

# Minangkabau local wisdom: the philosophy of *aua jo tabiang sanda basanda* in disaster mitigation along the watershed (DAS)

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**Abstract.** The number of events and losses due to disasters along the West Sumatra Watershed in 2022 is large. Damage to roads, bridges and other buildings has caused many material and non-material losses. If material losses can be calculated clearly, carefully, the components of the loss and set the numbers. Non-material losses tend to be greater because many aspects of life are interrelated. Data on the number of rivers in regencies and cities in West Sumatra are also numerous and further increase the potential for disaster damage. Meanwhile, Minangkabau local wisdom, known as the philosophy of *aua jo tabiang sanda basanda* or translated as bamboo and river cliffs lean on each other, complement and strengthen from river water scouring. This local wisdom has been understood, applied and proven over a long period of time. This paper would like to discuss this Minangkabau local wisdom as a scour barrier along the watershed. In many cases it has been shown that bamboo piles are more economical, compared to concrete and modular piles. In addition to being more economical, they also provide additional income for the surrounding community. Isn't prevention better than repair?

## 1 Introduction

West Sumatra Province has a high potential for disasters such as coastal abrasion, strong winds, floods, flash floods, earthquakes, forest and land fires (*Kahutla*) and landslides. Data from the BPBD (Regional Disaster Management Agency) of West Sumatra during the period 2019-2023 shows that there have been 3,770 disasters, with material losses estimated at Rp 1,590,645,949,619

(One Billion Five Hundred Ninety Million Six Hundred Forty-Five Thousand Nine Hundred Forty-Nine Rupiah Six Hundred Nineteen Cents). This is a large material loss that should be minimized in number and incidence [1]. The disaster occurred in all districts/cities in West Sumatra. In addition to the material loss, there was also a non-material loss felt by the community due to death, loss, displacement, injury/sickness, as summarized in the following table:

**Table 1.** Recapitulation of disasters in West Sumatra Province in 2019-2023

Disaster Type & Loss	Year					Total
	2019	2020	2021	2022	2023	
<b>A. Disaster Type:</b>						
1. Coastal Abrasion	1	5	4	5	8	23
2. Strong Winds	75	375	658	674	562	2,344
3. Flood	33	84	113	123	144	497
4. Flash Flood	6	17	7	5	10	45
5. Destructive Earth quake	1	7	-	2	1	11
6. Forest Fire ( <i>Kahutla</i> )	54	15	36	92	76	272
7. Land slide	27	146	10	120	166	469
Disaster Total	<b>208</b>	<b>649</b>	<b>925</b>	<b>1021</b>	<b>967</b>	<b>3770</b>
<b>B. Loss</b>						
1. <b>Material</b> (Rp)	171,017,356.156	66,655,994,000	170,835,655,000	1,136,849,586.796	45,287,357.667	<b>1,590,645,949.619</b>
2. <b>Non-Material:</b>						
a) Died	7	7	21	28	30	<b>93</b>
b) Missing		2		4	-	<b>6</b>
c) Inquired/Sick	79	11	651	456	3,188	<b>4,385</b>
d) Displaced	3,066	4,674	476	26,265	5,480	<b>39,961</b>

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Table 1, above shows that seven types of disasters have resulted in material and non-material losses that are not small. Non-material losses that resulted in the death of 93 people, and four people missing cannot be compared with material losses of any size [2]. Not to mention if you count other non-material losses, which are much greater in number and quality than material losses, including other non-material losses as will be explained in the next section.

## 2 Results

Disaster mitigation is the process of managing natural disasters to reduce and minimize the impact on people and property. Mitigation includes a series of efforts to reduce or eliminate the negative impacts of disasters, before, during, and after a disaster occurs. The ultimate goal is to protect people, reduce property losses, and minimize community disruption. Disaster mitigation is an important part of disaster risk management that aims to create communities that are more resilient and prepared for different types of disasters. There are four risk reduction strategies: risk avoidance, risk reduction, risk transfer, and risk storage. Risk can be avoided by turning the hazards

that can arise into something useful. Risk transfer is done by addressing vulnerabilities to damage and disruption. Risk transfer is done by ensuring the alteration of hazards that have a financial effect on individuals and communities. Meanwhile, risk storage is an effort to prepare finances to compensate for losses due to hazards that will occur. Mitigation can be divided into structural and nonstructural mitigation. Structural mitigation is an effort to avoid losses due to hazards that arise by doing physical development, with infrastructure construction techniques that have durability in providing protection against hazards. Nonstructural mitigation is an effort to avoid losses due to hazards that arise by empowering the community. Empowerment is done by making policies, increasing public awareness of hazards, and developing knowledge of hazards. In addition, community empowerment is also carried out by using community participation methods in the prevention of damage, disturbance and hazards. Unlike disasters such as earthquakes and tsunamis, the potential for floods and landslides along watersheds on roads, bridges and other buildings can be anticipated early by planning a number of programs and activities. This anticipation is important to reduce the risk of damage and maintain the safety of road users (Table 2).

**Table 2.** Damage to roads, bridges, and other buildings due to floods and landslides in 2019-2023 at West Sumatra

Damage	Year					Total
	2019	2020	2021	2022	2023	
School (unit)	14	25	36	5	35	<b>115</b>
Houses of Worship (unit)	19	33	25	4	79	<b>160</b>
Health Facilities (unit)	2	7	3	1	2	<b>15</b>
Offices (unit)	1	4	4		10	<b>19</b>
Bridges (unit)	23	23	21	19	30	<b>116</b>
Road (km)	9	24	2	24	1	<b>60</b>
Rice Field (ha)	543	913	1042	18	17,894	<b>20,410</b>
Garden/Forest (ha)	52	184	3,132	9	4,963	<b>8,340</b>

The damage varies in level from minor to severe damage resulting in:

1. Erosion, which causes structural damage, i.e. damage to key structural elements, which reduces their ability to withstand loads and thus threatens the safety of users.
2. Potholes and Cracks, due to water flowing under the surface making it unsafe to pass.
3. Weakening of foundations due to river water erosion, reducing stability and increasing the risk of collapse.
4. Drainage damage, due to blocked water flow or damaged structures can worsen conditions and cause greater waterlogging.
5. Landslides, which can block roads and threaten the safety of users.
6. Erosion of riverbanks, which has the potential for roads, bridges and other structures to collapse into the river.

Material losses due to damage to roads, bridges and other buildings have been obtained in nominal terms as shown in the table above. However, non-material losses, if calculated more carefully, tend to be greater because many aspects of life are interrelated, but not immediately

visible [3]. Non-material losses due to damaged roads, bridges and other buildings can have a wide impact on various aspects of people's lives. Several aspects of non-material losses were identified, namely:

1. Disrupted mobility of people and goods, i.e. difficulty and limited access to health facilities, education, employment and markets and others. In addition, travel time becomes longer because of the need to find alternative roads.
2. Social impact, isolation between locations because they are separated by broken roads or bridges, potential for stress and anxiety, in the form of uncertainty of access and travel.
3. Disruption to business and reduced revenue due to a decrease in customers reaching their shops/business premises as well as a reduction in economic activity, due to difficulties in the distribution of goods and services.
4. Psychological impact, uncertainty about when the road or bridge will be repaired and may cause concern among the affected population. In addition, events during and after the incident can cause trauma.

5. Environmental degradation, using alternative routes that are not designed for high traffic volumes can cause environmental damage, such as soil erosion.

Understanding these non-material losses is important to discuss in order to deal with emergency situations caused by failing roads and bridges. This is an important point of thought that can also help in planning for disaster risk mitigation in the development of more disaster-resilient infrastructure in the future [4] The next important point is that non-material losses last for an indeterminate period of time, which can be overnight, a week, a month or even two or three months depending on the severity of the damage and the timing of the repair work. So far, there is no official record that can be used as a reference to calculate these non-material losses. It is as if non-material losses due to damage to roads, bridges and other buildings have received less attention, calculation and budget from the relevant parties.

Potential losses due to floods and landslides along the rivers in West Sumatra are reinforced by the large number of rivers in all districts/cities. Based on data from the Department of Water Resources and Bina Konstruksi, the West Sumatra region drained by this large river can be divided into eight SWS (River Area Unit), namely:

1. SWS Natal-Batahan (380 km<sup>2</sup>)
2. SWS Rokan (2,190 km<sup>2</sup>)
3. SWS Kampar (2,591 sq. km)
4. SWS Inderagiri-Akuaman (10,545 km<sup>2</sup>)
5. SWS Batang Hari (8,264 km<sup>2</sup>)
6. SWS Masang-Pasaman (6,313 km<sup>2</sup>)
7. SWS Tarusan-Silaut (6,280 km<sup>2</sup>)
8. SWS Siberut-Pagai-Sipora (7,338 km<sup>2</sup>)

The potential for floods and landslides along the rivers in West Sumatra that can damage roads, bridges and other buildings can be explained from various aspects, namely:

1. Geomorphology, explaining the number of rivers and water flow. The more rivers a region has, the more waterways there are so that rainwater flows faster into the river, and can reduce the potential for flooding if the river is able to accommodate it. However, if there is not enough capacity in the river, especially during the rainy season, the risk of flooding increases. Smaller rivers that drain into larger rivers can also potentially cause a buildup of water flow that eventually overflows and causes flooding.
2. Topography, in effect, in areas with many rivers, the topography varies from lowlands to mountains. Mountain rivers are fast-flowing and have the potential to cause erosion and landslides. Whereas in low-lying areas, rivers cause flooding if natural or artificial drainage is unable to drain water effectively.
3. Spatial Planning, good watershed management, can reduce the risk of floods and landslides such as reforestation, building embankments, and spatial planning that does not narrow the flow of the river. Poorly managed rivers tend to have a higher risk of floods and landslides. Deforestation in the upper reaches of rivers can reduce the soil's ability to

absorb water, which increases surface flow and the risk of floods and landslides.

### 3 Discussion

Bamboo has several species and Latin names such as:

1. *Bambusa vulgaris*, the single most common type of bamboo and used in construction.
2. *Phyllostachys edulis*, or Moso bamboo, is used in the food and textile industries.
3. *Dendrocalamus asper*, betung bamboo, is used in furniture making and building.
4. *Bambusa blumeana*, or thorn bamboo, is widely grown in Southeast Asia.
5. *Gigantochloa apus*, or wormy bamboo, is used in handicrafts and furniture.
6. *Phyllostachys aurea*, yellow bamboo or golden bamboo, is often used in landscaping.
7. *Fargesia murielae*, umbrella bamboo, as an ornamental plant due to its attractive shape.

Each bamboo species has unique characteristics that make it suitable for various uses and environments. Furthermore, it is understood that the species *Bambusa vulgaris*, *Phyllostachys edulis*, and *Dendrocalamus asper*, are more appropriate as scour retaining walls along watersheds [5]. For the people of West Sumatra, bamboo has many names such as *buluah*, *batuang*, and *aua*. Bamboo that is suitable for retaining river water scour is the *Aua* type, as shown in Fig. 1.



**Fig. 1.** *Aua* retaining scour along the watershed

Bamboo is a plant that comes from the kingdom plantae with order *poales poaceae* family. Bamboo has a rapid growth rate with the influence of the soil conditions where it grows, as well as the climate. Some types of bamboo can grow to a height exceeding 30 M with a stem circumference of 30 cm, and bamboo can grow 3 to 12 cm per day. Bamboo develops by means of its roots and rhizomes below the soil surface. Its easy spread means that young bamboo shoots can appear in many places, which makes bamboo a potential invasive plant if its spread is not controlled [6].

The benefits of bamboo can be seen from various aspects, such as related to water, air, land and various other benefits. Bamboo helps to improve water catchment sources or helps the availability of water content in the soil. Bamboo forests have a greater

ability to absorb water when compared to other types of plants. When compared to pine forests, bamboo forests are far superior, absorbing up to 240%. If other trees are only able to absorb 35%-40% of rainwater, while bamboo absorbs up to 90%. There are those who can use bamboo as reforestation in former coal mines that can help provide a groundwater level of 6.3 m within 4 years.

Bamboo is also able to help withstand and even reduce noise and air pollution. Regarding noise pollution, bamboo can withstand noise. With regard to air pollution, bamboo has the potential to absorb up to 62 tons/Ha/year of CO<sup>2</sup>. That amount is much greater when compared to other types of plants that are only able to absorb 15 tons/Ha/year. Bamboo can also release the results of the photosynthesis process in the form of oxygen up to 35% greater than the release of oxygen from other trees.

Bamboo roots also have benefits for the soil in which it grows. The bamboo root system itself can strengthen the soil layer it grows on. So, planting bamboo is perfect for preventing erosion and landslides. Bamboo is an easy alternative choice to prevent these two things from happening. Besides strengthening the soil layer, bamboo roots can also help maintain the quality of the soil it grows on. In addition, the root system can prevent soil destruction by retaining and filtering various pollutants that could potentially damage the soil. The roots can also at the same time trigger nutrients needed by the soil. All of these are related to the benefits of bamboo with nature directly and with humans indirectly. Humans can also enjoy the direct benefits of bamboo, which can be used to make various crafts of high economic value. Such as bamboo watches, bamboo bicycles, bamboo walls, etc.

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Bamboo plants have various advantages when planted on the riverbank, namely:

1. Prevents erosion, as it has strong, dense and extensive roots that can help stabilize the soil along the riverbank, reducing the risk of soil erosion due

to heavy water throughout the watershed. There will also be increased soil stability as the roots are able to bind soil particles, making it more difficult for them to break away and be carried away by water.

2. Water Conservation, reduced velocity of water flow as the roots, stems and leaves can slow down the flow of surface water, allowing more water to seep into the soil and reducing the risk of flooding and soil erosion. There is also an increase in groundwater storage as the roots of bamboo can help to increase the infiltration of water into the soil, which helps to maintain soil moisture around the river.
3. Natural Purification of Water, as bamboo roots act as a natural filter that helps filter out sediments and water pollutants, improving the quality of river water.
4. Flora and Fauna Habitat and Biodiversity, as bamboo forests provide an important habitat for a variety of plant and animal species, increasing biodiversity in the ecosystem along the river. Bamboo can also grow faster and provide effective ground cover, which can help restore vegetation in degraded areas.
5. Economic Benefits as a source of raw materials, as it can be harvested for a variety of purposes, including building materials, handicrafts, and food.
6. Ecological Benefits Bamboo has a high ability to absorb carbon dioxide, helping to reduce carbon emissions and mitigate climate change. It can also improve air quality, as bamboo releases large amounts of oxygen, improving the air quality around the river.
7. Aesthetics and Recreation, with bamboo plants will add to the landscape, and visual beauty along the river, making it a more attractive place for recreation and tourism. Bamboo areas along the river can serve as recreational areas, walking paths, and green spaces.

Riparian bamboo plants bring a variety of ecological, economic and social benefits. It not only helps to protect and restore the river ecosystem but also provides a sustainable resource and natural beauty. Bamboo is therefore an excellent choice for river rehabilitation and conservation projects [4].

In civil engineering, there are turaps, which are civil engineering structures that retain soil to prevent landslides or erosion; built on hillsides, cliffs, highways, and other areas prone to movement or landslides. Turaps can be made of reinforced concrete, making them stronger and more durable. Or they can be made from piles of stones, or from special wooden structures for small and temporary projects. Wooden tiers are not as strong as concrete and wood, but are cheaper and quicker to install. Sandbag turrets can also be used for temporary or emergency solutions. There are also modular turrets, made up of modular blocks that can be installed quickly and easily, for projects that require flexibility and speed of installation as shown in Figs. 2-4.



Fig. 2. Concrete turret



Fig. 3. Modular turret



Fig. 4. Concrete turret not working

Tarps are very important because they not only play a role in maintaining soil stability, but also in protecting infrastructure and the surrounding environment. After searching the literature on turrets, almost no bamboo turrets were found. This is somewhat surprising because why would this be the case? No academically and methodologically satisfactory answer has yet been found. In fact, there have been various literature studies on the biological, and other disciplinary benefits of bamboo as a flood and landslide barrier.

Fortunately, there is Minangkabau local wisdom with the philosophy of *aua jo tabiang sanda basanda*. Literally, this local wisdom can be translated as bamboo and cliffs leaning on each other, symbiotically

strengthening each other, and complementing each other from river water scouring/erosion. Cliffs are better understood as river cliffs not riverbanks. There is no historical evidence that explains the year when this philosophy began to be used as a local wisdom. Local wisdom is a collection of knowledge developed in a society that is passed down from generation to generation on many aspects. This knowledge covers various aspects of life, such as farming methods, traditional medicine techniques, customs, and daily habits that are considered good and right by the community. Local wisdom reflects a community's deep understanding of their natural, social and cultural environment [7].

As local wisdom, the philosophy of *aua jo tabiang sanda basanda* includes knowledge about sustainability and environmental preservation, cultural identity and communal pride that can maintain Minangkabau cultural heritage. It is also a form of adaptation and innovation, which although based on old traditions, local wisdom is not static and is able to adapt to environmental and social changes, and is open to innovation so that people can combine local knowledge with modern technology to create relevant and effective solutions. In the case of Minangkabau local wisdom, this philosophy has been proven, in terms of bamboo biology, civil engineering and also economics and other aspects. The cost of planting bamboo as flood and landslide retaining walls along a watershed is also cheaper, and the growth period is faster, among other considerations. The question is why hasn't the *aua jo tabiang sanda basanda* philosophy been applied? Are there biological, economic and other considerations that prevent the utilization of bamboo as a barrier to water scouring, flooding and landslides along the watershed?

Isn't the principle of "prevention is better than repair" still relevant? This principle essentially emphasizes the importance of preventive measures to avoid problems or damage rather than having to deal with the impact after it occurs. It applies in a variety of contexts, including the environment, infrastructure management and more. In terms of the environment, it is understood that using natural resources wisely and safeguarding ecosystems can prevent environmental damage that takes time and money to restore. Infrastructure management includes routine maintenance work, and longer design. Performing regular maintenance on roads, bridges and buildings can prevent major breakdowns that require expensive repairs and cause significant disruption. Designing infrastructure with risks such as flooding, erosion and earthquakes in mind can prevent major damage. The principle of "prevention is better than repair" is useful because it can reduce costs more efficiently, because prevention is cheaper than repair. Isn't it true that avoiding problems means avoiding costs too? Preventive measures can reduce or eliminate the negative impact of a problem, and can lead to a better quality of life. Preventing the scouring of water along a river (watershed) that causes roads, bridges and other buildings to be damaged, or cannot be utilized is cheaper than dealing with these problems after they occur. It is also understood that prevention efforts can save time that could be used to address other problems. Resources and manpower can be more

efficiently allocated to other, more productive activities. Overall, the principle of "prevention is better than repair" encourages thinking ahead, identifying potential problems before they become major, and implementing appropriate preventive measures to reduce the negative impacts that could occur.

## 4 Conclusion

Based on the above explanation, it can be concluded that the following are:

1. Bamboo is very suitable to be used as a retaining wall for river water scouring, because it has advantages in terms of biological, civil and economic engineering and other aspects.
2. The planting period of bamboo is also very fast, which further strengthens the argument that bamboo is very suitable as a river water scour retaining wall.
3. As a local wisdom, planting the right type of bamboo can minimize the risk of disaster mitigation due to scouring in areas along the river basin,
4. It is better to start now to avoid greater risks in the future.

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