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Research article

Traditional Flood Mitigation by the Indigenous People of Sampang Madura

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Abstract.
Flooding has taken place in Sampang every year for the last decade. However, before 2010, flooding in this area only occurred on average once every 5-10 years. This paper attempted to analyze the flood intensities and the traditional flood mitigation practices of indigenous people from Sampang. The authors used historical methods consisting of heuristics, criticism, interpretation, and historiography to analyze the problem. By perusing government archives, newspapers, photos, videos, and interviews, the authors learned that flooding in Sampang has become more frequent and the range has become wider than in earlier periods, and this is due to the geomorphological condition and unfinished construction of sheet pile in Sungai Kemuning. This condition causes the residents to be flooded every year. To cope with flooding the residents use traditional mitigation techniques before and after flooding. They can feel *hawa banjir* through environmental signs surrounding their place. They measure the flood water level with a wooden stick called *brenggongan*. As an early warning system, they use *kentongan* and cell phones (to call family or colleagues in the North). When the floods come, important goods are stored in a shelter called *ra' para'an* or *paray*. Moreover, the upper-middle class usually builds an attic (*loteng*) in their house, while the lower-middle class prefers to raise the floor of their house.

Keywords: flood, traditional mitigation, Sampang, Madura

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1. Introduction

"Sampang Kota Bahari, Banjir Sehari-hari" [1] [18] [22]. The quote is a controversial title of online website in October 2016. The slogan of the City of Sampang, which should have been *"Bahari: bersih, agamis, harmonis, aman, rapi dan indah"*, was spoofed by the local people as *"Bahari: Banjir Sehari-hari"* (means: flooding everyday). A response as well as public criticism of the flood disaster that drown the City of Sampang Madura almost every year [2] [3] [4] [5][6].

Based on historical data, the floods in the area of Sampang and its surroundings (West Madura) had been recorded in news reports since the 19^{th} century, exactly in 1872 until the late colonial period [7] [15] [16] [22]. Then, it continuously happened till now with high intensity and varying flood heights, start from 0.5 meters to 2.1 meters. To date, there are a lot of research related to flood mitigation in the area. Start from

mapping analysis of flood-prone areas, mitigation by the government, construction of flood infrastructure, flood hazard models, as well as community participation on the flood management in Sampang. However, almost all of these researches were carried out by academics in the fields of science and engineering [8] [12] [14] [21] [23] [26].

The result of several previous research has not revealed the flood intensity and the efforts of residents facing the floods through their local wisdom. In fact, according to Nawiyanto, the success of mitigation and environmental conservation have been integrating to the conception of the indigenous and it local wisdom [20] [22] [23]. Therefore, this paper tries to explain the causes of the flood intensity in Sampang which occurred frequently in the last 10 years through the flood events in the past. In addition, another important goal is to find out what kind of traditional mitigation by indigenous in Sampang.

2. Method

This paper uses a historical method which have five stages, that is topic selection, source collection, criticism, interpretation (analysis and synthesis), and historiography [17]. The author perusing of some archival sources from the colonial period, as well as archives for the period of research, that is 2012-2020. The archives that have been processed are government reports (colonial and Sampang Regency Government), newspapers, magazines, photos, maps, and some supporting literature for research. Some of archives including: *Algemeen Handelsblad voor Nederlandsch-Indie, De Indische Courant*, Dinas Sosial Archives Collection, BPBD Archives Collection, Bappeda Sampang Regency Archives Collection, *Surabaya Post, Suara Karya*, and Newspaper Clipping Archives Collection by Humas of Sampang Regency. In addition, the author does also an in-depth interview with several informant from the government and also the resident who affected by the flood.

A collection of archives and interviews from several sources above were selected and analyzed to find facts about the history of flooding and mitigation efforts through the local wisdom of indigenous Sampang, Madura. For supporting material for this paper, the researcher also uses several supporting literatures that have studied the floods in Sampang and its impacts. Because traditional mitigation efforts have not become mainstream studies by academics yet, this paper attempts to present a new perspective to understand the history of flooding and its mitigation through local wisdom for the last 10 years. Of course, because it also discusses about history, the author uses supporting sources in the form of literature books and articles, such as: Kuntowijoyo's

work entitled *Perubahan Sosial dalam Masyarakat Agraris Madura 1850-1940*; Gita Ayu Cahyaningrum entitled *Bencana Banjir di Pulau Madura 1875-1940*, Hj. Hosnanijatun entitled *Sejarah Babad Sampang*, and several other supporting literatures.

The author conducts an in-depth reading and analysis of the three types of sources, then interpreting the sources, in order to get the accurate facts about flood events in the past. In addition, the author also collects facts about mitigation efforts through the local wisdom of the indigenous. The final stage compiling and narrating the selected facts into a historiography or flood history writing and mitigation efforts through the local wisdom by indigenous of Sampang Madura.

3. Result and Discussion

3.1. Before and After 2010

For the last 10 years, Sampang has never been absent from flooding. Both big and small floods, almost every year local residents are always be alert, because the water from the North will come to the South with an unknown volume. As stated by one of informant namely Pak Totok, *"kita harus waspada, Allah memberikan banjir tanpa kita ketahui ukurannya"* (mean: we have to be alert, Allah gives us an unmeasurement flood) [25]. Therefore, since 2010 till now the people of Sampang take it as it comes because they believe this disaster is come from the God [22].

Then what about the flood before 2010? It had been explained previously that the flood incident in Sampang has been reported in the newspapers and colonial archives. The oldest flood information is in 1872, which was recorded in the telegram of Assistant Resident Booscher to the Dutch East Indies government in Batavia. In the telegram it was reported that in 1872 not only Sampang was flooded, but also Pamekasan [17]. Then, in several Dutch newspapers, there were also many reports of flood disaster from 1875 to the 1930s [1][5][7][9][10]. This fact show that the flood disaster is not something new for the residents of Sampang. And if we talk about mitigation efforts, surely the indigenous should have a local wisdom to adapt with the disaster.

From the memory of several indigenous Sampang, they said that flood had ever been occurred since the 1960s until the early 2000s, but not every year [22] [24]. The intensity of flooding at that time was about every 2-3 years, even 5-10 years with a fairly high flood volume, around 1-1.5 meters (see table 1). Even the residents of Sampang considered the flood at that time as *"bencana yang dirindukan"* (mean: missed disaster) [22] [25].

Table 1: Flood Disaster Events in Sampang City in 1968-2020.

No.	Flood Years Event	Affected Area	Flood Height (cm)
1	1968/69	Jl. Imam Bonjol, Jl. Mawar Jl. Melati, Jl. Panglima	100
2	1971	Kel. Dalpenang	150
3	1978	Kel. Dalpenang Kel Gunung Sekar	150
4	1980s	Kel. Dalpenang	100
5	1991	Kel. Dalpenang Kel. Gunung Sekar Kel. Rongtengah	300-400
6	2002	Kel. Dalpenang Kel. Gunung Sekar Kel. Rongtengah	150
7	2010	Kel. Dalpenang Kel. Gunung Sekar	<100
8	2011	Kel. Dalpenang Kel. Gunung Sekar	<100
9	2012	Kel. Dalpenang Kel. Gunung Sekar Kel. Rongtengah	180
10	2013	Kel. Dalpenang	<100
11	2014	Kel. Dalpenang	<100
12	2015	Kel. Dalpenang Ds. Panggung Dsn. Glisgis Ds. Paseyan	20-80
13	2016	Ds. Tanggumong Ds. Kemoning Ds. Paseyan Ds. Panggung Ds. Gunung Maddah Kel. Gunung Sekar Kel. Rongtengah Kel. Karang Dalem Kel. Dalpenang	70-150
14	2017	Ds. Tanggumong Ds. Kemoning Ds. Paseyan Ds. Panggung Ds. Gunung Maddah Kel. Gunung Sekar Kel. Rongtengah Kel. Karang Dalem Kel. Dalpenang Kel. Polagan Kel. Banyuanyar Kel. Banyumas Ds. Pangilen	20-120
15	2018	Ds. Tanggumong Ds. Kemoning DS. Paseyan Ds. Panggung Ds. Gunung Maddah Kel. Rongtengah Kel. Karang Dalem Kel. Dalpenang Kel. Polagan Kel. Banyuanyar Kel. Banyumas Ds. Pangilen	20-80
16	2019	Ds.Banyumas Ds. Pangilen Ds. Kamoning Ds. Tanggumong Ds. Gunung Maddah Ds. Panggung Ds. Paseyan Kel. Dalpenang Kel. Rongtengah Kel. Gunung Sekar	20-70
17	2020	Ds.Banyumas Ds. Pangilen Ds. Kamoning Ds. Tanggumong Ds. Gunung Maddah Ds. Panggung Desa Paseyan Kel. Dalpenang Kel. Rongtengah Kel. Gunung Sekar Kel. Karang Dalem Kel. Polagan Kel. Banyuanyar Kel. Tambelangan	20-100
Sources: [2] [19] [22] [24] [25] [27]			

If we look at the table above, the floods that occurred from 2010 to 2020 are indeed fluctuates. It means, there are several years that occurred the major floods, and there are also small until medium flooding events, but the intensity is so frequent because continuously happens every year. Several major floods were recorded in 2012, 2013, 2016, 2017, and 2020. While others were included in the small and medium categories. Residents of Sampang also complain, why the recent flooding is frequent and the area coverage is larger than before. Even the rarely flood areas like Kelurahan Karang Dalem, Desa Paseyan, Desa Panggung, and Desa Gunung Maddah, nowadays is also affected by flood. The flood is not too big, but it spread in almost all villages in Sampang. This causes further questions regarding the real cause of the flood.

Major floods in several years were caused by overflowing water from the Kemuning River that crosses the city center. Meanwhile, the water in the Kemuning River comes from small rivers in the Northern area of Sampang, such as Robatal, Kedungdung, Karangpenang, and Omben. These four areas have medium rainfall and rare forest [11] [12] [17] [26]. As a consequent, rainwater flows from small rivers to the meeting point of streams of the Kemuning River which is located in Sampang City. These conditions then, make the city area receive the impact, that is the flood [22].

In addition, the topography of the city which resembles a spoon also affects the occurrence of flooding. The condition of the height of Sampang City is 0-12.5 cm above sea level [2] [13] [14]. This means that land and sea have the same height. Meanwhile, the condition of the Kemuning River has many meanders and every year experiences siltation. Since 2017, the Sampang Regency Government trying to mitigate it with the river normalization project and the installation of sheet piles along the river. However, the project has not been completed to date, and caused the flood coverage to be wider than before.

In addition, the rainfall in this area is also quite high, which is around 250-300 mm (Jeihan, 2017). This research undermines the opinion of most people and government who think that so far it has been the highest rainfall in the North. The frequent flooding in the last 10 years is also due to the habit of local people who like littering, either throwing it in rivers or sewers. Meanwhile, sanitation conditions in densely populated urban areas can be said to be poor. Many sewers are not running properly, even clogged. This condition has exacerbated the intensity of flooding in Sampang City [3] [13]. Therefore, it is not surprising that the intensity of flooding in urban areas reaches 17-21 times a year, even 4 times a week [22].

3.2. Mitigation Before the flood

Flood mitigation is a step or action taken by residents and the government to reduce the impact or risk of a flood disaster [4]. As previously discussed, floods in Sampang have been reported very frequently and have even been reported since the colonial period. Therefore, the long history of disasters has led to mitigation efforts carried out by the community and the local government. This paper specifically discusses flood mitigation through local wisdom of the population or it can also be called traditional mitigation.

Local wisdom is a view of life and knowledge as well as various life strategies in the form of activities carried out by local communities in responding to various problems in meeting their needs. Local wisdom is the result of thinking from a particular community in dealing with a problem that is obtained through community experience based on local community values and not necessarily experienced by other communities.

When the flood occurs, the thing most affected by the flood is how to keep people and their important goods safe. Some important items such as electronics, important papers, possessions, and logistics must be saved first in order to survive when their house is flooded. Therefore, the affected residents tried to put the items in a higher place so that they would not be flooded. From this, local wisdom emerged from the Sampang community as a mitigation effort in dealing with floods that occur every year.

Mitigation efforts can be seen before and after (when) the flood. Believe it or not, the people of Sampang can know the *"hawa-hawa banjir"* (mean: flood weather). That is, when there will be a flood, some residents, especially those who have experienced flooding for a long time, can feel the air. Because of the frequent flooding, even once in a year about 21 times, local residents can understand the signs. In this case, there are natural signs such as unusually cloudy clouds, fairly strong and cold winds, and the phenomenon of many worms suddenly coming out of the ground. Natural phenomena like this were then marked by some residents to predict, "*engan cuaca nah banjir*" (like the flood weather).

After saying this sentence and other residents also believe it, there is a possibility that a flood will come. Although this is not always true because it only relies on feelings, it is undeniable that this often happens in the community. This community feeling includes mitigating local wisdom because only people who often experience floods can feel this, also when they feel it the residents begin to prepare for the possibility of large and small floods. The residents' preparations began with seeking information from the North, either by contacting their families or colleagues. Is it raining heavily there or

not. Whether the small rivers that lead to the Kemuning River start to overflow or not. Using this way, they can anticipates with traditional tools such *as brenggongan* and *kentongan* [24] [25].

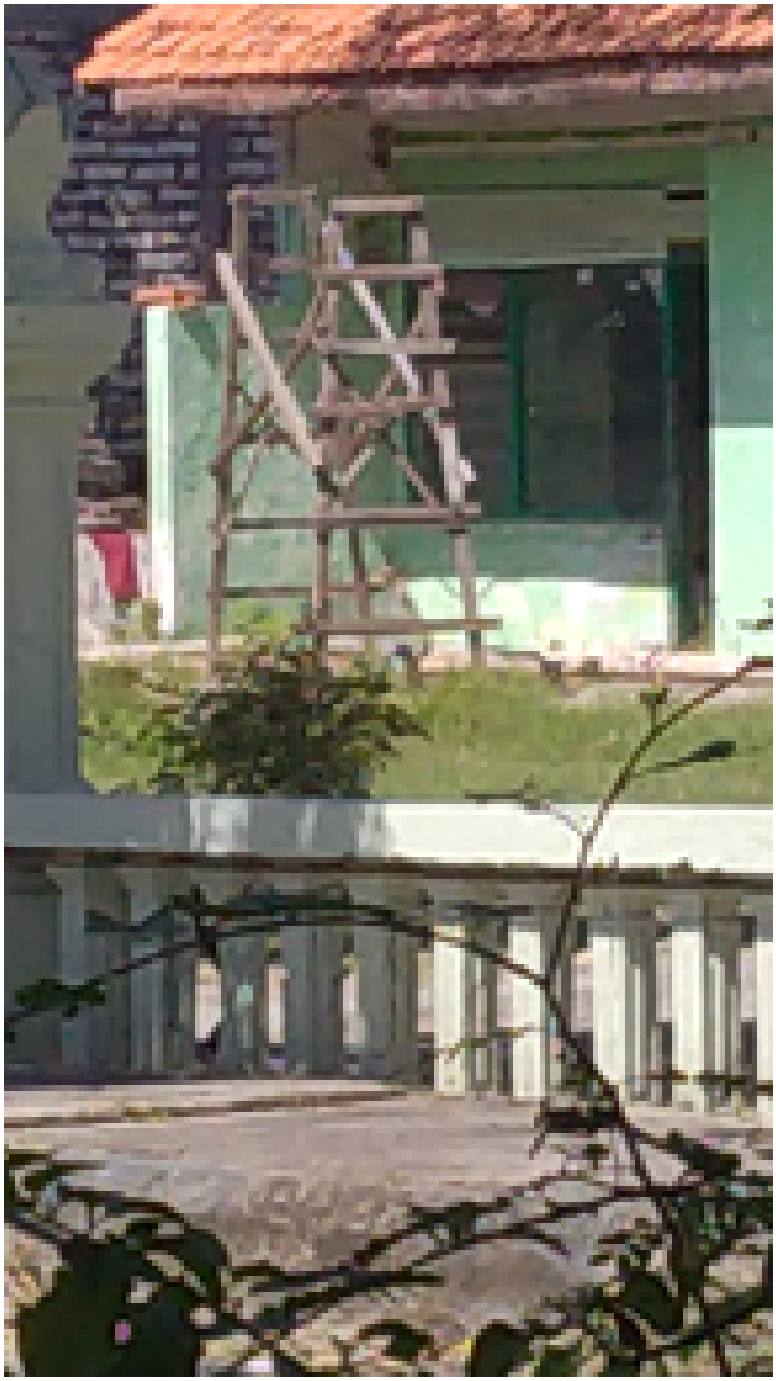

Figure 1: *Brenggongan* In Front Of The Houses At Dalpenang Village. Source: Personal documentation, 2021.

Brenggongan is an object made of wood that has a fairly high size and its shape is similar to the stairs (see Figure 1). This *brenggongan* being a traditional flood mitigation in Sampang because it used to measure the flood water levels and also sooner or later

the water will rise to residential areas. *Brenggongan* made of wood generally has a height of more than 2 meters so it is possible to use it to monitor the development of flood waters. Usually, after monitoring the flood water level using a *brenggong*, it can be seen how fast or slow the increase of water and the level of water also. When the water is looking rise rapidly, the *kentongan* will sound as a sign that flooding is likely to be high and residents are asked to be prepared to protect their families and important goods [27].

Kentongan not only as a sign when there is a thief, but in Sampang it has been used as one of the traditional mitigation by indigenous as a sign that the flood will be coming. Actually, *brenggongan* can not only be used to monitor the water level, but it can also used as a buffer to put some important goods in a higher place so as not to be flooded [19].

However, over time and the development of the times, grunts and gongs are no longer used. This is because flood information can be recorded by the Early Warning System (EWS) in the North Sampang area. Furthermore, through the Sampang Regency BPBD, flood information was distributed via Whatsapp (WA) which contained predictions of the affected area, the peak of incoming water and also the time of receding. Sometimes there are also BPBD cars that go around flood-prone areas to announce that there may be flooding in the area and ask residents to be prepared [27].

3.3. Mitigation After (When) Flood

When the flood came, the residents were also prepared, they made small shelters to accommodate their important items. The terms also varies, some said *paray*, *pare'*, or *ra' para'an*, but most people call it *ra' para'an* (see Figure 2). It means a place to store or save things when a big flood comes. Starting from logistics, cooking utensils, important files, even humans [22] [27].

Basically, *ra'para'an* or *paray* have the same function, that is a place made under the roof of the house and generally above the kitchen or living room. In the past it was usually used to put or store goods such as firewood, agricultural products (such as rice, secondary crops, corn), kitchen utensils or other logistical materials. The thing that distinguishes it is the mention in each area, residents of Rongtengah Village called *paray*, while residents of Dalpenang Village called *ra' para'an*. Over time, these two shelters became local wisdom to minimize the impact of flooding in Sampang. Until now, almost all houses in Dalpenang and Rongtengah Villages have this shelter [23] [25] [27].

Figure 2: *Ra' para'an* in one of the houses in Dalpenang Village. Source : Personal documentation, 2021.

The use of *ra'para'an* not only by local residents, but also applied in SMKN 1 Sampang, especially in the teacher's room (see Figure 3). This school is located in Dalpenang Village, which is affected by floods every year. In 2012 and 2016 this school was affected by heavy flooding because of its location very close to the meander of the Kemuning River. This school is submerged up to 1.5-2 meters. Many electronic items and important files belonging to teachers and schools were damaged, even lost in the flood currents. To anticipate this, the teachers and education staff make ra'para'an in the teacher's room and several other rooms. That way, the belongings of the school and the teachers can be saved when the water comes in a high volume [27].

Figure 3: The location of *ra'para'an* in the teacher's room at SMKN 1 Sampang. Source : Personal documentation, 2021.

In addition, there is another shelter called the *loteng*, which is a house that is leveled, consisting of 2 to 3 floors. The *loteng* or in Indonesian better known as attic is the most common mitigation effort carried out by residents whose areas are prone to flooding. Mitigation by building a *loteng* is usually carried out by residents with middle to upper economic conditions because indeed building a *loteng* requires a large amount of money so that most people in the lower middle class choose not to build a *loteng*. The construction of this attic began to be carried out a lot around 2010 until now, because above that year floods were frequently happens [19] [25] [27].

When the Sampang people build a house, the first thing they take into account is the location. If the house is located in a flooded area, such as Dalpenang and Rongtengah Villages, it is likely that the house will be built along with loteng as a traditional mitigation. One of the proofs is the house of Mr. Abdul Maat around Jl. Bahagia, a flood-prone area (see Figure 4). In addition, King Residence 2 in Rongtengah Village was also built with a high foundation and almost all houses have *loteng*, only about 5 houses without *loteng* out of a total of 25 houses [19]. This happened not only in Rongtengah, but also new houses in Dalpenang Village were mostly built with *loteng*.

Figure 4: *Loteng* in Abdul Maat's house, Rongtengah Village Source : Personal documentation, 2021.

Building a *loteng* is a reasonable mitigation carried out by residents whose houses are in flooded areas, because with the *loteng* people can save themselves and still have a place to rest. In addition, by building an *loteng*, the person has a place to store

valuables more safely. Building a *loteng* is a fairly effective mitigation effort, but the problem is that it costs a lot of money to build it, and not everyone can do it. While the upper middle class can build *loteng* for flood mitigation, the lower middle class people prefer to raise the floor of their house every time there is a big flood. This effort was made because it did not have a lot of money [19] [22] [27]. The floor height that even reaches 1.5-2 meters. When an adult enters one of the rooms in the house, they have to look down because their head can touches the upper door frame (see Figure 5).

Figure 5: Conditions of a house in Dalpenang Village. Source : Personal documentation, 2021.

For residents of the lower middle class, there is no choice but to raise the floor of their house. In fact, sometimes there are also those who make *penyanggeh*, which is a kind of bamboo pole that is staked in front of the house. Its function is to hang items such as chairs, mattresses, and other household furniture. The furniture of the house cannot be placed in *ra'para'an*. If it is flooded, it will be submerged. Some other residents also chose not to buy chairs and other furniture in the living room, because if they were hit by a flood, everything would be damaged quickly. So it is not uncommon to find people's houses, especially in Dalpenang where the living room is empty and has no furniture [22] [25] [27].

Mitigation using *penyanggeh* is quite effective in delaying and reducing the risk of household furniture being flooded. Furniture that is exposed to water will always have traces of water mixed with mud for a long time, even for years if it is not cleaned and repainted [25] [27]. Another effect of flood water when soaking goods made of wood that is not good will cause damage and brittleness. Some furniture such as wardrobes and tables will quickly be damaged if they are often flooded. At first, the wood fungus will grow, emit an unpleasant odor, and become brittle, then broken and cannot be reused.

Interestingly, the people in Sampang always doing *gotong-royong* to help the victims of flood. If the neighbor don't have a shelter to protect himself, the other neighbors always offer to be in their shelter. They help each other and together survive the flood.

The Madurese are famous for their very strong solidarity and kinship attitude. Not only in the land of Madura, even overseas, fellow Madurese also help each other. This *gotong-royong* culture later became a local wisdom for flood mitigation.

During the flood, fellow residents helped each other if there were difficulties. In this case it can be seen from the use of the *loteng*. Neighbors who do not have *loteng* can stay with other neighbors who have a *loteng*, which is very common in Sampang City. Not only that, even people who have important belongings but there is no safe place, they can entrust them to neighbors who have *loteng*. In terms of *gotong-royong*, the Madurese, especially Sampang, must be appreciated because even in difficult conditions they still solid [22] [25].

The wisdom of *gotong-royong* can also be seen when receiving disaster relief, both the government relief and the community groups (see Figure 6). If the team of disaster relief passes in a flood-affected area, people who see it will scream with the word *"bantuan-bantuan!"* (means: relief-relief). They doing this in order to get people around him out from the home. If one family does not go out because of take a rest, their neighbors will ask for more disaster relief from the teams to be distributed to neighbors who have not received a relief [25] [27].

Figure 6: Distribution of logistics by Tagana (Taruna Siaga Bencana) & Gaspala (Gerakan Siswa Pecinta Alalm). Source : Gaspala Photo Archive Collection, 2019.

On the one side, the Sampang flood is indeed a troublesome and boring disaster because it frequently occurs. However, on the other side, *gotong-royong* to face the

flood made the indigenous stronger because they helped each other and safed other residents affected by the flood. Supposedly, this local wisdom, *gotong-royong,* should be uses to minimize the risk of floods in Sampang, not only when a flood occurs.

4. Conclusion

The flood disaster in Sampang Madura has become a natural routinity. This is caused by high rainfall and sedimentation in the Kemuning River. Meanwhile, urban conditions with densely population were not balanced with environmental awareness, because there are still many who littering and have poor sanitation. The location of the city is crossed by the Kemuning River which has many meanders and the location of the meanders isin the centers of the crowd. This causes the city of Sampang to be flood-prone. Instead of minimizing the impact of floods, the government's efforts to normalize rivers and installing sheet piles have actually created new flood points. The Sampang flood, which initially inundated 2-3 villages, nowadays it affecting almost 13 villages in Sampang.

Learning from local wisdom or the traditional mitigation by indigenous Sampang when facing floods. Evidently, they had accepted this disaster as a God's fate. All they can do is help each other among affected people and how can they living friendly with the flood disaster. They should also think about how to use their local wisdom to prevent flooding. If there is a proverb, *"mencegah lebih baik daripada mengobati"* (mean: prevention is better than medicates), for the flood case in Sampang, "it is better to prevent the flood than continuously to be a victims".

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