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Effect of velocity flow patterns on viscosity in Saddang River

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Abstract. River conditions in Indonesia are very concerning. Furthermore, uncertain climate changes between dry and rainy seasons, make sediment concentrations are increasing over time increase in sediment makes river utilization not optimal. The purpose of the research was to find out the flow rate of the results of field measurements using an Acoustic Doppler Current Profiler (ADCP). From the results of measurements in the field using ADCP obtained the flow velocity value in the Mamasa River is 1.362 m / sec at a depth of 3.20 m and viscosities 761.412 MPa, in Sungai Buntu Batu the flow velocity value is 2.184 m / sec at a depth of 1.99 m and viscosity of 1827 MPa, at River Mata Allo flow velocity value is 0.379 m / sec at a depth of 1.47 m and viscosity of 105 MPa, and in Pekkabata River the flow velocity value is 0.614 m / sec at a depth of 1.47 m and viscosity is 516.565 MPa. In general, the Saddang watershed has a low floating sediment level.

1. Introduction

The river is an open channel that is formed naturally on the surface of the earth and not only holds water but also flows it from the upstream to the downstream. Flow conditions in open channels are complicated, based on the fact that free surface positions tend to change according to time and space. The river flow will always have a straight, curved, and branched groove. In river bends, problems often occur, namely river erosion both on the riverbed and on the river wall, this can lead to collapse on the river wall so that it can cause infrastructure around the bend.

The movement of river water is strongly influenced by the type of landscape, the larger the size of the bedrock and the more rainfall, the movement of the water becomes stronger, and the speed of the flow is faster, thus affecting the discharge. In SI (International Unit), the amount of flow velocity is expressed in units of m/s [1]. The viscosity of a fluid is the inhibitory force caused by friction between liquid molecules that are able to withstand the flow of fluid so that it can be expressed as an indicator of viscosity. Sediment is the result of an erosion process, either in the form of surface erosion, trench erosion, or other types of soil erosion that settle under the foothills, in floodplain areas, waterways, rivers, and reservoirs [2]. There are two categories of sediment transport mechanisms, namely: bedload and suspended a load. The process of sediment movement in the type of bedload moves on the riverbed by rolling, sliding, and jumping, whereas the suspended load consists of fine grains that drift and float in the river water.

Sediment transport is the amount of sediment measured for a moment. If the debit does not change quickly, then one time measurement of the sediment transport rate is sufficient to determine the average rate in one day. But if the debit changes rapidly and the sediment rate is high, then several measurements are needed to determine the average daily rate accurately. Erosion control is an important topic in river and coastalengineering. High-velocity flows in rivers and high wavesimpinging on the coastline can cause erosion [3]. Sediment transport analysis always requires flow velocity data, and any water building planning will take into account the problem of sediment transport that occurs, along with the velocity of the flow in the flow. In a river channel, the turbulence flow field develops more rapidly when both waves and current are present as opposed to a situation where no current exists [4]. Channel roughness can cause it to increase curvature of the vertical velocity distribution curve. On bends, speed increases on the convex portion, cause centrifugal force on the flow. Motion the curved channel is symptoms that must be considered in planning [5]. The combination of each channel parameter will affect the speed that occurs. On the other hand, changes in speed will determine the state and type of flow. This is what you want to know to determine the effect of the flow velocity that occurs.

2. Methodology

The research location is on the Saddang River. This research was conducted in 4 research locations consisting of Mamasa River as location 1 representing the Mamasa Sub-watershed, Buntu Batu River as location 2 representing the Tator watershed, Mata Allo River as location 3 representing the Mata Allo watershed. Where locations 1 to 3 include upstream from Saddang watershed and Pekkabata river as location 4 represents downstream from Saddang watershed. Where is the Saddang River, one of the largest rivers in the Saddang River region. The watershed area is + 6848.20 Km^2. The Saddang River has 294 tributaries.

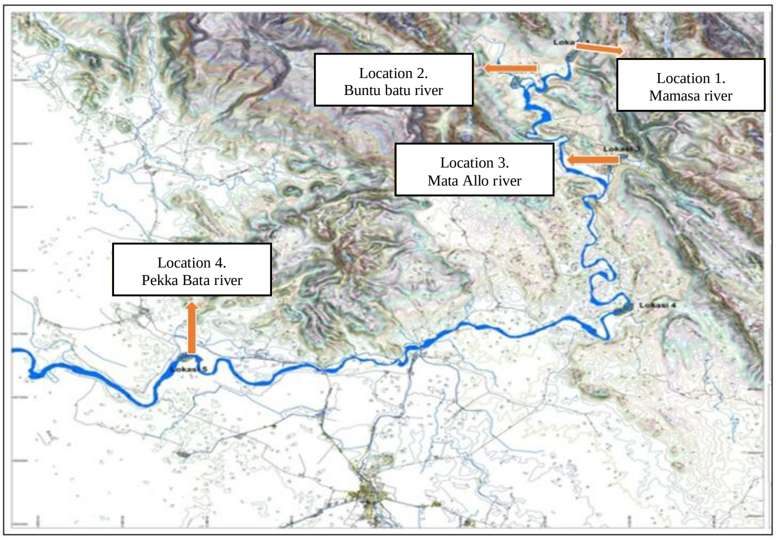

Figure 1. Saddang River research location.

This research uses Acoustic Doppler Current Profiler (ADCP) Sontek Hydro Surveyor, which can measure flow velocity and water quality/viscosity. ADCP can calculate in full, the direction of spectrum wave frequency, and can be operated in shallow and deep waters. One of the advantages of ADCP is that, unlike directional wave buoys, ADCP can be operated with little risk or damage. In addition to spectral wave frequencies, ADCP can also be used to calculate velocity profiles and also water levels. This study also uses a Digital Viscometer NDJ-8s tool, which is used to measure the value of viscosity. Digital Viscometer is also used in various applications such as oil, painting, fascination, and adhesives. The research flowchart can be seen in figure 4.

Figure 2. Tools used Acoustic Doppler Current Profiler (ADCP) Sontek Hydro Surveyor.

Figure 3. Digital Viscometer NDJ - 8s.

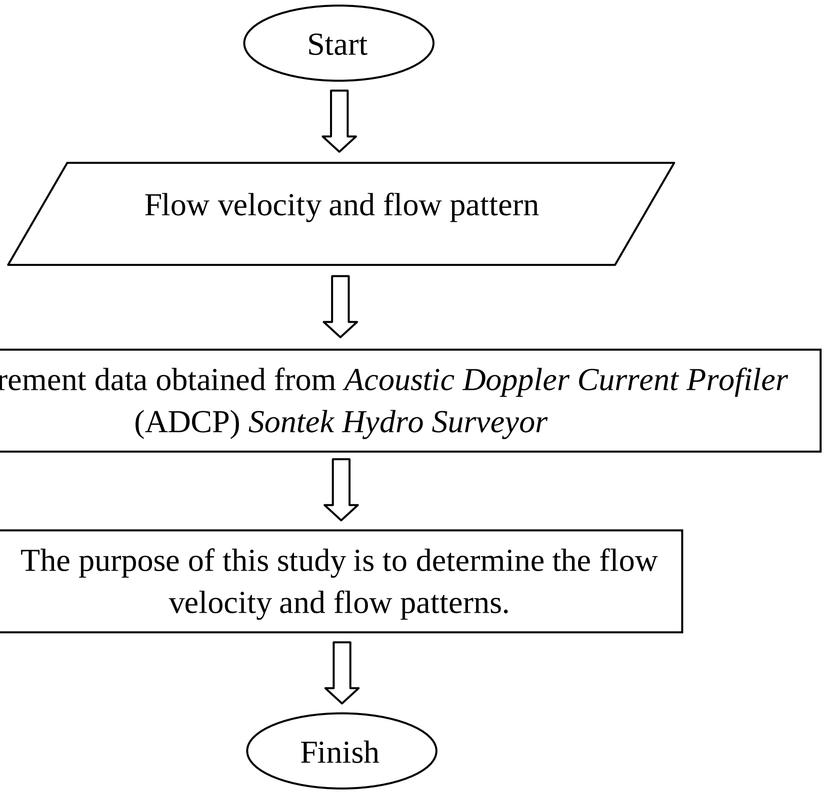

Figure 4. Research flow chart.

3. Results and Discussion

The location of the research conducted on the Saddang River is at 4 points as follows:
1). Mamasa River, 2). Buntu Batu River, 3). Mata Allo River, 4). Pekkabata River.
This research uses tools Acoustic Doppler Current Profiler (ADCP) Sontek Hydro Surveyor, which can measure flow velocity and water quality/viscosity. The cross section and flow velocity in the river research are as follows:

a. Mamasa River (3°30'14,48"LS;119°43'34,11"BT) can be seen in figure 5 has a flow rate of 1.362 m/sec at a depth of 3.20 m with a mean river width of 31.07 m and a wet cross-sectional area 65.76 m^2.
b. Buntu Batu River (3°28'59,02"LS;119°45'07,86"BT) can be seen in figure 6 has a flow velocity of 2.184 m / sec at a depth of 1.99 m with an average river width of 53.55 m and a wet cross-sectional area 67.42 m^2.
c. Mata Allo River (3°33'23,61"LS;119°46'44,32"BT) can be seen in figure 7 has a flow rate of 0.379 m/sec at a depth of 1.47 m with a mean river width of 55.26 m and a wet cross-sectional area 51.25 m^2.
d. Pekkabata River (3°42'03,75"LS;119°33'50,15"BT) can be seen in figure 8 has a flow velocity of 0.614 m/sec at a depth of 1.47 m with a mean river width of 201.09 m and a wet cross-sectional area 193.37 m^2.

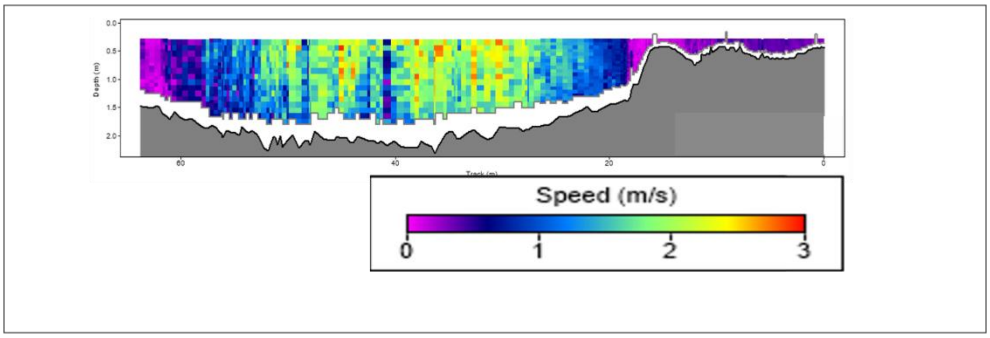

Figure 5. Cross section based on a speed of Mamasa River.

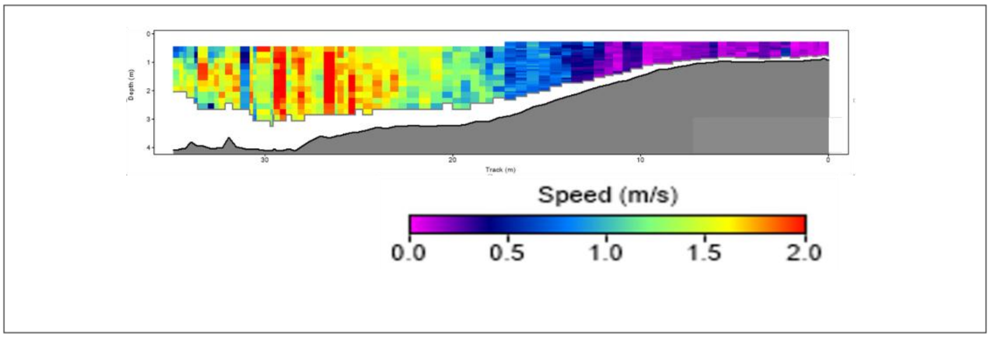

Figure 6. Cross section based on the speed of the Buntu Batu River.

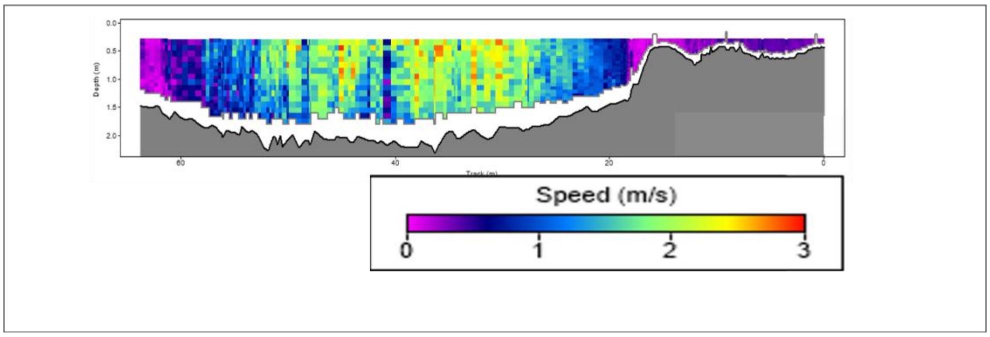

Figure 7. Cross section based on the speed of the Mata Allo River.

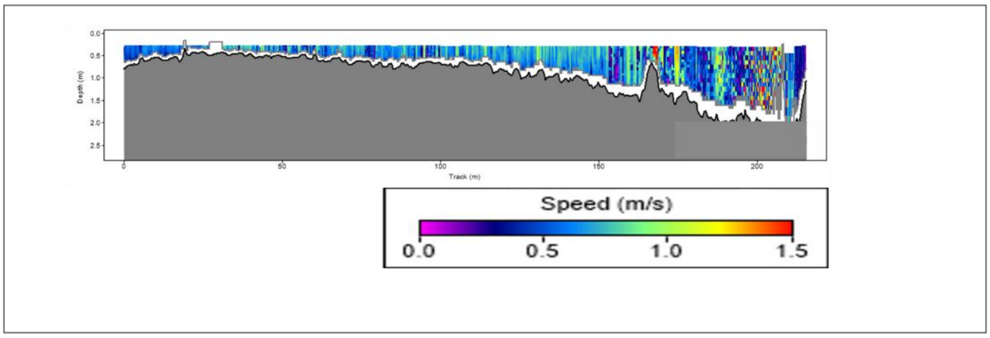

Figure 8. Cross section based on a speed of Pekkabata River

Measurement Viscosity or turbidity can be seen in figure 9 as follows:

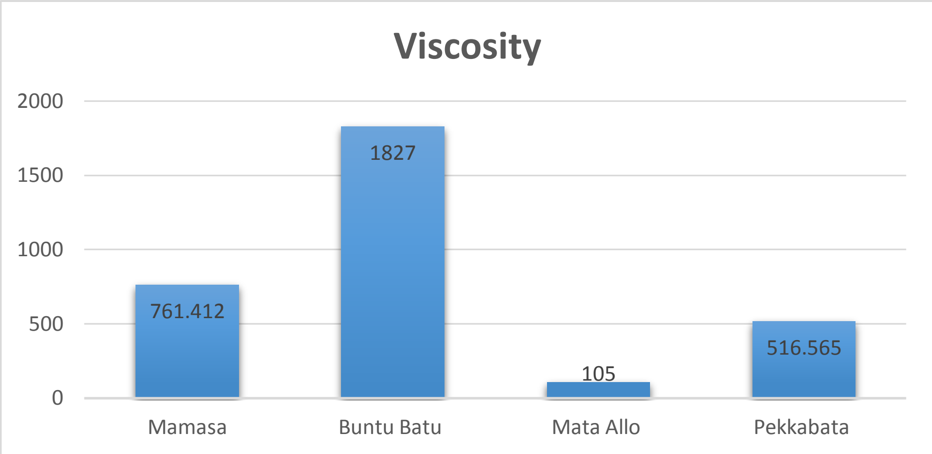

Figure 9. Viscosity measurement results using digital viscometer NDJ - 8s.

Based on the results of the study of flow velocity and viscosity at 4 locations (Mamasa River, Buntu Batu River, Mata Allo River, Pekkabata River) it can be concluded that in the Mamasa sub-watershed represented by Mamasa River and Tator sub-watershed represented by Sungai Buntu Batu high flow velocities of 1.362 m / sec and 2.184 m / sec and high viscosity values of 761.412 MPa and 1827 MPa indicate that the river has low floating sediments due to the influence of rough river roughness. The Mata Allo sub-watershed represented by Mata Allo River has a low flow velocity of 0.379 m / sec, and a low viscosity value of 105 MPa indicates that the river has high floating sediments due to the influence of the bottom roughness of the small river. Whereas in the downstream part of the Saddang watershed represented by the Pekkabata River has a flow velocity of 516.565 m / sec and a viscosity value of 516.565 MPa due to sediment mixing in the estuary between river water and seawater.

4. Conclusions

Based on the results of research conducted in the Saddang River watershed. It can show that in the Mamasa and Buntu Rivers, the sedimentary rocks float low due to high viscosity and high flow rates. The Mata Allo River shows that sediment floats high due to low viscosity and low flow velocity. Whereas in the Pekkabata River, there was sediment mixing in the estuary.

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