

Sediment Transport in Channels in the TanjungKemala Village Area, Martapura District, East OKU Regency

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Abstract

This research aims to determine and obtain the coefficient of determination (R^2) and the correlation value (R) between bed-load sediment transport (q_s) and sediment capacity (q_d) for a 50-year return period (Q_{50}) in the channel/river located in TanjungKemala Village (Kampung Sawah Hamlet), Martapura District, East OKU Regency.

Research methodology using a flume model was conducted in the standard flume laboratory at Bina Darma University. The experimental procedure is A rectangular channel model—measuring 50 cm in width and 30 cm in height with a 90° bend—constructed with brick walls and a total length of 600 cm.

The sediment transport pattern based on the 50-year return period discharge (Q_{50}) yielded a coefficient of determination (R^2) of 0.7634—indicating that 76.34% of the data variation is explained by the model—and a correlation coefficient (R) of 0.58278 (58.28%), signifying a reasonably strong relationship between bed-load sediment transport (q_s) and the (Q_{50}) discharge.

Keywords: Coefficient of determination, bed-load, sediment capacity, return period

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I. INTRODUCTION

Lanzoni and Seminara (2006) and Camporeale and Ridolfi (2006) demonstrated that bend instability is primarily convective in nature; for sub-resonant rivers, this implies that the upstream boundary must be continuously perturbed to sustain dynamic meandering (Figure 2.3). Analyses of bank and bend instability indicate that meander bends and their dynamics are determined by a low width-to-depth ratio, which is controlled by bank erosion processes.

Determining the equilibrium of a river channel relies on calculating the potential sediment transport capacity at each cross-section under review. Sediment transport capacity is an instantaneous value. There is a mutual interaction between sediment transport capacity and river geometry; sediment transport capacity can drive degradation or aggradation, thereby altering river morphology. These morphological changes, in turn, modify flow hydraulics, which subsequently affects sediment transport capacity.

Consequently, local sedimentation and erosion processes shift toward a dynamic equilibrium—where degradation and aggradation remain balanced—resulting in a relatively stable river cross-section. Beyond sediment transport equilibrium, the phenomenon of sediment sorting occurs on the riverbed, leading to "armoring." This process involves the riverbed surface becoming covered by coarse sediment (such as stones), which enhances the bed's stability against erosion. This phenomenon is particularly significant in rivers with varied sediment sizes. Due to armoring, bed erosion does not occur even when there is a deficit in sand supply from upstream areas or tributaries.

This riverbed equilibrium can be disrupted by the extraction of stones from the bed; such activity exposes the finer sediments sheltered beneath, making them susceptible to erosion during periods of sediment transport deficit.

Critical equilibrium refers to the riverbed slope condition under which the bed material remains stationary. When the flow velocity reaches a point capable of mobilizing bed particles, the resulting tractive force is termed the critical tractive force, denoted as U^*c (Suyono, Masateru: 330).

In this study, sediment transport is calculated using an empirical equation selected from several options, while flow and hydraulic profiles are determined using fundamental one-dimensional flow equations—which incorporate geometric data as a key input. Sediment transport is determined based on the grain size of the bed-load material.

The model is also designed to simulate long-term erosion and deposition trends by varying the frequency and duration of discharge data or by altering the geometry of the channel under study.

II. MATERIAL AND METHODS

This research was conducted at the Hydrology and Hydraulics Laboratory of Bina Darma University, Palembang, as shown in the sketches in Figures 1.

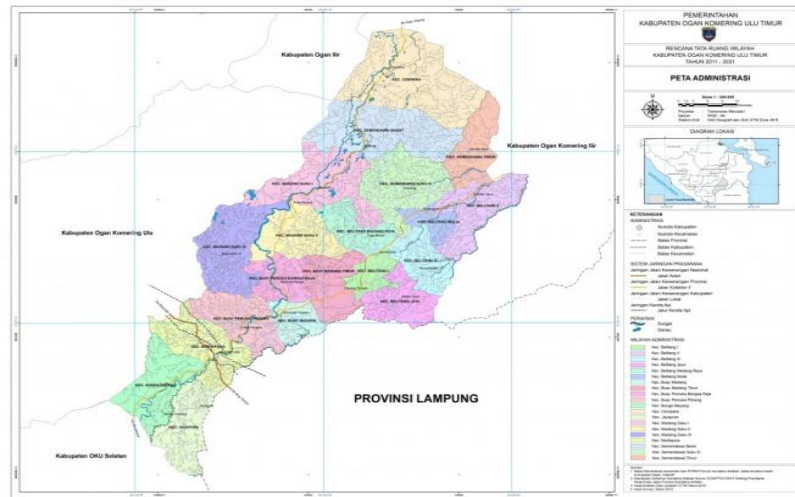


Figure 1: Map of the research area

Research using a flume model was conducted in the standard flume laboratory at Bina Darma University, as shown in Figure 2 below.



Figure 2: Flume standard model.

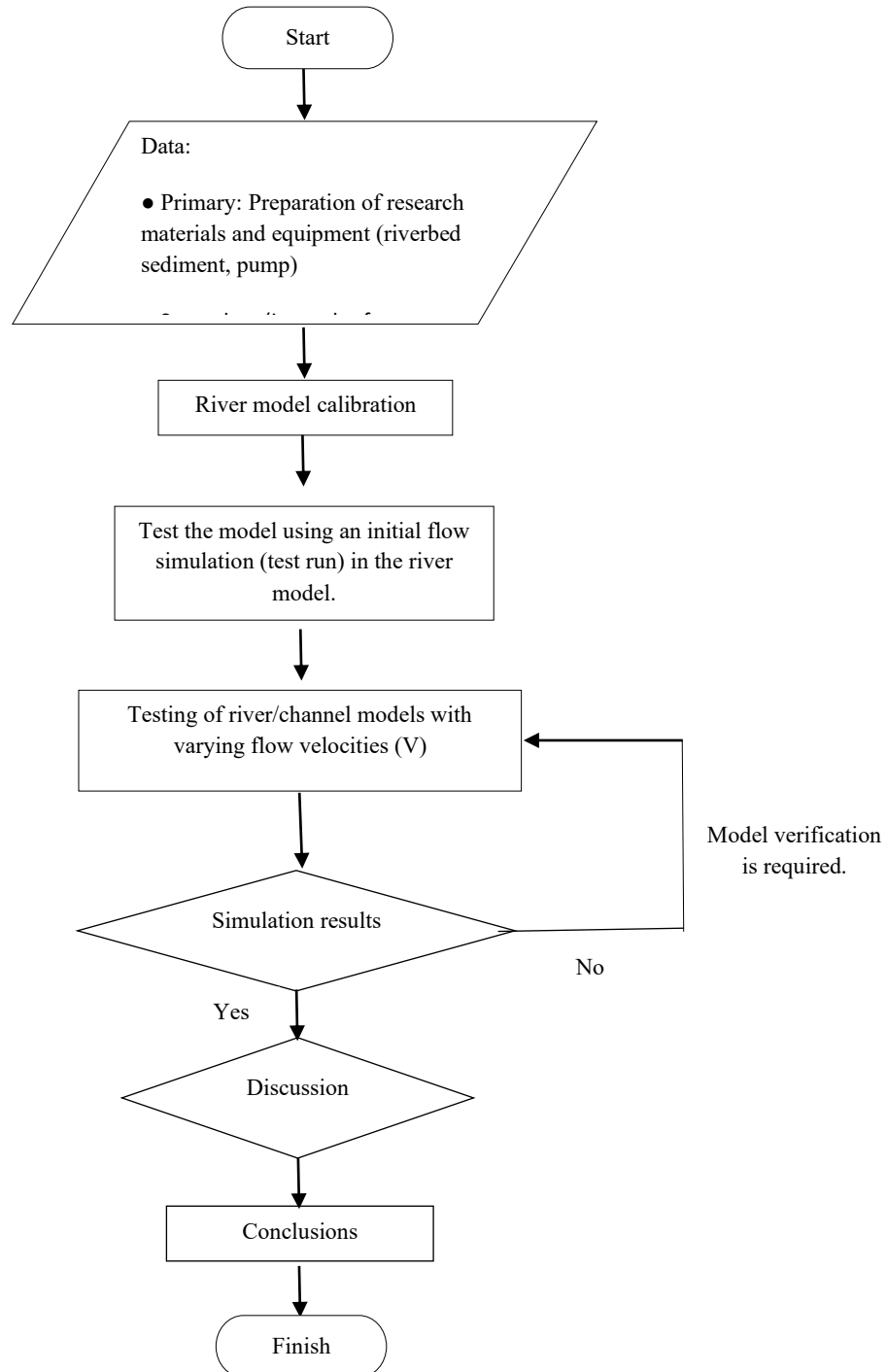


Figure 3.Flowchart

III. RESULTS AND DISCUSSION

3.1 Graph of the relationship between (ds/t) and (v/t) with $Q_{50} = 0.113 \text{ m}^3/\text{sec}$

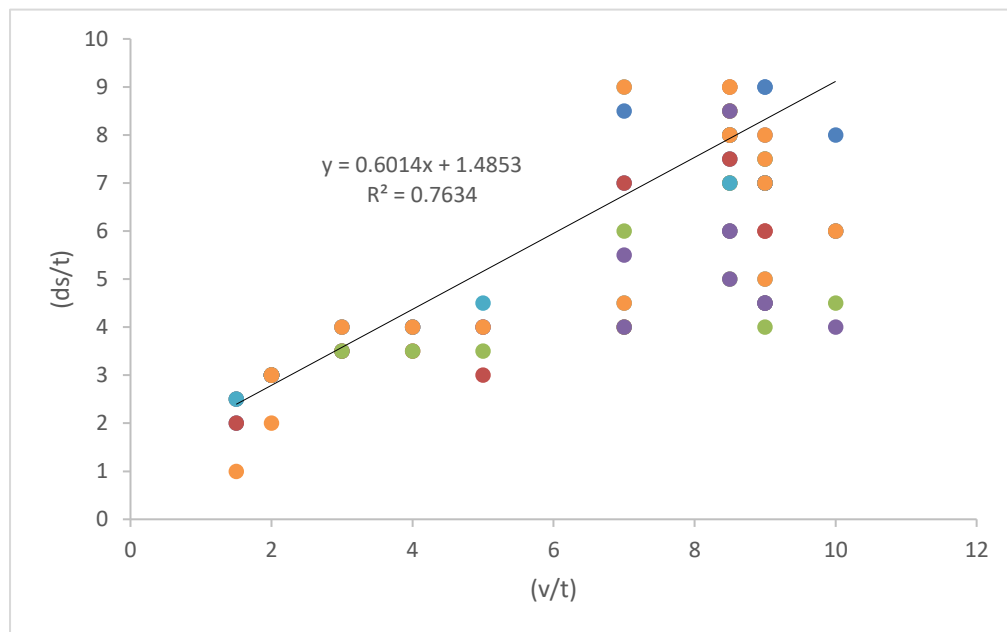


Figure 4: Sediment (bed load) movement pattern, $Q_{50} = 0.134 \text{ m}^3/\text{sec}$.

Figure 4 illustrates the sediment transport pattern associated with the 50-year return period discharge (Q_{50}); the model yields a coefficient of determination (R^2) of 0.7634—indicating that 76.34% of the data variation is explained by the model—and a correlation coefficient (R) of 0.58278 (58.78%), signifying a reasonably strong relationship between bed sediment transport (ds) and discharge (Q_{50}).

IV. CONCLUSION

Based on the data analysis and discussion, the conclusions of this study is The sediment transport pattern based on the 50-year return period discharge (Q_{50}) yielded a coefficient of determination (R^2) of 0.7634—indicating that 76.34% of the data variation is explained by the model—and a correlation coefficient (R) of 0.58278 (58.28%), signifying a reasonably strong relationship between bed-load sediment transport (qs) and the (Q_{50}) discharge.

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