



## Community Perceptions towards the Causes of Flood in Air Pacah area, Padang City, Indonesia

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**Abstract:** There is a rapid development in Air Pacah area since 1999. This area used to be a remote area and a retarding basin of Padang City. In 2011, it was designated as the new head quarter complex for Padang City government. One of the negative impacts of its development was the increase of flood frequency. In order to mitigate the flood, government conducted a flood control project at Maransi River which passes this area. However, this project has not completed yet due to land acquisition problem. Accordingly, this paper aims to identify community perception on flood causes and into what extent the flood control project has benefited the community. Thirty semi-structure interviews were conducted between May and October 2015 and analysed using descriptive statistic and content analysis method. It was found that community feels that there has been an increase in flood frequency, flood depth, and flood duration. There are four dominant factors that have significant impact on flood, rain duration, low infiltration area, massive construction of real estates and offices, and bad drainage system. Community who live exactly next to the construction site has benefited from the flood control project, on the other hand community at the upstream has not feel the positive impact yet because the construction halted due to land acquisition problem. As a result, it is strongly recommended that government to immediately acquire the land needed for the flood control project.

**Keywords:** community perception, flood, flood causes, flood control, land acquisition

### 1. Introduction

Air Pacah is a new developed area at the east of Padang City ( $0^{\circ}57'0''S$ ;  $100^{\circ}21'11''E$ ). The development was marked by the construction of Padang Bypass Road and Bus Terminal in 1999. In 2011, this area was designated as the new head quarter complex for Padang City government. Since then, massive construction of new government building, universities, hospitals, private office and real estate was took place.

As a result, it seems there is an increase of flood frequency in this area. As noted by Istijono [1], there have been 12 flood occurrences between 2011 and 2013 in Air Pacah. Damage and losses into property, economic disruption, fatalities are evitable. Fig 1 shows where Padang Bypass road cannot be passed by vehicle.

To overcome the problems, government has tried to mitigate flood events; one of them is by carrying out a flood control project in Maransi River and Luruih River which pass through Air Pacah area. The construction of this project was planned for 2200 meters long and implemented from 2012 to 2014 by Water Resources Department of West Sumatra Province. However, due to land acquisition problem by the Government of Padang City, river widening work can only be carried out for 840 meters. As a result, the expected benefit of the flood control project is not optimal. Accordingly, the purpose of this paper

is to find out how the public perception of flood events that occurred in the area of Air Pacah and into what extent community perceived the benefits of the flood control project.



Figure 1 Flood at Padang Bypass road

## 2. Literature Study

### 2.1. Flood, Causes, and Mitigation

According to BNPB [2] flood is water runoff which exceed its normal confines, Istijono [1] adds that flood process can be explained. Menurut Istijono [1] the occurrence of flooding can be explained by looking at surface run-off which is equal to the total volume of rainwater deducted by interception of water, water infiltration, water storage, water evaporation, and plant transpiration. This factor can be simplified into:

$$AP = VH - (C + R + T) \quad (1)$$

where AP is the flow of surface water, VH is the volume of rainwater, C is water interception, R is infiltration area, and T is water reservoir.

The value of AP will be greater if the value of C, R and T are small, and vice versa AP value will be small if the value of C, R and T are large. The greater the flow of surface water, the greater the potential of flooding event, and if AP exceeds the carrying capacity of the river then flood will occur.

In more detail Kodoatie and Sugiyanto [3] classify the causes of flooding into two factors, natural factors and human factors. Naturally the cause of flood is heavy rainfall, the effect of physiography, erosion and sedimentation, low capacity of rivers, inadequate drainage capacity, and the influence of tide. While the causes of flood due to human actions are the changing conditions of river bank, slums area, litter, dams, damage to flood control building, and inappropriate flood control systems.

For flood control, further Kodoatie and Sugiyanto [3] explain that there are two approaches can be made, non- structural and structural methods. Non- structural methods include watersheds management, land use regulation, erosion control in the watershed, flood warning system, and legal approach. While the structure method include by construction of dams, retention ponds, check dams, reducing the slope of a stream, river improvement, diversion, and construction of embankment.

### 2.2. Flood in Padang City

Padang City is the capital of West Sumatra province. Administratively, the city of Padang is composed of 11 districts and 104 villages. According to BPS [4] the population of Padang City in 2014 is 876.678 inhabitants and population density is 1261 inhabitants/km<sup>2</sup>. In 2013, the rate of precipitation of Padang reached an average of 347.50 mm per month with an average of 18.83 days of rainy days per month.

As Padang city is located in lowlands with relatively flat topography and next to the beach, and is passed by five major rivers and 16 small rivers, the city was frequently inundated by flood. Indonesian disaster

data and information (DIBI) [5] notes that from 2002 to 2015 there have been 32 occurrences of floods in Padang City. One of the areas which are often flooded is Air Pacah area.

Most recent flood events are flood on March 16, 2008 at Kuranji River and Limau Manis River, flood on 24 July 2012 and 12 September 2012 (Hidayat, [6]). The last flood event has pushed some houses to be relocated to a safer place. On Wednesday, September 4, 2013 floods in Air Pacah caused Padang Bypass road impassable (Figure 1) and lead to Padang City Hospital patients had to be evacuated (Figure 2).



*Figure 2. Flood in Local Hospital of Padang City in Air Pacah area*

### 2.3. Flood Control

Flood control structure has been carried out Padang City dating back during Dutch colonial era which marked by the construction of Banda Batang Bakali (digging river). This project is carried out to divert some of the flow of Arau River which passing through the trade center of Padang at the time.

Considering the frequent occurrence of flood in Padang City, a comprehensive study was undertaken for flood prevention in 1983. This study was conducted by JICA (Japan International Cooperation Agency) namely Padang Area Flood Control Project. This project aims to conduct a thorough study of flood control, drainage plans, and feasibility studies to identify and prioritize activities to be implemented. Results of the study have become the basis of a flood control project in Padang city (JICA, [7]).

Some projects that have been implemented for flood control in Padang city are normalization of Flood Canal and Batang Arau River in 1992-1997, Kuranji river normalization, Padang coast defence system, and

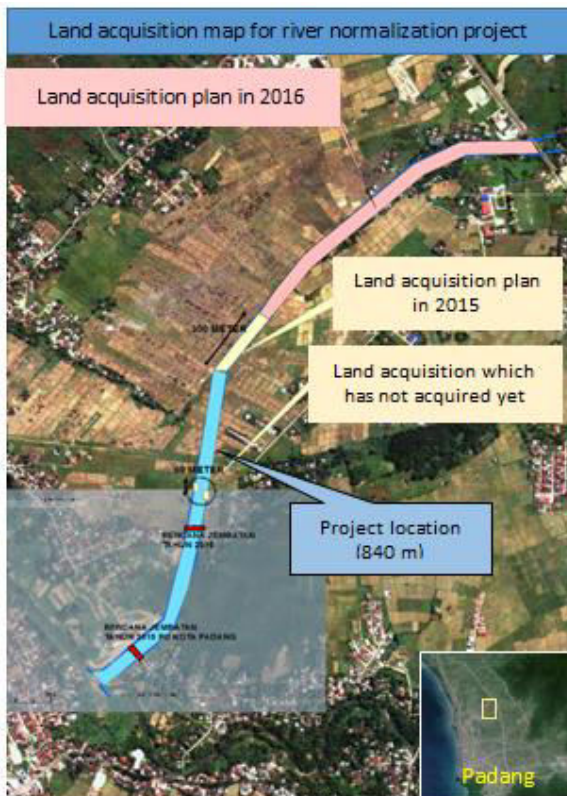
the most current flood control project, Maransi river year 2012-2014.

## 2.4. Community Perception

According to Bahasa Indonesia dictionary (KKBI) [8], perception can be interpreted as a response (acceptance) directly from something or what someone knows through the senses. Referring to this definition, community perception is how community perceived the flood events that occurred in the area of Air Pacah.

## 3. Case Study

Case study on this research is associated with the flood control project at Luruih/Maransi River in Air Pacah area. With this project, it is expected that Air Pacah area as the center of Padang City would be a flood-free areas. The consequence is that the government should increase Luruih River and Maransi River capacity so it will be able to accommodate the flood discharge over a period of 25 years 120 m<sup>3</sup>/sec and 34 m<sup>3</sup>/sec respectively.



**Figure 3** Project layout and land acquisition (source: Dinas PSDA Sumbar)

The detail location of the project is shown in Figure 3. The funding is come from the West Sumatra provincial budget with a contract value of Rp. 30 billion (USD \$ 2.5 million), implemented with a multi-year contract from 7 December 2012 until 6 November 2014. Initial plan was to conduct 2400 m river normalization. However, due to land acquisition problem, the project can only be carried out along 840 meters. Chronologically, the distance of land that can

be acquired is 150 meters in 2012, 250 meters in 2013, and 440 meters in 2014.

Forms of activities that have been carried out from 2012 to 2014 include the construction of estuaries; dike and canal wall (Figure 4).



**Figure 4** Luruih River normalisation project (source: Dinas PSDA Sumbar)

## 4. Methodology

This paper was a further development from a preliminary research regarding community perception at Aia Pacah area (see Ophiyandri et al., [9]). Previous study was conducted using 20 respondents which become an issue on its validity and reliability. As a result, this study was resulted from 30 semi-structure interviews. The interviews were conducted between May and October 2015. Sampling method used is a purposive sampling, where the respondents have to be lived in Air Pacah area before 1999.

Respondents profile is shown in Table 1. It can be seen that the average age of respondents is 43.4 years and majority respondents have lived in this area more than 35 years. None of respondents graduated from university and majority of them working as a farmer.

The interview guideline is structured into four sections, where the first section is about respondents details, and the second and the fourth sections are about community perception towards flood based on time occurrences, before 1999, between 1999 and 2012 (before the flood control project begin), and after 2012. Respondents were invited to share their opinion about flood causes, frequency, impact, and

especially for questions after 2012 respondents were asked whether they already have benefited from the project. For this section, the area is divided into three: (1) Kurao Pagang where the construction project was exactly taken place, (2) Gunung Sangku, 1.5 km upstream from construction area and at the west of Padang Bypass road, and (3) Batang Luruih, 2.5 km upstream from construction area and the east side of Padang Bypass road. From 30 respondents, 11 respondents live in Kurao Pagang, 10 respondents live in Gunung Sangku, and 9 respondents live in Batang Luruih. Further, data was analysed using descriptive statistics and content analysis.

Table 1 Respondent profile

Age (years)		Lived in Air Pacah (years)		Educational Background		Occupation	
Description	Age	Description	Total	Description	Total	Description	Total
Min	22	0-20	1	Non educated	1	Businessman	7
Max	75	20-35	8	Elementary	10	Farmer	14
Average	43.4	35-55	11	Junior High Sc	10	Housewife	8
		>55	10	Senior High Sc	9	Others	1

5. Results and Discussion

5.1. Frequency and Flood Height

Community perception towards flood frequency and flood depth were shown in Figure 5 and Figure 6. It can be seen from Figure 5 that before 1999, 77% of respondents said that flood was rarely occurred in Air Pacah. However, after 1999, majority of respondents (43%) claim that flood was always occurred, and unexpectedly 27% of them said that flood occurred every time rain poured. It implies that the flood frequency increase significantly.

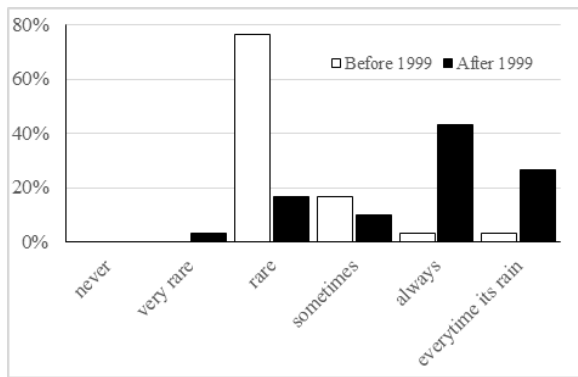


Figure 5 Community perceptions towards flood frequency

Figure 6 shows the average of flood depth according to community. Before 1999, 70% of respondents said that the average of flood depth is less than 50 cm. After 1999, respondents which say that the average depth was less than 50 cm decrease into 43%. Majority of respondents said that the flood depth was between 0.5 and 1 meter.

Respondents were also asked about the maximum height of flood and flood duration. According to them, there is an increase in the average of highest flood

depth, from 28 cm before year 1999 to 71 cm after year 1999. The time of flood duration also rise from 4.7 hours before year 1999 to 13.3 hours after year 1999.

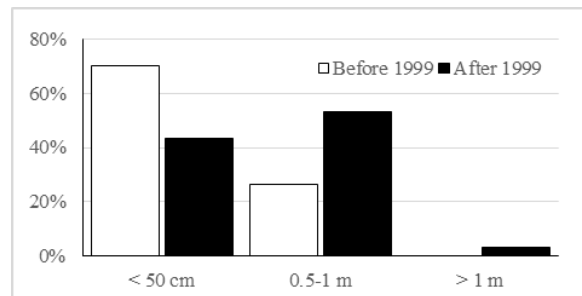


Figure 6 Community perceptions towards flood depth

5.2. Flood Causes

Table 2 shows the causes of flood according to community perceptions. From 8 factors introduced, at the time period before 1999, only one factor has an extremely significant impact to flood, which is ‘a long time rain duration’. Sixty five percent of respondents agree with this opinion. At the time period after 1999, majority of respondents said that there are four factors classified as an extremely significant contribution to flood. They are ‘long rain time duration’, ‘low infiltration area’, ‘many residential areas and offices building’, and ‘bad drainage system’.

There is a significant shift on three factors according to time analysed (before 1999 and after 1999), namely low infiltration area due to the construction, the increasing number of residential area and office buildings, as well as bad drainage system. The last is in line with Kamil [10]. In the period before 1999, people thought that the lack of water infiltration areas and the rapid development as a factor that 'not significant at all'. This factor increases to 'extremely

significant' and 'very significant' respectively in the period after 1999. While the drainage conditions transform from 'significant' to 'extremely significant'.

Furthermore, the public perception of the length of rain time, deforestation, and the will of God is not

shifted between categories before and after 1999. The length of rain time is still considered as a factor that "extremely significant", while deforestation and God's will destiny remain in the 'significant' category.

**Table 2** Percentage of community perception to the causes of flood (before and after 1999)

Causes of flood	Not significant at all		Slightly significant		Significant		Very significant		Extremely significant	
	<99	≥99	<99	≥99	<99	≥99	<99	≥99	<99	≥99
- Long-time rain duration	0.0	0.0	0.0	3.3	6.7	3.3	33.3	6.7	60.0	86.7
- Low infiltration area	36.7	0.0	26.7	3.3	26.7	10.0	10.0	13.3	0.0	73.3
Many residential areas and office building	43.3	0.0	43.3	6.7	6.7	3.3	3.3	46.7	3.3	43.3
- Bad drainage system	6.7	0.0	33.3	6.7	40.0	20.0	13.3	16.7	6.7	56.7
- Deforestation at river upstream	3.3	3.3	33.3	20.0	63.3	66.7	0.0	6.7	0.0	3.3
- lack of public awareness to preserve the river	43.3	0.0	16.7	43.3	36.7	56.7	3.3	0.0	0.0	0.0
- throwing garbage into river and sewers	46.7	20.0	33.3	46.7	13.3	33.3	3.3	0.0	3.3	0.0
- God's will	0.0	0.0	3.3	3.3	93.3	86.7	0.0	3.3	3.3	6.7

### 5.3. Impact of Flood Control Project

This section will discuss what the respondents' perceptions on flood control and the impact that they have felt since project construction. As explained in the methodology section, for this section the study area is divided into three locations. All respondents stated that they had been aware of the activities, which in general they know from other community (60%) with 13 % stating that they know from a socialization carried out by the government.

Since the flood control project was implemented only 9 respondents (30 %) stating that there has been a decrease in the frequency of flood in this area, and all of stating this is that people who live in the area Kurao Pagang (near the project site). Respondent 1 states that:

"... In the past, prior to this project, we experienced flood, water inundated a lot of places, our rice fields were flooded and sometimes washaway. After the construction, when raining, water flows smoothly and does not block anymore."

Respondent 2 added that there is a decrease in flood height level. He stated:

"Since the flood control project taking place, we were not experiencing flood anymore. Before, the flood height was three hollow brick, but now less than one hollow brick"

Meanwhile, for community living in Region 2 and Region 3, none of them stating that there has been a decrease in flood frequency. Respondent 3 complained as follows:

"When its rain for 3 hours, rain is turning into pond. Padang bypass roas blocked the water flow, causing floods".

Respondent 4 adds:

"In the past, flood only happened when it's raining for all day, but now, only a few hours our area becoming flooded, as height as adult's knee. In Junior High School 27, the flood was higher, forced the school to close."

From above, it can be stated that the people who live close to the flood control project already feel the benefits of this project. Community at this location perceive that there has been a decrease in the intensity of floods. While those who are at a bit far from the project site (toward upstream) have not yet benefited from this activity. Considering this benefits, then it is highly recommended that the government to immediately do land acquisition programme.

## 6. Conclusion and Recommendation

### 6.1. Conclusion

It can be concluded that:

1. The community perceives that there has been an increase in flood frequency, flood height, as well as the length of flood time between the periods before 1999 compared to the period after 1999.
2. Prior to the rapid development in Air Pacah area, factors that have extremely significant impact on flood are just the length of rainy time. While after 1999, there are four very influential factors on the occurrence of flood, the length of rainy time, lack of water infiltration areas, the number of residential area and office buildings, as well as poor drainage conditions

3. Communities who live near the location of flood control already feel the positive impact of this project. While community who live slightly upstream from the project site has yet to feel the benefits of this project.

## 6.2. Recommendation

The construction of Maransi River flood control project was hampered by land acquisition. By looking at the benefit that already felt by some community, it is strongly suggested that the government of Padang City to immediately acquire the land needed for flood control project.

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