL
19	TELUK BETUNG UTARA	BATU PUTUK	2	2	1	1.34	1.65	2.21	2.06	1.56	L	L	L	M-L	VL
41	TANJUNG KARANG PUSAT	DURIAN PAYUNG	1	1	1	0.00	0.00	0.00	0.00	0.00	VL	VL	VL	VL	VL
48	TANJUNG KARANG PUSAT	GOTONG ROYONG	1	1	1	0.00	0.00	0.00	0.00	0.00	VL	VL	VL	VL	VL
47	TANJUNG KARANG PUSAT	ENGGAL	1	1	1	0.32	0.55	0.90	0.87	0.59	VL	VL	VL	VL	VL
44	TANJUNG KARANG PUSAT	PELITA	1	1	1	0.00	0.00	0.00	0.00	0.00	VL	VL	VL	VL	VL
43	TANJUNG KARANG PUSAT	PALAPA	1	1	1	0.11	0.19	0.31	0.30	0.20	VL	VL	VL	VL	VL
42	TANJUNG KARANG PUSAT	KALIAWI	1	1	1	0.00	0.00	0.00	0.00	0.00	VL	VL	VL	VL	VL
45	TANJUNG KARANG PUSAT	KELAPA TIGA	3	3	4	0.00	0.00	0.00	0.00	0.00	M-L	M-L	M	M-L	M
46	TANJUNG KARANG PUSAT	TANJUNG KARANG	3	3	4	0.00	0.00	0.00	0.00	0.00	M-L	M-L	M	M-L	M
56	TANJUNG KARANG PUSAT	GUNUNG SARI	1	1	1	0.00	0.00	0.00	0.00	0.00	VL	VL	VL	VL	VL
15	TANJUNG KARANG PUSAT	PASIR GINTUNG	1	1	1	0.00	0.00	0.00	0.00	0.00	VL	VL	VL	VL	VL
16	TANJUNG KARANG PUSAT	PENENGAHAN	1	1	1	0.00	0.00	0.00	0.00	0.00	VL	VL	VL	VL	VL
17	TANJUNG KARANG BARAT	SUSUNAN BARU	1	1	1	0.00	0.00	0.00	0.00	0.00	VL	VL	VL	VL	VL
18	TANJUNG KARANG BARAT	SUKADANA HAM	2	3	3	1.34	1.65	2.21	2.06	1.56	L	M-L	M	M	M-L

No	Kecamatan	kelurahn	Coping Capacity Index			Composite Climate Hazard Index					Climate Risk Index				
			2005	2025	2050	2005	A2 2025	A2 2050	B1 2025	B1 2050	2005	A2 2025	A2 2050	B1 2025	B1 2050
96	TANJUNG KARANG BARAT	SUKA JAWA	1	1	1	0.00	0.00	0.00	0.00	0.00	VL	VL	VL	VL	VL
13	TANJUNG KARANG BARAT	GEDONG AIR	2	1	1	0.00	0.00	0.00	0.00	0.00	L	VL	VL	VL	VL
11	TANJUNG KARANG BARAT	SEGALA MIDER	2	2	1	1.48	2.00	2.45	2.34	2.14	L	L	L	M-L	L
9	TANJUNG KARANG BARAT	GUNUNG TERANG	5	3	5	0.00	0.00	0.00	0.00	0.00	M-H	M-L	M-H	M-L	M-H
1	KEMILING	SUMBER AGUNG	1	1	1	1.50	1.88	2.42	2.62	2.18	VL	VL	L	L	L
2	KEMILING	KEDAUNG	2	1	2	1.50	1.88	2.42	2.62	2.18	L	VL	M-L	L	M-L
3	KEMILING	PINANG JAYA	1	1	1	0.00	0.00	0.00	0.00	0.00	VL	VL	VL	VL	VL
95	KEMILING	BERINGIN RAYA	1	1	1	0.00	0.00	0.00	0.00	0.00	VL	VL	VL	VL	VL
4	KEMILING	SUMBERREJO	2	2	3	0.00	0.00	0.00	0.00	0.00	L	L	M-L	L	M-L
5	KEMILING	KEMILING PERMAI	2	3	1	0.00	0.00	0.00	0.00	0.00	L	M-L	VL	M-L	VL
10	KEMILING	LANGKAPURA	3	3	3	0.00	0.00	0.00	0.00	0.00	M-L	M-L	M-L	M-L	M-L
12	KEDATON	SUKAMENANTI	3	3	1	0.00	0.00	0.00	0.00	0.00	M-L	M-L	VL	M-L	VL
59	KEDATON	SIDODADI	3	3	4	0.00	0.00	0.00	0.00	0.00	M-L	M-L	M	M-L	M
60	KEDATON	SURABAYA	3	3	1	0.00	0.00	0.00	0.00	0.00	M-L	M-L	VL	M-L	VL
73	KEDATON	PERUMNAS WAY HALIM	4	4	4	0.00	0.00	0.00	0.00	0.00	M	M	M	M	M
71	KEDATON	KEDATON	5	5	4	0.03	0.03	0.06	0.05	0.05	M-H	M-H	M	M-H	M
70	KEDATON	LABUHAN RATU	3	3	4	0.00	0.00	0.00	0.00	0.00	M-L	M-L	M	M-L	M
68	KEDATON	KAMPUNG BARU	3	4	4	0.00	0.00	0.00	0.00	0.00	M-L	M	M	M	M
69	KEDATON	SEPANG JAYA	5	4	4	0.00	0.00	0.00	0.00	0.00	M-H	M	M	M	M
8	RAJABASA	GEDONG MENENG	4	4	4	0.00	0.00	0.00	0.00	0.00	M	M	M	M	M
6	RAJABASA	RAJABASA	2	2	1	0.09	0.14	0.19	0.21	0.16	L	L	VL	L	VL
7	RAJABASA	RAJABASA RAYA	3	3	3	0.00	0.00	0.00	0.00	0.00	M-L	M-L	M-L	M-L	M-L
66	RAJABASA	RAJABASA JAYA	2	3	3	0.00	0.00	0.00	0.00	0.00	L	M-L	M-L	M-L	M-L
67	TANJUNG SENANG	LABUHAN DALAM	3	3	3	0.05	0.07	0.13	0.10	0.11	M-L	M-L	M-L	M-L	M-L
75	TANJUNG SENANG	TANJUNG SENANG	5	5	5	0.00	0.00	0.00	0.00	0.00	M-H	M-H	M-H	M-H	M-H
76	TANJUNG SENANG	WAY KANDIS	5	3	5	0.00	0.00	0.00	0.00	0.00	M-H	M-L	M-H	M-L	M-H
77	TANJUNG SENANG	PERUMNAS WAY KANDIS	4	4	4	0.00	0.00	0.00	0.00	0.00	M	M	M	M	M
63	SUKARAME	GUNUNG SULAH	2	2	2	1.44	1.76	2.28	2.24	1.99	L	L	M-L	M-L	L
72	SUKARAME	WAY HALIM PERMAI	3	3	3	0.12	0.20	0.33	0.32	0.21	M-L	M-L	M-L	M-L	M-L
79	SUKARAME	SUKARAME	3	3	1	0.48	0.63	1.72	1.51	0.86	M-L	M-L	VL	M-L	VL
74	SUKARAME	WAYDADI	5	5	3	0.00	0.00	0.00	0.00	0.00	M-H	M-H	M-L	M-H	M-L
78	SUKARAME	HARAPAN JAYA	2	2	3	0.00	0.00	0.00	0.00	0.00	L	L	M-L	L	M-L
62	SUKABUMI	JAGABAYA II	2	2	3	0.00	0.00	0.00	0.00	0.00	L	L	M-L	L	M-L
65	SUKABUMI	JAGABAYA III	2	1	1	0.00	0.00	0.00	0.00	0.00	L	VL	VL	VL	VL
82	SUKABUMI	TANJUNG BARU	2	1	1	0.00	0.00	0.00	0.00	0.00	L	VL	VL	VL	VL
80	SUKABUMI	KALI BALOK KENCANA	2	2	1	0.00	0.00	0.00	0.00	0.00	L	L	VL	L	VL
81	SUKABUMI	SUKABUMI INDAH	2	2	1	0.00	0.00	0.00	0.00	0.00	L	L	VL	L	VL
87	SUKABUMI	SUKABUMI	1	1	1	0.00	0.00	0.00	0.00	0.00	VL	VL	VL	VL	VL