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Contribution of Avicennia marina Mangrove to Wave Reduction for The Importance of Abrasion As An Alternative to Coastal Buildings (Case Study at Lampung Lampung Mangrove Center, East Lampung Regency, Indonesia) Abstract: Mangrove ecosystems have ecological functions and physical protection functions to the coast. Mangrove function can perform wave attenuation naturally. The purpose of this research are : (1). To know the function of Avicennia marina mangrove to wave attenuation.

(2). To obtain the function of wave attenuation for alternative coastal buildings. Research located in Lampung Mangrove Center (LMC) Lampung University, East Lampung Regency, Indonesia. Wave attenuation measurements carried out on the thickness of 3m, 5m, 10m, 20m and 50m. The instrument for measured wave are used the type SBE26 and RBRDUO T.D.,

cooperation between DISHIDROS TNI Navy with the University of Lampung. The measurement method was done directly at the station point. The conclusion of this research are: (1) Avicennia marina mangrove at a distance of 0 - 50 m capable of performed wave attenuation ranges from 60% to 98%. (2) Obtained a wave attenuation formula of thickness, is ?H = -0,022x2 + 0,259x + 0,393, Avicennia marina mangrove can be used as a natural breakwater and environmentally friendly.

Keywords: Mangrove, Avicennia marina; Ecocity, Wave reduction, East Lampung

INTRODUCTION Mangrove forests are forests in coastal areas that are regularly inundated by sea water and affected by tidal sea water but are not affected by climate. While the coastal area is the mainland located downstream of the Watershed that borders the sea and is still affected by tides, with slopes of less than 8%.

(Herison et al, 2014(b)) The most important function of mangroves for coastal areas is to be a link between the mainland and the ocean. Plants, animals, another objects, and plant nutrients are transferred inland or in the direction of the sea through mangroves. Mangroves act as a filter to reduce the adverse effects of major environmental changes, and as a food source for marine (coastal) and terrestrial biota.

If mangroves do not exist then the production of marine and beaches will decrease significantly. The physical function of mangroves is to withstand abrasion and coastline. (Bengen, 2000) Mangrove ecosystem was a coastal ecosystem that had ecological function and physical protection function to the coast.

The ecological function of mangroves as spawning ground and nursery ground is very important for the survival of marine life. The function of mangrove protection against the coast was caused by rooting system and standing trees that could dampen the rate of waves and winds leading to the coast. Thus the existence of this ecosystem is necessary for the sustainability of fishery resources and environmental balance. (Herison, 2014).

Related with abiotic components in mangroves, waves play a significant role in the ecological processes of mangroves. Waves also can cause abrasion in the coastline. For that Author with background of science at civil engineering majors with coastal Engineering specialties, will be conducted research of wave reduction / reduction in Avicennia marina mangroves. (Yulianda et al, 2014).

The area around the Lampung Mangrove Center (LMC) has a fairly long dynamics of mangrove cover, since the existence of 700 meters of natural mangrove forests to the sea in the 1970s, the loss of mangrove cover due to aquaculture and cultivation business around 1987-1994, and the extent of mangrove forest area that has reached ± 300 hectares. Various researches on mangrove have been done here. Likewise this research to be conducted.

Therefore, this research was done by directly measuring the wave attenuation of Avicennia marina mangroves in the field that were used as field laboratory models. This research focused only on one type, the Avicennia marina mangrove (Noor et.al., 1999), which grew at the sites of the research. The purpose of this research was to discover the

Avicennia marina mangrove’s ability in wave attenuation. The purpose of this research are : (1).

To know the function of Avicennia marina mangrove to wave attenuation. (2). To obtain the funtion of wave attenuation for alternative coastal buildings. DETAILS EXPERIMENTAL 2.1. Location The research was conducted in the mangrove ecosystem in around LMC, East Lampung Regency with coordinates 5°31'43.81"S 105°49'20.21"E. 2.2.

Materials and Procedures The research data were collected by several stages, among others: gathering information and literature study, determination of observation point station, identifying and observing of mangrove vegetation, measurement of wave height coming and going wave at each thickness, and phase of data analysis. Wave height measurement has used type SBE 26 and type RBRDuo T.D. from DISHIDROS TNI Navy each 1 unit (Fig 1). Manual tools existed in the references.

SBE26 tool mounted in front of the mangrove and RBRDUO tool T.D. mounted behind mangroves. Determination of observation points was based on the location with bathymetry conditions, the condition of the upwind perpendicular to the coastline, the long line of mangroves and the coming free waves from obstacles and barriers such as breakwaters.

Selected one research site with five variations of wave measurements such as 3m, 5m, 10m, 20m and 50m. Phase of the measurement process as follows: Set up a wave measuring devices, synchronized the time of recording, as well as its control tools. Set up the tool that has been done on land, so that the sea is directly installed. The first measurements were carried out with a mangrove thickness of 3m.

During the measurement, it was observed that the tools were not distracted by objects or organisms that could make the tools did not work out. Once completed, the measurement team returned to land and uploaded the data. Then re-preparation for wave measurements with mangrove thickness of 5m, 10m, 20m and 50m. illustration of data retrieval in Fig 2. 2.2.

Waves on Mangroves Wave height in each region has its own characteristics, influenced by wind, bathymetry, currents, and climatic conditions at the time. Mangrove groves are a unique ecosystem which grows in the intermediate region between the mainland and the oceans above the mud substrate. This gives the mangrove groves multiple important roles in terms of ecological, socio-economic, and physical protection of coastal areas (Bengen, 2002).

In terms of the physical protection of coastal areas (Mazda et.al., 2003, Salm et.al., 2000). The density of mangrove vegetation determined wave attenuation. For that reason, this research would investigate the relationship among factors that affected wave attenuation through a simulation technique. The factors of bathymetry, water depth, wave height, width/spacing of wave propagation, and the overall mangrove factors are interrelated factors that determine wave attenuation (McIvor, et.al. 2012).

According the study conducted by Anna McIvor, Iris Möller, Tom Spencer and Mark Spalding, waves can be characterized by their height (H) (which is twice of their amplitude (a), their length (L) (the distance from peak to peak or trough to trough), and their steepness, defined as H / L (as shown in Fig 3; Park, 1999). The time between two successive peaks passing a given point is called the period (T) and the number of peaks (or troughs) passing a given point in a given time is known as the frequency (f). The sinusoidal waveform shown in Fig 3 (c) is an idealized, monochromatic (single frequency) wave.

In reality, waves vary in their height and length, and sea waves were usually made by many component waves with different frequencies and amplitudes. A wave spectrum can be used to represent this mix (Park, 1999). To characterize real waves, the significant wave height H? or Hs is often used, which is calculated as the average height of the highest one-third of all waves occurring in a particular time period (Park, 1999). When the wind waves approached the shore, the change in depth caused them to shoal, i.e.

they increased the height, maintained their wave period but became steeper. Advancing wave crests slowed down more than successive crests until at some point, the waves broke onto the shore, dissipates the energy in the wave. Waves became depth-limited when the depth of the water was approximately half the wave length of the wave.

At this point, the oscillatory motion of the water changed from circular oscillations to elliptical oscillations (Fig.3 (b)) (Herison et al, 2014). / Figure 3. (a) Circular oscillatory motion when the wave is not depth-limited. (b) Elliptical oscillatory motion in a wave which is depth-limited. (c) Vertical profile of an idealized (monochromatic) ocean wave, showing the linear dimensions and sinusoidal shape (adapted from Park, 1999).

As depth-limited waves approached the shore (before breaking), the only detriment of energy occured through bottom friction. In the absence of vegetation or an uneven substrate and in the presence of the shoaling process which increases wave height, bottom friction over a smooth bed (substrate) was not usually enough to cause a net reduction in wave height (i.e. wave attenuation).

The presence of vegetation result in a drag force which greatly enhanced wave attenuation compared to a smooth bed. Mangrove vegetation caused wave attenuation because it acted as an obstacle for the oscillatory water flow in the waves, created drag: as the water flows around the mangrove vegetation, it had to change direction and did work against the friction of the mangrove surfaces.

This dissipates some of the energy of the waves, thereby reduced wave height as shown in Fig 3. The rate of wave height reduction (r) per unit distance in the direction of wave propagation was defined as the reduction in wave height (?H) as a proportion of the initial wave height (H) over a distance (?x) travelled by the wave (Mazda et al., 2006). The units of r are /m or m-1.

For example, if wave height is reduced by 1% over a distance of 1 m, then r = 0.01 /m. Where H0 is the incident wave height (cm) and Hx is the wave height (cm) after the wave has travelled x meters (Mazda et al., 2006). The similar equation could be derived from wave theory (Han Winterwerp, pers. comm.): Where ki is the imaginary wave number.

When this number is negative, the waves are being damped (i.e. they are reducing in height), while if this number is positive, waves are increasing in size. From the results of this analysis, relationships between multiple variables measured with variable wave mangroves will be observed, related to coastal engineering, and the relationship between Mangrove Ecosystems and Coastal Engineering will be sought for its association with environmentally friendly coastal engineering.

Furthermore, the mangrove management pattern and sustainability will be observed (Herison et al, 2014). RESULTS AND DISCUSSION 3.1. Avicennia marina mangrove as Wave Attenuation Wave attenuation is the wave at the front minus the wave behind the mangrove. Below is the result of wave attenuation analysis for each mangrove thickness. The wave data was made by graph of the relationship between wave attenuation and time.

See graph 1 through graph 5. Graph 1. Wave Attenuation based on 3m thickness Hmax / Graph 2. Wave Attenuation based on 5m thickness Hmax / Graph 3. Wave Attenuation based on 10m thickness Hmax / Graph 4. Wave Attenuation based on 20m thickness Hmax / Graph 5. Wave Attenuation based on 50m thickness Hmax / Visible, the data value of the attenuation (H front - H back) generated by the wave measuring instrument is correct by looking at the trend value of uniformity r2 above 0.5. From the wave attenuation value, a graph of the percentage is made (graph 6). Graph 6.

Percentage of Wave Attenuation by Avicennia marina Mangrove Based on H max / The wave attenuation percentage of mangrove thickness 3m between 60% - 78%, 5 m between 65% - 82%, 10m between 82% - 96%, 20m 93% - 98% and 50m between 94% - 98%. The data indicated that the deeper and the thickness of the mangrove the greater the ability of wave attenuation. 3.2.

Wave Attenuation Formula Average wave energy attenuation values at mangrove thicknesses of 3m, 5m, 10m, 20m and 50m respectively by 0,6573 m, 0,7641 m, 0,9875 m, 1,1109 m and 1,1109 m. Made a graph of wave energy attenuation of the thickness of the mangrove (graph 3). Graph 3. Delta of Hmax Based on Thickness / The thicker the mangrove wave attenuation was getting bigger. Obtained formula ?H= -0,022x2 + 0,259x + 0,393.

The formula can be used as a reference in planning the building breakwaters naturally and environmentally friendly. CONCLUSIONS Avicennia marina mangrove with a thickness of 0 - 50 m, capable of performing wave damping ranges from 60% to 98%. Obtained a wave attenuation formula of thickness, is ?H = -0,022x2 + 0,259x + 0,393, Avicennia marina mangrove can be used as a natural breakwater and environmentally friendly.

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