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Estuaries Hidrofisis Characteristic

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Abstract

Estuaries hidrofisis characteristic can be based on the moon changes phases as the earth's major satellite, distribution of physical variable position, flow rate, bed material transport, and weather condition in Indonesia (dry and wet season). Physical characteristic of flow rate and the change of bed material transport sliding as bed load along the estuaries is spatially functioned by an expert to study water flow characteristic. Analysis of flow rate variable and bed load is especially based on the phases of the moon and seasons. Their change along the river estuary can show the characteristic of erosion change and sediment deposition in the estuary. Measurement in the rainy season was done during full moon and first quarter moon, as well as in the dry season of full moon when sea level rises and downs. The measured variable during high tide includes water flow around the riverbed surface, bed load concentration, material diameter of riverbed, water flow of river bed surface during high tide, and bed load concentration. Analysis of hidrofisis characteristic of estuaries will refer to two things, firstly, profile of water flow parameter and load change of basic material. Secondly, modeling and data interpolation, towards data of measurement result. Water flow characteristic during low tide in rainy season of full moon shows higher price compared to the first quarter of rainy season. It becomes different in the rainy season of full moon and is much lower with the decrease of gradient that happens during high tide. While estuary hidrofisis characteristic, bed material transport of dry season during high tide of full moon is larger than rainy season during high tide of full moon and first quarter moon. Dry season of full moon with lower flow velocity compared to the rainy season of full moon and first quarter phase is evidently enough to settle bed material transport along the river estuary.

Key Words: Bed Material Transport, Estuaries ups and downs, Moon Phases, Stream

INTRODUCTION

Process of deposition and sediment transport of river estuary is a process of deposition, erosion of base estuary and sediment transportation on earth surface [1]. Material transport load sliding as bed load and suspended load determines formation of sediment result which is extremely based on the characteristic of river flow velocity that transport its. [2] states that river flow velocity is a determiner factor of bed material transport (bed load) of riverbed (aside from type and dimension of material transport) which also becomes estimation of parameters of hidrofisis change of estuaries. Quantity of bed material transport at a position of river section can be stated in a suspended load (amount of water mass plus by material transport of volume combination) and in the form of bed load is a particular material transport mass of sample volume combination.

Hidrofisis variable of the Ranoyapo Amurang North Sulawesi estuary can be based on the moon changes phases as the earth's major satellite and position distribution, flow velocity, bed material transport, and weather condition in Indonesia (dry and wet season). Physical characteristic of flow velocity and change of bed load along the estuaries is spatially functioned by an expert to study water flow characteristic [3,4].

Hidrofisis characteristic of estuaries, according to the profile of flow velocity and bed material transport moving as bed load along the estuary during ups and downs in the full moon and first quarter phase of rainy season and during full moon phase of dry season becomes important to exploit estuaries resources so the environmental balance of estuary happens, meaning that flow velocity profile which becomes the determiner of spreading pattern of bed-material transport later important to do based on the phases of moon and seasons. According to the moon phases and seasons and its change along the estuary, hidrofisis variable analysis (flow velocity and bed material transport) can show characteristic of erosion change and sediment deposition of estuary. Hidrofisis analysis of flow velocity and change of bed material transport along the estuary can be reference of management and control as well as solution for the impact resulted by conveyance and material deposition. This study will present rating curve of flow velocity variable, bed material transport and it later plays role to analyze transportation and conveyance pattern of bed material transport as a determiner of hidrofisis characteristic of estuary.

Progressively accumulated that transported sediment both on riverbed and floodplain or water

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body at which a river reach its finish truly depends on sediment discharge and how large the speed of deposition carried by the river. For that reason, deposition happens as a result of the gradient of river or small surface slopes and flow discharge of small river so the power to transport is no longer able to transport sediment [1]. According to [5], bed load moves by rolling, sliding, and/or saltating (hopping) on a river flow, depends on 1) Composition (size and a mass of bed load); 2) Flow condition (flow rate), flow depth, etc. According to the original resources, bed material transport can move as bed load and suspended load [2].

An amount of bed material transport at alluvial rivers depends on hydrolysis condition. Movement pace of bed material transport is not same as flow rate, but discharge increase (related to flow rate increase) will rise movement pace and volume of bed load that moves from higher riverbed into the lower one [6,7]. [3,8,9] stated that there was consistent change of transformation of particle size of bed load into discharge increase (or flow rate). Meaning that the increase in flow discharge except for increasing discharge of bed load also rises drop size carried by flow.

Progressively accumulation analysis of bed material transport that changes as bed load and estuary flow rate profile can refer to the condition of moon changes phases and seasons (rainy and dry). Phases of the moon is the shape of the illuminated (sunlit) portion of the moon as seen by an observer on earth the lunar phase depends on the position of the moon against the sun when viewed on earth. The first phase after the new moon comes is waxing crescent; it is the phase when the moon leaves conjunction on the first three days. The first quarter moon is the phase after the moon leaves conjunction at the first quadrant of protractor angle measurement. This phase occurs at 3 days after the waxing crescent, the moon reaches this stage when half of the moon is visible. The following phase is waxing gibbous moon, this phase occurs three days after the first quarter phase is passed, the beginning of this phase is marked when the moon is half the size of the full moon (phase when conjunction event occurred). The moon's surface illuminated by the sun will be visible from the earth. This phase occurs three days after waxing gibbous moon passed, where the side of the moon facing the earth gets full sunlight, then the whole month is seen. This happens when the moon is on the opposite side of the earth. Here is the phase of wanning gibbous moon, occurring three days after full moon, followed by third quarter phase, waning crescent moon and new moon is the phase when there is a conjunction between the moon and the sun. The side of the moon facing the earth does not receive light from the sun, so the moon is not visible.

Full moon occurs fourteen days after the new moon; it is very influential on the coastal spaces and estuaries on earth, such as the occurrence of the highest tide (maximum pairs) during the period of one cycle. This happens because of the influence of the position of earth, moon and the sun is in a straight line. Spring tides occur twice, i.e. in the full moon and new moon. Ups and downs are fluctuations in the water level due to space object's gravitational force, especially the sun and the moon's gravitational force to the sea water mass on earth. Ups and downs occur due to the gravitational force of the moon, sun, and planets, and tidal periods is the time required from the water level position on the mean water level to the next position. Tidal periods that occur each day are determined by the earth's rotation for 24 hours. High tide occurred to the sea water mass is during perigee, at which the moon has the nearest position to the earth. Low tide occurs during apogee, at which the moon has the farthest to the earth.

The tidal link at the Ranoyapo estuary has semidiurnal tide where high and low tide occur twice a day with the same height and period. The highest tide occurs in the full moon, while the lowest is in first quarter moon. It is the phase after the month leaves conjunction at the first quadrant of protractor angle measurement (seven days after the full moon). Height of sea level during high and low tide is greatly influenced by the distance from the estuary and the condition of seasons (Rainy and dry).

MATERIAL AND METHOD

Analysis and discourse upon the hidrofisis characteristic of estuaries refer to the methodological measurement of bed material transport moving as bed load and distribution of flow velocity of the Ranoyopo estuary. Determination of measurement was conducted in rainy season of full moon, first quarter moon of rainy season and dry season in full moon. Identification of estuary flow in rainy and dry season during ups and condition of moon phases shows six segments of measurement and seventeen measurement positions becoming basic of analysis of physical variable along the estuary.

Variable measurement of this study when low tide starts from position 1 into position 2 and finish at position 17 heading to shoreline. But, during high tide the measurement was performed the reverse, that is, from position 17 to position 1.

Measured variable when low tide includes: flow around the riverbed, bed load concentration, and diameter material of riverbed (d). Measured variable during high tide includes: flow around the riverbed and bed load concentration. Procedure to collect data covers to: (1) Arranging the boundary of research location, i.e. floor limit of ups and downs until the boundary of significant change of physical variable happens (2). Arranging stream segment, according to stream condition which is observed at surface stream. (3). Position arrangement of measurement along the river estuary. (4). Measurement segment arrangement based on the direction of the width of the river. (5). Arrangement of vertical measurement point, which is conducted at the layer around the base surface.

Further, hidrofisis characteristic analysis will refer to: firstly, the parameters of the flow rate of the position near the bottom of the river and the profile of bed material transport which moves as bed loads along the estuary in the tidal and full moon phase, rainy season in first quarter moon, and dry season in full moon. Both modeling and interpolation of data during highs and lows, rain and dry conditions during full moon, first quarter moon, expressed in the absolute deviation mean and bias of data from the modeling result as well as interpolation of data from measurement result, so that the result of flow modeling and bed load can be expressed to have high accuracy to determine the estuary hidrofisis characteristic.

RESULT AND DISCUSSION

As explained in the research method, analysis and presentation of hidrofisis variable data are performed between segments in one flow position, so that the description of variable of flow velocity change and bed material transport along the estuary can meet the assumption of steady, non-turbulent and cooperative. Further, hidrofisis characteristic analysis will refer to: firstly, flow rate parameter profile of the position near riverbed and bed material transport which moves as bed loads along the estuary during tidal of the rainy season in full moon, rainy season of first quarter moon, and dry season of full moon. Secondly, precision result of modeling and interpolation data of high and low tide expressed in the absolute deviation mean and bias of data from the modeling result as well as interpolation of data from measurement result. Analysis conducted provides an average of absolute deviation for the entire measurement data at a price range of 0.533155 to 0.803702, it is small enough so that the modeling results can be expressed as having a high accuracy to present price changes in flow velocity and bed load along the estuary. Constants and coefficients of speed function approach the riverbed during low tide of full moon, first quarter moon of rainy season, and in full moon during dry season almost have similarity. The results of the analysis show that the constant values are the modeling function coefficients which can be used to obtain the flow velocity value, so the rating curve of flow rates and its change for the same spaced point has the same pattern to describe bed material transport characteristic along the estuary.

The curve rating pace approaches riverbed during low tide at the three periodic lunar phases showing the same shape as the polynomial function, as shown in the following figure.

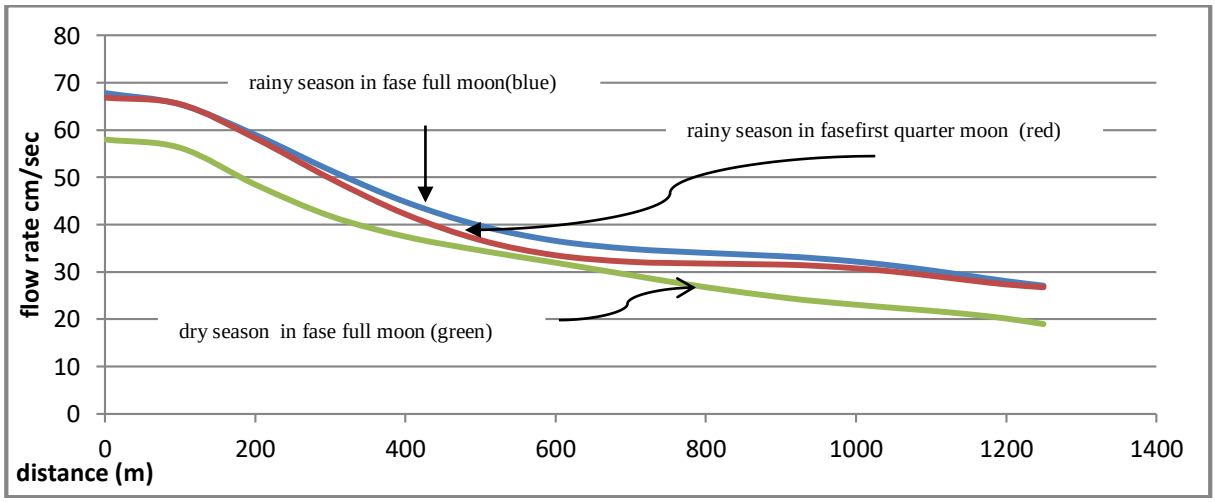

Figure 1. Flow rate during low tide.

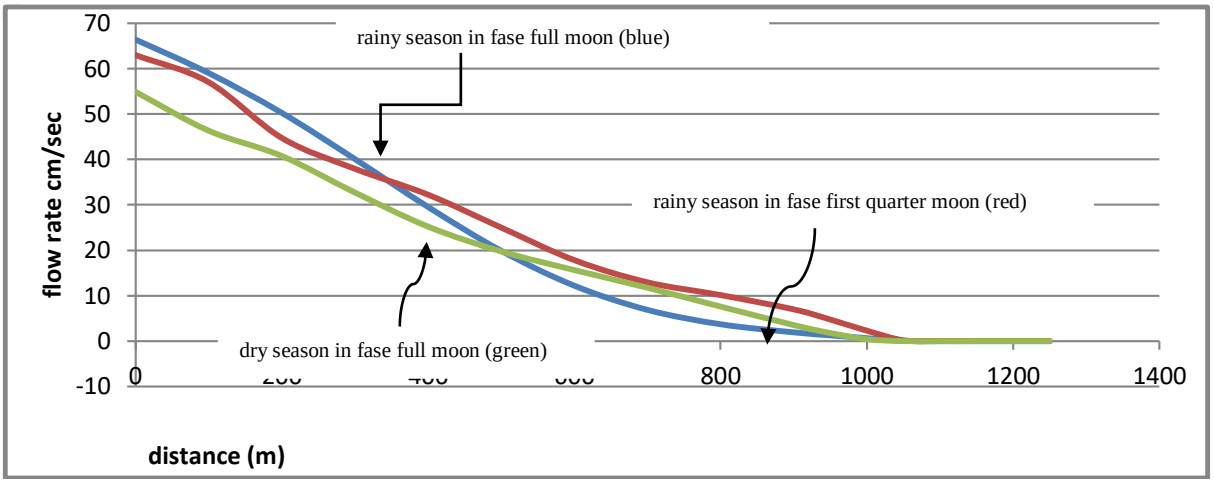

Figure 2. Flow rate during high tide.

Rating curve of flow velocity at low tide in the rainy season of full moon shows higher value with similar gradients compared to data and model curve when water subsided in first quarter moon of rainy season. It becomes very different with the rating curve of velocity at low tide of full moon in dry season, much lower with a gradient lower than the full moon of rainy season. The variation in the distribution of velocities during the rainy and dry seasons is significant in the same measurement position (first measurement position x = 0 m), and the same thing occurs in the measurement position of a dept. 200 m to 1,200 m. This condition can be understood that, physically in the rainy season rate discharge of the stream will be greater than the dry season, which results in a change in flow velocity with the gradient of rating curve of velocity in the rainy season being above the graph speed in the dry season. Rating curve of data modeling speed approaching riverbed for three lunar phase when high tide shows the shape of the polynomial function with the model and graph functions as shown by the following figure.

Rating curve of flow velocity during high tide of full moon in dry season has a lower speed compared to flow velocity during rainy season in full moon and first quarter moon. It can be seen clearly that the flow velocity near river bed of high tide conditions for rainy and dry seasons is considered having differences. The amount of rainfall is above the dry season as a result of the increase of river flow discharge in the rainy season condition. Thus the gradient changes and the zero velocity position will depend on the flow rate and the high tide. The increase of sea level will enhance the gradient of rating curve and shift the position of zero velocity to the upstream. The same study was conducted [10], [11], which obtained a flow velocity profile at the estuary having a decreasing gradient by distance.

Bed material transport character analysis provides a constant and polynomial model functional coefficient and result of bed material transport functional modeling during rainy season in the full moon and first quarter when high tide is more steep compared to the functional gradient at high tide of full moon in the dry season. Mixed rating curve of bed material transport that slides as bed load during high tide of full moon, first quarter moon of rainy season, dry season of full moon is presented in the following figure.

In the dry season of full moon and during high tide, bed material transport characteristic along the estuary is different from rainy season in full moon and first quarter moon. The change of bed material transport in the dry season of full moon is greater than the full moon and first quarter moon in the rainy season. An interesting this is in the theory, the increase of flow discharge is always accompanied by the increase of flow rate, and in the rainy season flow rate will transport sediment in a larger number than in dry season [12] illustrates that sediment transport rates are a function of river flow velocity and sediment particle size. The analysis results give a different view, rating curve characteristic of bed material transport for the dry season is at the top compared to the rain conditions for full moon and first quarter moon, meaning the price of bed material transport in dry season of full moon is higher than the rainfall conditions of full moon and first quarter moon. Physically, in the rainy season (during full moon and first quarter moon) with greater flow discharge of the dry season has a larger flow rate or with high flow rate will carry a high load of basic materials,

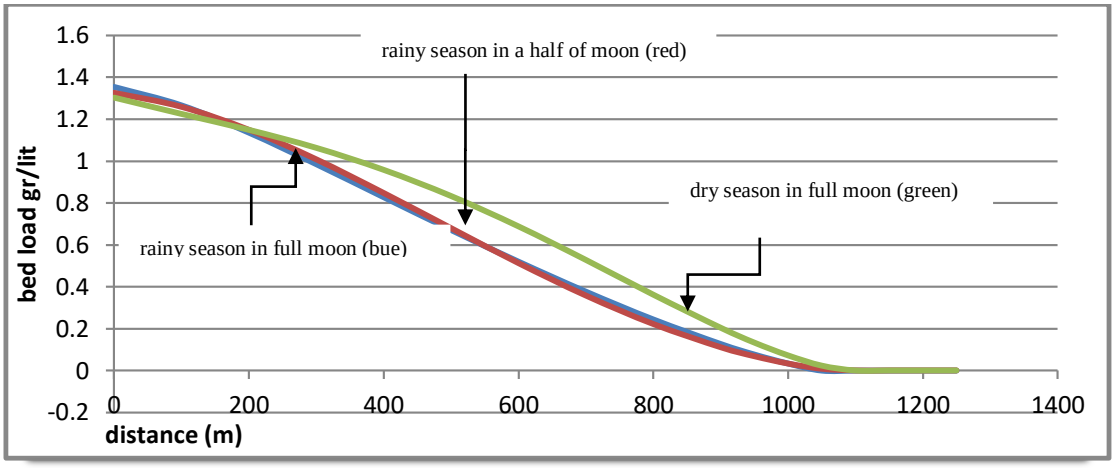

Figure3. The spread of bed load in the rainy and dry season during high tide.

this corresponds to the theory that sediment transport is principally related to the flow of sediment transported by streams [12].

The research results of the physical characteristic of sandy bed material transport at the Ranoyapo estuary are small enough to be transported by flow velocity, leading to substantial transport of bed material transport in the rainy season, even some of the basic load is tot deposited in the mouth of the river, but it is swept by the flow to the shore. This condition corresponds to the theory that, upstream water with the sedimentary material it transports will reduce the flow rate, while the softer material that can still be transported by the flow at a reduced speed will be passed to the sea [13].

In the dry season of full moon, with a lower flow velocity compared to the rainy season in full moon and first quarter moon, it is sufficient to precipitate bed material transport and increase its spread along the river mouth. Further, hidrofisis characteristic of deposition and transportation of bed material transport can be explained physically by taking into critical treshold velocity value of bed material transport conveyance and deposition of bed material transport. Measurement result of full moon, first quarter moon, and rainy season in full moon when high tide, all segments have the smallest price variation of 0.099934 m/sec.The highest velocity of bed stream (68 cm/sec or 0.68 m/sec) is higher than the smallest critical value, so it can be explained that in all measurements segment, bed material transport experiences conveyance. Physically, if there is an increase in river flow, then volume velocity in the layer near the riverbed will increase beyond the critical price, then bed material transport will also increase, thus, the conveyance area of bed material transport will shift upstream as described by Figure-3. [12] explains that the amount of sediment transport in the river basin is a function of sedimentation supply and stream energy.

During high tide in full moon and rainy season in first quarter moon, stream characteristic shows (figure-3), the first position up to 800 m and flow rate price ranges from 0.11 m/sec to 0.68 m/sec. It is higher than the smallest critical price for transporting bed load material, i.e. of 0.0901 m/sec, so that it can be described that in this position there is an occurrence of bed material transport. On the contrary, position of 1,000 m to 1,400 m is the area where the material of bed material transport cannot be transported, at this position, stream flow velocity is less than the smallest river critical value to transport bed material transport, meaning that the flow rate at that position is not capable to transport deposition of bed material transport to the shoreline. The same study was conducted [14].

During low tide, deposition critical price depends on the type of precipitated material, acquired critical precipitation price range of 0.7331 m/sec to 1,0735m/sec. The highest rate of flow velocity on the layer near the riverbed for three phase periods (figure-1) at the first measurement point up to 1,250 m is 0.71 m/sec to 0.29 m/sec is lower than the critical value of precipitation 1.0735 m/sec. As a result, it gives illustration in the measuring location at a distance of 0 m to 1,250 m is the area where the concentration of bed material transport in the form of fine sand settles even suspected to be partially transmitted to the sea. This condition is in line to the theory of "Sediment transport pace is tightly related to flow rate and size of sediment particle" [12,15].

The Ranoyapo Amurang estuary hidrofisis characteristic, according to the analysis of flow velocity profile and change pattern of bed material transport illustrates that rating curve of water flow rate during high tide in full moon of dry season is

lower than and full moon and first quarter moon. The value of bed material transport at dry season in full moon is higher than the rainfall conditions of full moon and first quarter moon. During high tide of full moon and first quarter moon of rainy season, the first position until depths of 800 m is the position where transportation of bed material transport happens, while depths of 1,000- 1,400 m is an area where material of bed material transport cannot be transported. The similar thing comes at the same period, that is, full moon in dry season.

CONCLUSION

Estuaries hidrofisis characteristic illustrates, it will be truly different during the full moon of dry season at which the gradient is much lower. During the dry season of full moon and when the sea level rises, bed-material transport along the estuary is different from the condition when rain comes of full moon and first quarter phases. Change of bed material transport when dry season comes in full moon phases is larger than the period of full moon and first quarter moon in rainy season. When the sea level rises in full moon and first quarter moon of rainy season, the first position until depths of 800 m is the position where transportation of bed material transport happens, while depths of 1,000 m - 1,400 m is an area where material of bed material transport cannot be transported. The similar thing comes at the same period, that is, full moon in dry season.

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