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## 印度尼西亞三馬林達的洪水管理：最新進展

**Flood Management in Samarinda, Indonesia: Recent Progress**

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**Abstract**

Samarinda's flooding issue is threatening future city development. As the most populated city in Kalimantan, Samarinda (the municipality of East Borneo) plays a role-model in disaster management for a neighboring city. This paper introduces current flood disaster handling in this city. History of disaster management in Indonesia is started from the earlier of Indonesian independence. Year 2008, after hit by severe Tsunami in Aceh and its surrounding, Government of Republic of Indonesia form special agency to manage disaster specifically, namely National Board for Disaster Management (in Bahasa called: Badan Penanggulangan Bencana Nasional [BNPB]) and follows by the regional and local government to form similar agency in provincial and local scale (including Samarinda), called Regional Board for Disaster Management (in Bahasa: Badan Penanggulangan Bencana Daerah [BPBD]) which is formed in 2009 and 2011, respectively. The aim of this paper is to explain flood management in Samarinda where is flood hazard increase gradually and need to be a priority. Descriptive analysis is used in this study including secondary data and interviewed stakeholders. Finally, the finding of study obtains found five constraints related to Samarinda's flood management including administrative and policy, social, economic, environment and technical and knowledge constraint. This study also promotes several schemes of non-structural approach to enlarge alternative perspective in flood management.

Keyword: urban flooding; flood management; flood disaster; Samarinda;

**抽象**

三馬林達的洪水問題威脅著未來的城市發展。作為加里曼丹人口最多的城市，三馬林達（東婆羅洲市）在鄰近城市的災害管理中扮演著榜樣。本文介紹了該市目前的洪水災害處理情況。印度尼西亞災害管理的歷史始於印度尼西亞獨立的早期。2008年，在亞齊及其周邊地區受到嚴重海嘯襲擊後，印度尼西亞共和國政府成立了專門管理災難的機構，即國家災害管理委員會（在 Bahasa 稱為 Badan Penanggulangan Bencana Nasional [BNPB]），並由區域和地方政府在省級和地方級別（包括三馬林達）組建了類似的機構，稱為災害管理區域委員會（在 Bahasa：Badan

Penanggulangan Bencana Daerah [BPBD])，分別於 2009 年和 2011 年成立。本文的目的是解釋三馬林達的洪水管理，洪水災害逐漸增加，需要優先考慮。本研究使用描述性分析，包括二級數據和受訪的利益相關者。最後，研究結果發現了與三馬林達洪水管理有關的五個制約因素，包括行政和政策，社會，經濟，環境以及技術和知識約束。該研究還推廣了幾種非結構性方法，以擴大洪水管理的替代視角。

關鍵詞：城市洪水; 洪水管理; 洪水災害; 三馬林達;

## 1. INTRODUCTION

Flooding is the most damaging natural hazard globally with the disastrous of property and loss of lives (Dadson et al., 2017). Indonesia is one of the most disaster-prone countries, given its high exposure to a range of natural and climatic hazards as well as considerable social vulnerabilities (Surtiari, Djalante, Setiadi, & Garschagen, 2017). Indonesia's flooding issues are threatening many cities (Sukmara & Wu, 2019) including metropolitan cities such as Jakarta, Surabaya, Semarang, and Bandung. etc. and municipalities such as Samarinda, Ambon, Jayapura, etc.

Flood hazard is characterized by the depth of water in the location where it may cause harm, and also by its velocity, the rate of rising water level, duration of inundation and water quality. Flooding is a natural process, but the floodplains are ideal for agriculture and urban development close to water resources and navigation. Regarding the floodplain, the consequences of development in that area have increased the exposure of people, property, and infrastructure to flood. In many cases, it is not practical, cost-effective or politically feasible to relocate communities, property, and economic activities away from flood-prone areas.

In Indonesia's cities including Samarinda, the effort of flood handling widely used an engineering-based approach such as building dike or dams, constructing detention ponds and channelization. Most of the Regional and Local Governments argue that conservative approach such as engineering-based approach is the best solution without consideration of the non-structural approach. In the other hands, the implementation of a non-structural approach may give an alternative perspective in further flood management program implementation.

## 2. METHODS

Data is collected through desktop literature review and stakeholder interviews. Journal articles and organizational report were analyzed to identify current and planning program of flood management in Samarinda. Some government institutions have interviewed such as Department of Public Work and Spatial Planning, Regional Agency for Disaster Management of East Borneo, Local Agency for Disaster Management of Samarinda and River Basin Authority of Kalimantan III.

## 3. STUDY LOCATION

Samarinda is the municipality of East-Borneo Province and located in the Borneo Island, Indonesia. The UTM coordinate location is 513575 – 536589 E and 9943710 – 9972162 N. Based on the statistical data, total population in this city approximately 820.000 inhabitants (BPS Samarinda, 2018) and become the most populated city on the entire Borneo Island and the 19<sup>th</sup> populated city in Indonesia. The density is 1.174/km<sup>2</sup> with total area approximately 718km<sup>2</sup>.

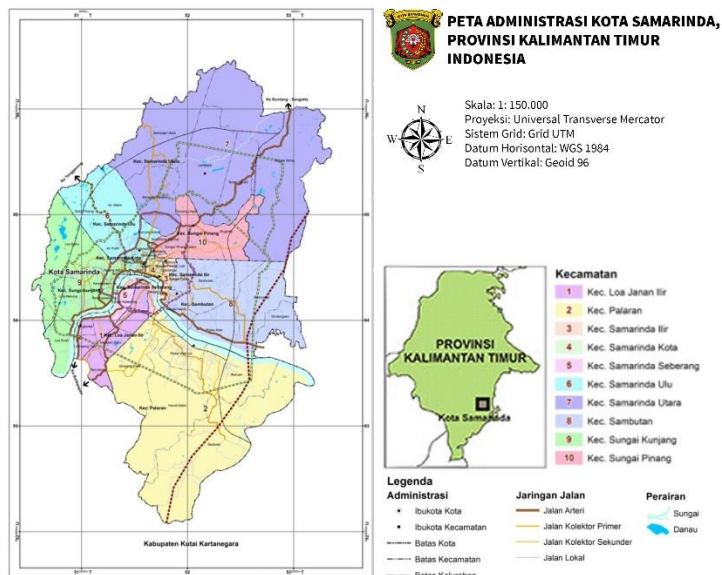


Figure 1. Map of Samarinda City

The governmental hierarchy of Indonesia and the position of Samarinda city showed below.

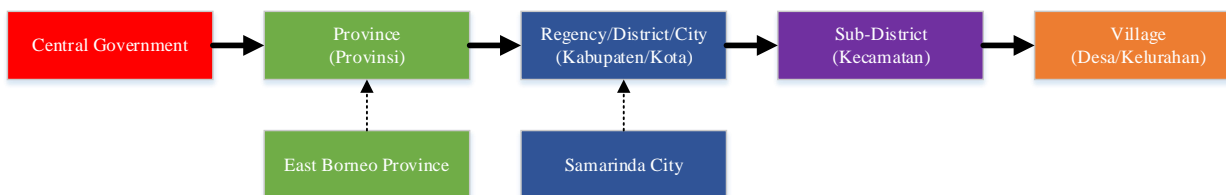


Figure 2. Hierarchy Government System of Indonesia

#### 4. RECENT FLOOD DISASTER IN SAMARINDA

Samarinda has suffered by natural disaster such as flooding, forest fire, drought, extreme weather, land slide and social conflict. In recent days, natural disasters are becoming much stronger and more frequent. Table 1 shows the occurrence time, casualty and damaged property of recent 30 years on each natural disaster.

Table 1. Human and Property damaged by natural disaster in Samarinda

Disaster Type	Occurrence Number	Victim			Damaged Houses (Unit)				Damaged Facility (Unit)		
		Loss of lives	Injury	Suffered/Relocated	Severe Damaged	Medium Damaged	Low Damaged	Flooded	Health Facility	Worship Facility	Education Facility
Flooding	45	8	8	208,953	2,005	0	45	53,968	0	4	16
Landslide	41	3	2	422	80	4	40	0	0	1	1
High Tide	1	0	0	0	0	0	0	0	0	0	0
Whirlwind	6	0	3	623	34	2	99	0	0	3	1
Drought	4	0	0	0	0	0	0	0	0	0	0
Forest Fire	47	2	0	4	0	0	0	0	0	0	0

Source: (InaRISK, 2019)

Regarding flood disaster, we need to consider the geographical condition in Samarinda. This city located in the downstream of Mahakam river (the longest and biggest river in East Borneo) and has a complex history of urban disaster (Ghozali, Ariyaningsih, Sukmara, & Aulia, 2016). Statistic data shows that 42.77% area of Samarinda is a low land area with elevation ranged between +7m to +25m and approximately 20.11% located below +7m. Moreover, because of the city was located in the downstream area of Mahakam river, the tidal process will be disrupted to the tributaries flow which was located in the Samarinda area. Zulfakar said in his research, the elevation of tide in Makaham River reached to 1.68 masl (Zulfakar, Soetomo, Suripin, & Buchori, 2013). The biophysics condition is vulnerable to erosion, sedimentation, and flood. These vulnerabilities are supported by types of soil, dominated by undulating to the hilly land surface, high rainfall and lack of drainage network system. The average annual rainfall in this city approximately more than 2600mm (Sukmara & Wu, 2019) and its roughly 2.5 times bigger than global average annual precipitation.



Figure 3. Flood in Samarinda, (a) 2019 (Rania, 2019) ; (b) 2018 (Christoper D., 2018); (c) 2018 (Agustina, 2018); (d) 2017 (Media Indonesia, 2017); (e) 2016 (Samarinda Pos, 2016); (f) 1998 (Muliawan, 2018)

Samarinda Flooding has a long history. The historical data was recorded the severe flood event occurred in 1998. The flood inundated thousands of houses for approximately 1-week duration with estimated depth ranged between 2 m to 3 m and killed 4 people (Sukmara & Wu, 2019). Flood hits Samarinda almost every year in a certain location and always flooded during heavy rainfall in rainy season. Some flooded area located in several important location including center of economic-activities, transportation access and education facilities such as schools and campuses. The lack of drainage system is dominated factor because of insufficient capacity of drainage channel and deadlocked-channel caused by sedimentation and garbage inside the channel. Residents behavior contribute to the lack of drainage system, some residents were less care to the channel maintenance proses, they are covering the open channel using concrete or wood block to increase the parking spaces or built small shop above the drainage channels. These practices create some difficulties for the government maintaining drainage channels.



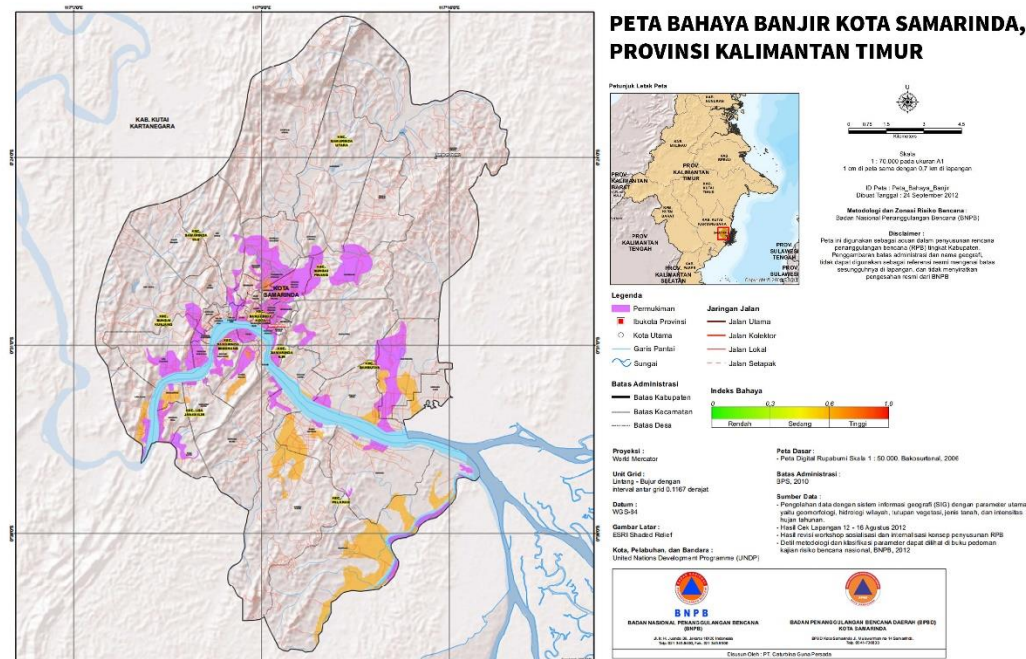


Figure 4. Flood Hazard Map of Samarinda City

Samarinda has several tributaries which are flow to Mahakam River. One of the biggest tributaries is Karang Mumus River and has approximately 40 km length with the catchment area covered roughly 50% area of Samarinda. The existing condition, there are many people lives along the riverbank. The pattern of settlement along the river is parallel with the river meandering and road routes, grouped and irregular (Mislán, Sudaryanto, Ayub, & Hadiati, 2018). In certain locations, the houses create some constriction and decreasing the river capacity. Moreover, the change of the land use and land cover also contribute to the flood issue in Samarinda. The increasing population is parallel with the need of settlement. This issue is forcing people to develop and create new area to build houses. This practice will change the runoff behavior due to change of runoff coefficient in that area.

Flooding causes several disadvantages to city development and triggering the raises loss and damages including direct-losses, indirect-losses, tangible damage, and intangible damage. The flood is damaging the infrastructures including public and private property, disrupting the economic growth and human activities in this city. In the economic sector, the total loss of flooding disaster in Samarinda, the flood risk assessment matrix estimated approximately 112,311,000,000 IDR (equal with 7,867,565.71 USD in the year 2016) (BNPB, 2016).

## 5. RECENT FLOOD MANAGEMENT IN SAMARINDA

### 5.1 Evolution of Disaster Management Institution in Indonesia

Explaining the recent flood management in Samarinda, we need to trace the general disaster management in Indonesia. Disaster management in Indonesia is started from colonial era. In 1883 after the eruption of Krakatoa, member of European community in Batavia (now Jakarta) set the separate fund for European victims (Schrikker, 2016) and after eruption of Kelud Mt. in 1848, 1875 1901 and 1919 the Dutch colonial government set the project for volcano monitoring service and establish the first disaster prevention project by formed flood tunnel and become marked the application of science to geophysical hazard in Indonesia (Schrikker, 2016). The next step of disaster management development will be listed in the Table 2.

Table 2. Evolution of Disaster Management Institution in Indonesia

<b>Time Period</b>	<b>Disaster Management</b>	<b>Description</b>
Before Independence (under Dutch Colonial Government)	Set separate fund for European Victims	In 1919, the first disaster prevention project was form a flood tunnel
After Independence (1 <sup>st</sup> President Era/ Old Order) 1945 - 1966	In 1945, government was form The agency for Walfare of War Victims and Their Families (BPKKP/Badan Penolong Keluarga Korban Perang)	Mandate dominated by management of dangerous situation including war, war victims, displaced people and natural disaster.
2 <sup>nd</sup> President Era/New Order) 1997 - 1998	In 1967, under Suharto leadership, Government was formed National Coordination Team for Disaster Management (TKP2BA)	
	In 1979, TKP2BA changed to National Coordination Board for Natural Disaster Management (BAKORNAS PBA/ Badan Koordinasi Nasional Penanggulangan Bencana Alam)	In this period, government also form Cordinating Agency for Disaster Management for provincial level instructed by Ministry of Internal Affairs.
	In 1990, BAKORNAS PBA changed to National Coordination Board for Disaster Management (BAKORNAS PB/ Badan Koordinasi Nasional Penanggulangan Bencana)	Expanded mandate not only to deal with disaster impact of natural hazard but also other disaster including social conflict and humanitarian crises.
The Reform Era 1998 - 2004	In 2001 to 2004, government form new Agency called National Coordination Board for Disaster and Displace People Management (BAKORNAS PBP/Badan Koordinasi Nasional Penanggulangan Bencana dan Pengungsian) to replace BAKORNAS PB	Enlarge the mandate to include management of displaced people due to conflict
The 6 <sup>th</sup> President Era Democratic Era 2004 - 2014	In 2005, president gave mandate to BAKORNAS PB and also form the Tsunami Rehabilitation and Reconstruction Board (BRR/Badan Rehabilitasi dan Rekonstruksi) for Tsunami victims	Year 2004, the biggest Tsunami his several provinces in Sumatra Island, Indonesia.
	In 2007, the Central Government created new regulation for disaster management and establish the national agency for disaster management called Indonesia National Board for Disaster Management (BNPB/Badan Nasional Penanggulangan Bencana) and	This organization has mandate and accountability of coordinating, planning and implementing aspect on disaster risk management (DRM) and disaster risk reduction (DRR) in Indonesia.

	instructed Provincial and local government to formed similar agency in their level called Regional Disaster Management Agency (BPBD/Badan Penanggulangan Bencana Daerah)	
The present Era 2014 - Present	In 2015, for the first time, President Joko Widodo was mandated BNPB to responsible for extinguish fires.	In 2015, Indonesia hit by huge forest fire and haze affecting the other neighbor countries. Global community forced Government of Indonesia to strength its effort to reduce the risk of forest fire.
Source: (Surtiari et al., 2017)		

According to the Table 2, in year 2004 after severe tsunami hits Indonesia, it was a definitive turning point in risk reduction and management internationally and also Indonesia. The Government of Indonesia (GoI) has transformed from focus on emergency response after disaster to a more comprehensive and preventive approach to disaster risk reduction (DRR).

## 5.2 Overview of Flood Management in Samarinda

Government of Samarinda City (GoSC) is started the flood control program by a built multipurpose dam in the upstream of Karang Mumus River in 1977 but unfortunately, this dam has overtopped and broken in 1998 and has triggered severe flooding in Samarinda. After that accident, the government put investment to this dams and maintaining it in 2009 (reinforced upstream side of the main dam) and the spillway was reconstructed in the year 2013.

Flood control program in Samarinda in general divided by 3 categories, there are short-term program, medium-term program and long-term program. This program including 7 Sub-basins in Samarinda City, including (1) Karang Mumus River system, (2) Small Karang Asam River system, (3) Big Karang Asam River system, (4) Loa Bakung River system, (5) Rapak Dalam River and Keledang River system, (6) Loa Janan River system, (7) Palaran River system. In general, the flood control programs which are developed by GoSC mostly still dominated by structural approach such as channelization, channel normalization, channel shortcut, build dike, build retention pond, installation of water gate and pumps.

In 2014, management of Karang Mumus River system was move to Central Government and managed by Kalimantan III River Basin Authority and the Local Government of Samarinda cannot involve deeper in that river system (Sukmara & Wu, 2019).

Table 3. Flood control program in Samarinda City

Type of program	Description	Activity
Short-term	Controlling flood in the flood prone area and increasing people awareness and involvement in flooding issues.	Maintenance the drainage systems, normalization of river meandering, build retention ponds, build infiltration wells, increasing people concern to preventing flood.
Medium-term	Controlling flood from upstream and managing basin.	Development of dams or small dams, revitalization swamps, controlling erosion rate and sedimentation, reforestation and land conservation.

Long-term	Controlling tide of Mahakam River	Development of water gate and flood pumps at estuary areas, comprehensive management and arrangement in whole Mahakam Basin.
In term of non-structural approach, Government of Samarinda has been published several regulation and policy related to spatial planning, disaster management		

In Samarinda, flood management involve several institution including City Authority (Pemkot), Agency of Regional Development (Bappeda), Department of Public Work and Spatial Planning (DPURU), Department of Settlement and City Development (Dinas Kimbangkot), Department of public works - East Borneo Province (Dinas PU Provinsi), River Basin Authority (BWS Kalimantan III), Department of Forestry (Dinas Kehutanan), Regional Department of Environmental Impact Control (BAPEDALDA), Local Board of Disaster Management (BPBD Kota Samarinda), Regional Board of Disaster Management – East Borneo Province (BPBD Provinsi), NGOs and other related institutions.

## 6. ANALYSIS OF ISSUES IN THE FLOOD MANAGEMENT

Flood management issue in Samarinda becomes more complex and difficult to undertake, due to increasing population, increasing pressure on need of settlement, decreasing of river capacity, decreasing of dam capacity and difficulties of land acquisition for flood control infrastructures. However, experience in the past few years has reveal some weakness in the actual flood control system, such as:

- incomplete flood control infrastructure in entire Samarinda
- high number of technical defect in the existing drainage system
- inadequate urban drainage systems
- inaccurate planning of flood control systems
- no flood warning system or lack of public information system before and during flooding
- dilemmas and difficulties in land adjustment and resettlement of residents from high-risk area (such as floodplain area or riverbank area)
- Limited budget to develop sufficient flood control infrastructures
- Overlapping authority and lack of coordination between several institutions related with flood management systems.
- Social behavior and local wisdom triggering social conflict during implementation of existing flood management.

In order to achieve effective flood management in Samarinda, there are some difficulties and challenges must be determined in practice, so it can be implemented sufficiently:

- How to shift from flood control to flood management and how to integrated with spatial planning
- How to combine structural approach and non-structural approach?
- How to anticipate extreme flood event in term of safety and risk?
- How to break through the restriction in institutions, mechanisms and techniques in order to promote flood management?
- How to establish the shifting thinking from hard-engineering approach to adaptation and disaster risk reduction approach?

## 7. ANALYSIS OF CONSTRAINTS IN FLOOD MANAGEMENT

In context of transition from flood control approach to flood management approach, the need of new policy, and the willingness of peoples and government are crucial in term of supporting flood management implementation.

### 1. Administrative and policy constraints



- In case of implementing flood management, the administrative system of each institution should be clear. The overlapping authority and lack of coordination between institutions which are involved in the flood management system must be clear before development of policy of it. The integration of institution was relatively easy to develop and convey but it was difficult to implement. The division of duties and authority are important in term of flood management. So, it will not be crashed in the future.
- Political willingness is an important part in term to achieve sufficient goal of flood management. The inconsistency practice related with the policy's changing due to the turnover of leadership, so the commitment of Government's leader is needed to put the flooding problem become the main priority in the city development policy and need to guaranty that will be a sustainable program and policy.
- Nowadays, the regulations and policies related to disaster management and spatial planning were published in Samarinda, but no specific regulation and policy for flood management.

## 2. *Social constraint*

The social constraint occurs during implementation of flood management, such as social conflict, land acquisition process and social behavior and social culture in the flood prone area. Furthermore, it must be stressed that:

- New flood management concept may be hampered the prevailing tradition and socio-economic value. The behavior and social culture in Samarinda reveal that people cannot live far away from the river. In fact, a lot of people lives very close and even along the riverbank. Whereas, the regulation stated that the length of the buffer zone of a river in urban area at least 10 m and reach to 100m (Kementerian PUPR, 2015).
- Some of the people who live in riverbank area does not have land certificate (illegal settlement) (Retno, Susmiyati, & Apriyani, 2014). The people who live in the riverbank has been settled in that area for quite long time and several area has been claimed as customary land. So, the implementation of relocating program facing the unclear land ownership issues and creates difficulties to determine the compensation for their land and houses.
- Government facing difficulties to relocate some worship facilities which was built on the riverbank because it can be triggering social conflict (Ariyanti, 2017).
- Escalating the cost of land acquisition and resettlement are becoming a complicated constraint for the construction of new flood control infrastructures.
- Lack of knowledge about land use regulation, some people build houses/building in the water infiltration areas. This practice will decrease the land capacity to infiltrate runoff to the ground.
- Some risk management measures are difficult to implement because of most resident in the riverbank area relatively poor. So, they surrendered and also was feeling used to being flooded.

## 3. *Economic Constraint*

- The threat of policy-changing due to leadership turnover. The implementation of flood measurement and enforcement government regulation becomes a complicated problem. The government needs to relocate all of the people move out from riverbank and this will be very challenging. The relocation program has been started from 1997 by forming a team for relocating people along Karang Mumus River, there are 2591 household forced to relocate and will be relocated gradually. To implement this program, GoSC has prepared for the new residential area for all of them. In 2017, total household needs to relocate about 3.915 but only 1356 household was relocated. However, due to changing of Central Government regulation, this program facing

difficulties. Started on TEAR 2014, Local Government was prohibited to give grant by using National Budget (APBN) for compensation of relocated household.

- There is tendency to invest in flood control works only after flood event occurs. This situation is a restriction for achieving comprehensive flood management systems in due time.
- Being a developing country and being a large country area. The allocation budget is limited and tends imbalance compared to other cities located on Java island.

#### 4. *Environmental Constraint*

Environment and ecological constraint in flood management should be deal with the interaction between human and nature, including the impact of uncontrolled human activities.

- The existing flood control is Samarinda cannot work sufficiently due to change of environment, such as decreasing vegetation, deforestation in the upstream area, uncontrolled land use change, soil erosion, sedimentation in dams and rivers, wetland and swamp degradation (due to uncontrolled settlement). The impact consideration of increasing runoff discharge is needed because of the practice of coal mining in the upstream area of Samarinda and development of new Samarinda airport.
- The new retention ponds or dams will affect the risk safety of human lives near that area such as risk dam failure or risk of human to be sunken in the pond.

Along with the progress of civilization, the environmental factor will be considered more preciously. It will place a more significant restriction on structural measures (hard-engineering approach) dealing with flood control. It will automatically trigger more attention to the non-structural approach and mitigation measures will more preferable.

#### 5. *Technical and Knowledge Constraint*

These constraints deal with knowledge level and technical capacities, including operating capacity, practicability of information management and decision support systems, and skill of the professional and technical staff.

- Lack of awareness hampered the promotion of “new flood management strategy”
- Lack of technical support and devices to ensure the flood control system works appropriately
- Lack of real-time data and devices to monitor real-time condition related to the flood event
- There are many people still tend to think that the early warning system is just a single device and they do not think it a whole system of flood management.
- Lack of skilled professionals is a constraint in implementing flood risk management.
- Inequality knowledge, information and different understanding about flood management between institutions which are related to flood management in Samarinda
- Disaster management agency tend to concern only in the emergency situation during disaster and post-disaster management (Rafiq, 2014).

## **8. PROMOTING NON-STRUCTURAL APROACH FOR FLOOD MANAGEMENT IN SAMARINDA**

Structural measures are mainly about standard and installation disaster prevention facilities such as building dike or dams, channel improvement, control systems incorporating the result of water flow analysis (Kang, Lee, & Lee, 2018). Flood prevention is cost-effectively, but nearly 87 percent of disaster related aid spending goes into emergency response, reconstruction and rehabilitation, and only 13 percent toward reducing and managing risk before they became disaster (Zurich Flood Resilience Alliance, 2019). In practice, the structural approach is constructing permanent facilities to reduce damage risk. In other hands,

non-structural also called soft-engineering approach, it can be sub-divided into institutional control, land use regulation, land acquisition, and relocation, adaptation, flood forecast and prediction, warning systems and a flood insurance program, etc.(Faisal, Kabir, & Nishat, 1999). Non-structural measures are proven method and techniques for reducing risk and flood damage incurred within floodplains.

The following main approach are commonly implemented to avoid or mitigate flood damage (USAID, 2015) :

1. Flood assessment and mapping to identify prone area with specific risk of the risk (probability, depths and velocity and inundation time). Preventing and reducing flood damage by guiding land use and urban development.
2. Flood forecasting and warning systems. Giving an alert and warning to the residents can reduce total number of damage in their private property and contents.
3. Flood management structures can be used to protecting urban and agriculture communities, houses, and other valuable areas.

The implementation of Non-structural measures involves less work compared to structural measures and their environmental impact relatively low. To achieve the promising and effective outcome of the non-structural method, there needs good and sufficient cooperation between residents in flood-prone areas and government authorities.

In recent days, GoSC has been started to shift from structural approach toward nonstructural approach by publishing local regulation for land use management. This local regulation strengthens the central government regulation related to flood disaster and as an indicator that the local government has been pointing and concern to non-structural approach.

Implementing non-structural approach is not easy way, local government has critical role play in the program implementation. It has been recognized by GoI in regulation of regional autonomy. Improved capacity and capability for disaster risk reduction (DRR) of local government was a recommendation of Djalante (Djalante, Thomalla, Sabaruddin, & Carnegie, 2012) related to progress of Indonesia in implementing the Hyogo Framework for Action.

Below, in context to strengthening the shifting of flood management to a soft-engineering approach, there are some non-structural measure can be implemented and adopted in Samarinda, such as forecasting and warning, land use planning, resilience and insurance.

- *Forecasting and warning*

The flood warning is information in the form of a prediction about a flood that likely to happen. This process is targeted at and communicated to people who are in the path of the flood in advance of the flood occurring, with intention of enabling people to avoid harm and casualties (Parker, 2019). Flood warning provides time to the people to secure or move their property from flood. The accuracy of flood forecasting and prediction is a crucial factor for the warning system. However, the implementation of flood warning becomes useless without adequate public understanding and awareness, vice versa. A better understanding of flood warning includes knowing how to respond appropriately.

For instance, the difficulties of securing the entire city from a flood may overcome by implementing a flood warning system in Samarinda. In term of reducing flood risk, it will hypothetically helpful.

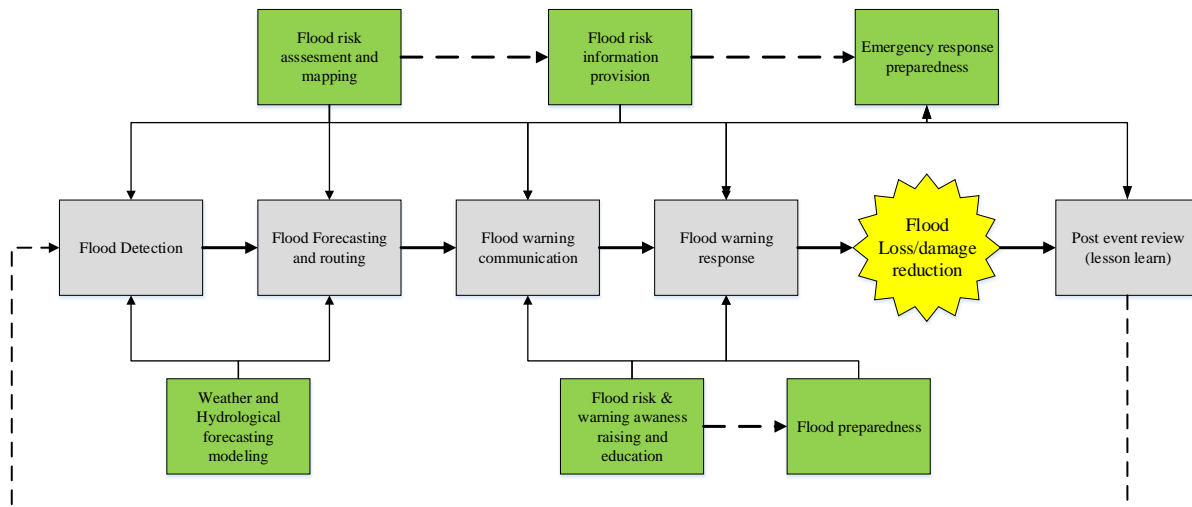


Figure 5. The flood forecasting, warning and response systems (FFWRS), adopted from (Parker, 2019)

Figure 2 shows the chain of flood warning systems, boxes with green color mean supporting process, the solid lines mean link in the forecasting and warning chain and dashed lines mean the main linkages between supporting processes and FFWRS.

#### - Land Use planning

Land use planning is carried out to optimizing the use of land based on its geographical, topographical, climatic and soil characteristics. Land use management plays a key role in flood management strategies to mitigate risk (APFM, 2016). In the context of flood management, land use planning measures can minimize development in a flood-prone area and reduce water runoff through development control for flood risk prevention, designate route and open space for better response and recovery, mitigate damages from unavoidable flood risk and accommodating urban growth (UFCOP, 2017). Land use planning process involves many different stakeholders such as land users, decision makers and the land-use planner itself. Implementing appropriate land use planning is Samarinda, people can know which area is a high risk of flooding. In case of reducing flood discharge, land use planning can control and maintain the water infiltration area and avoiding people to develop floodplain area. In the US, the concept of flood zoning categories has been introduced based on the risk of inundation (Faisal et al., 1999).

There is some example of land use planning implementation in US and Korea. Seoul Metropolitan Government mandates to do rainwater harvesting for new building larger than 5000m<sup>2</sup> and existing official building larger than 3.000m<sup>2</sup>. Water should be storage in tank and instructed to empty depending on the weather forecast. In Minnesota (US), development regulation allows people to use open space for garden, park, golf course, as long as they do not increase flood levels.

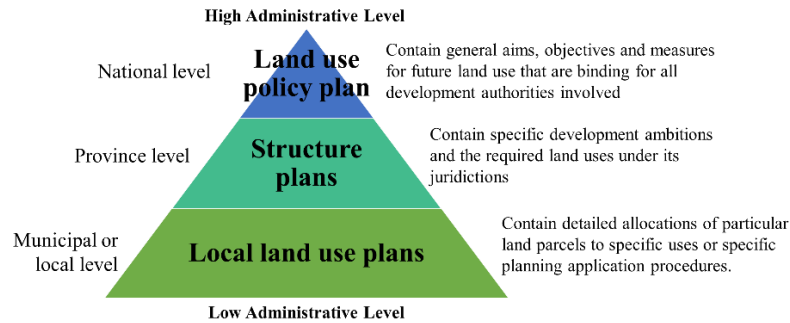


Figure 6. Administrative level involve in land use planning, adopted from (APFM, 2016)

#### - Flood Resilience

Disaster resilience is the ability of systems, community, or society to pursue its social, ecological, and economic development and grow objectives while managing its disaster risk over time in a mutually reinforcing way (Keating et al., 2014). In the context of City, the capacity to tolerate flooding and to recognize should physical damage and socioeconomic disruption occurs, so as to prevent deaths and injuries and maintaining current socioeconomic identity known as Urban Resilience (Liao, 2012). The comparison of between resistance city and resilience city is the socioeconomic tolerance range of both. The resistant city is dependent on flood-control infrastructures. On the contrary, the resilient city tolerates flood and much greater fluctuation in socioeconomic condition.

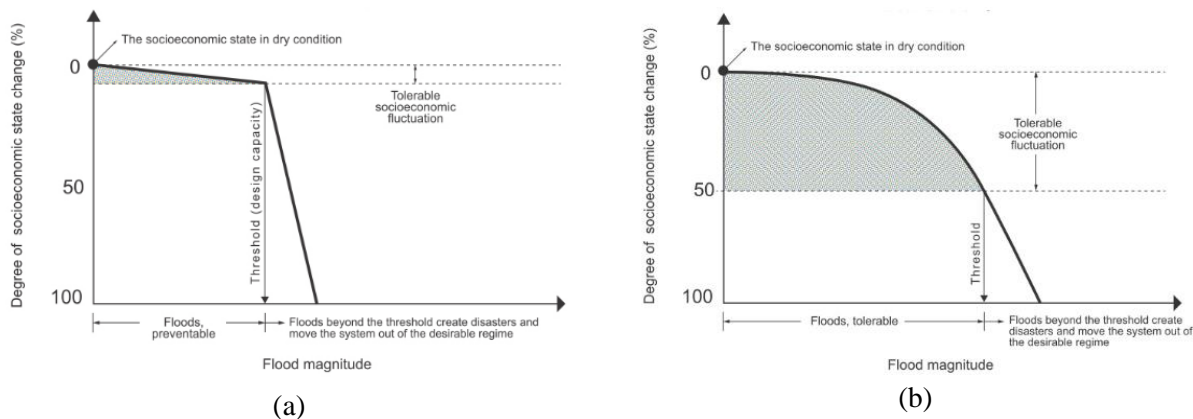


Figure 7. Comparison between (a) resistant city and (b) resilient city, adopted from (Liao, 2012)

Development of flood risk map can be helpful to support the city-resilience and capacity to the community to avoiding the high-risk flood locations and informs the people about how deep of flood at a certain location.

Due to difficulties in securing entire of Samarinda city from flood, facing periodic flood and the limited budget, then being a resilience city is more relevant. Being resilience is essentially a process of adaptation and allowing people to learn for preparing the extreme one. In the context of disaster risk reduction, by following the philosophy of “living with flood” is more reliable to Samarinda. Developing resilience communities has become widely recognized as critical for disaster risk management, such as flooding (Oladokun & Montz, 2018). Local wisdom of Samarinda’s indigenous people has potential strength with this scheme. They get used to living with river and adapting their house by build house in stilts to avoiding river tide. Nowadays, Regional Agency for Disaster Management in Samarinda is started to develop the resilient village to response disaster occurrence



but the program still in the pilot project stage. Hope, in the future, this program will cover the whole area of Samarinda and the goal of non-structural approach and flood risk reduction can be achieved. To increase the capacity of community resilience and reducing the flood impact, we can assess by following these steps below:

- Understanding the treats of flooding by evaluating the likelihood and the potential severity of flooding at your utility.
- Identify vulnerable assets and determine consequences by assessing critical operation and equipment that may be disabled or damaged by flooding
- Identify and evaluate mitigating measure by considering actions that will protect your utility from future flooding
- Developing a plan to implement mitigation measure by prioritizing cost-effective mitigation measures and scheduling completion.

As additional work to improve the resilience capacity are (a) giving education to the community about flood disaster and how the severity of it and how to respond to it; (b) scheduling drill session in order to make sure that the community ready to response the flood disaster; (c) determine the certain location or place as a muster point or safe-house such as mosque, church, hall and etc.

#### - Flood Insurance

Promoting and establishing flood insurance mechanism is a one of effective economic adaptation. Insurance will help people by providing money for house repairing and avoid spending their saving. The other benefit, insurance mechanism can decrease government budget spending in assisting victims. In many case, major government funds are spent on rehabilitation and reconstruction program, including public infrastructure such as road or office building or private property of low income citizens. Consequently, the government fund can be spent on other type of expenses in flood management. For instance, Switzerland use dual system of public and private natural hazard insurance exists, the Swiss cantons' monopoly insurers invest on average 15% of their premium incomes in prevention (Seifert-dähnn, 2018).

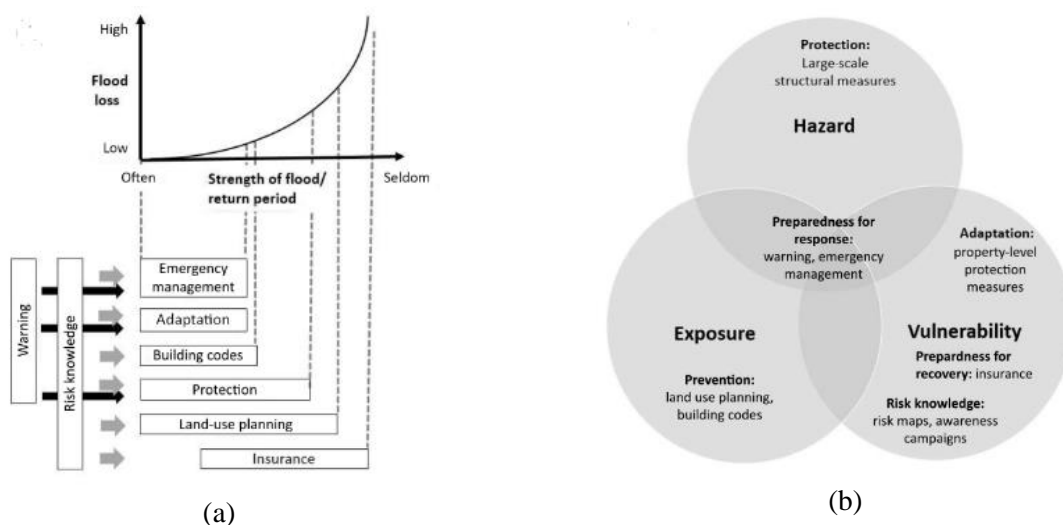


Figure 8. (a) Position of Insurance mechanism in the potential to reduce losses of flood event and (b) sorted according to their risk reduction mechanism (adopted from (Seifert-dähnn, 2018))

Introducing flood insurance in developing countries is challenging. A lack of understanding of the benefits of insurance and perceive that as a luxury and new thing for most people especially the poor (Feyen, Lester, & Rocha, 2011) in However, insurance can be important mechanism to stimulate flood risk reduction and thus decrease losses (Seifert-dähnn, 2018). In fact, until nowadays no single company in Indonesia provide specific insurance for flooding, even private or state-owned company. Existing insurance company only serve partially for life insurance, vehicles and property (houses). For houses, insurance company mostly cover for house fire and can be expanded to flood insurance with several preconditions. However, good communication and explanation about insurance is needed to reach successful implementation of flood insurance mechanism. Accuracy of flood zoning and determine the depth-damage have to be prepared to determine flood damage risk and corresponding to premium. For consideration, there are some countries have flood insurance scheme and divided by “for single hazard or multiple hazard” such as Switzerland, Spain, USA, France, Denmark, Austria, Sweden, UK, and Germany.

## 8. CONCLUSION

In this study has explained the metamorphosis process of disaster management institution in Indonesia, including Samarinda Municipality. Analysis obtains that a structural-approach still dominates the flood handling efforts. Samarinda is tried gradually toward non-structural flood management approach with an effort to develop regulations and programs to support flood handling. Implementing this approach does not mean that the structural approach will be further neglected. Despite the deficiency and constraints still, exist in several parts, these can be handled along with the development of knowledge and public awareness toward a non-structural approach which gives low impact to human and environment. This paper offers several schemes to promote the non-structural approach may be implemented in Samarinda but these works require good policy and adequate institutions in term of knowledge, science, theories, and skills and should be improved in practice. Finally, the commitment of leader and political willingness is the main actor to guidance flood handling effort keep in the right direction toward flood risk reduction approach.

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