Sediment Transport And Its Impact On Channel Morphology Of Forested Streams; The Case Of Chinda Creek In Ogbogoro Niger Delta, Nigeria

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Abstract: The study was conducted in Chinda creek a section of the New Calabar River, using 30 sample points with an interval of 21.4m each. Measurement of the cross sectional area was done using the Cuencea (1989) formula and Chang et al (2000) formula for sediment transport. Alongside this the US BLH 84 sediment sampler and the Depth-Integrating Suspended-Sediment Sampler Model DH 48 was used for collecting data on both the suspended load sediment yield and the bed load sediment yield. The result of the study revealed an insignificant relationship between sediment transport (suspended load sediment yield and bed load sediment yield) and channel morphology. The co-efficient of determination of each of the two independent variable showed that an insignificant 10.89% variation in channel morphology is explainable by each of the independent variable. This means that their contribution to change in the channel form of Chinda creek is insignificant. The study revealed that there are several other factors that contribute to channel form change not only sediment transport and as such studies aim at identify these factors was recommended.

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Key words: sediment transport, bed load sediment yield, suspended load sediment yield, channel morphology, change, channel form.

Introduction

Knowledge of sediment transport is important to such endeavors as river restoration, ecosystem protection, navigation, and infrastructure management. The processes governing sediment transport are complex. As such, accurate observations of sediment transport are crucial to provide data to properly understand the sediment transport process. Chinda creek which happens to be a tributary to the new Calabar river is an alluvial river, in that it flows through sands, silts, or clays deposited by flowing water, (Church, 2006). Natural alluvial rivers are usually wide with an aspect ratio (width to depth) of 10 or greater (Yalin and da Silva, 2001) and the boundary can be molded into various configurations as was demonstrated in the seminal work of Gilbert in Roberts (2010). With alluvial rivers, the channel geometry is influenced not only by the flow of water but by the sediment transported by the water. When the flow discharge changes, the sediment transport changes and, in turn, the channel geometry usually changes. This channel geometry change, common in sand-bed channels, can then influence changes in the stage; which results in further changes in sediment transport.

Sediment transport is divided into bed-material load and wash load. The bed-material load is defined as that part of the sediment in transport whose sizes are found predominantly in the bed, whereas the wash load is defined as that part of the sediment in transport that is not found predominantly in the bed (Roberts, 2010).

The flow and sediment transport dynamics of the sand-bed river is further complicated by the various types of bed forms occurring as a result of the interaction between the flow and the erodible bed, (Roberts, 2010).

Furthermore, sand is common in river systems. Fluvial sediment transport normally is measured according to operational principles that essentially correspond with the definitions of transport process. Perhaps this is a reason why relatively little emphasis has been given to the connections between transport and alluvial morphology; the available data of sediment transport do not conveniently lend themselves to the analysis of fluvial sedimentation.

A common problem faced by geomorphologists is identification of the dominant process responsible for creation of a particular form. Arising from this the study intends to evaluate the process of morphological change in the channel arising from sediment transport. Conclusively it is the interest of this study to investigate and examine sediment transport and its effect on channel morphology.

Materials and Methods

The study was conducted in the year 2011 and it was carried out in Chinda creek in Ogbogoro section of the New Calabar River. The channel measures about 643.2m, which was divided into thirty at an interval of 21.4m this served as the sample points for the study. Sediment transport was determined that is the bed load load, with the use of Handheld Bedload-US BLH-84 sediment sampler. To calculate the sediment transport the formula put forward by Chang et al (2000) was used.

$$g_b - \frac{w_i}{(T, X\, h_s)}\; X\, b$$

In which, g_b = transport in kg/s,
w_i = weight of bedload sample in kg.
T = sampling time in seconds,
h_s = width of sampler nozzle in meter
b = section width of the stream in meter.

The channel morphology, here is the shape of the channel. To determine this, the cross sectional area of each sample point is gotten. To do this the Cuencea (1989) formula for estimating cross sectional area was used,

Area = width x depth

Thirty (30) sample points was gotten for the study, to determine the cross sectional area of each sample point in the channel, measurements of the width and depth at every sample point was done and this generated the data used in the analysis of the study. In doing this the mean depth was used alongside the width to calculate the cross sectional area for each sample point.

Data Presentation and Analysis

In line with the aim of the study which is to examine sediment transport and its effect on channel morphology. This to a large extent tries to identify causality among the two variables which are channel morphology and sediment yield. In order to determine this, correlation matrix was used, this was gotten from a computer analysis using SPSS package.

Table 1: Correlation Matrix

	Channel morphology	Suspended sediment yield	Bed load sediment yield
Channel morphology	1.000	0.330	0.330
Suspended sediment yield		1.000	1.000
Bed load sediment yield			1.000

The table above displays the summary of the correlation matrix of two independent variables of bed load and suspended sediment load on the dependent variable of channel morphology of Chinda Creek in Ogbogoro.

From table 1, it is revealed that a marked linear relationship exists between the independent variable of suspended load sediment yield and the dependent variable of channel morphology.

The co-efficient of determination (r^2) for channel morphology and suspended load sediment yield of Chinda Creek is 10.89%. This explains the fact that 10.89% of variations in channel morphology is explainable by the independent variable of suspended load sediment yield in the creek. Channel morphology, however correlates with suspended load sediment yield of Chinda Creek as shown in table 1, above.

From the table also, it is evident that the regression co-efficient of channel morphology on bed load sediment yield of Chinda creek is 0.330, this means that there is a linear and positive correlation between channel morphology and bed load sediment yield.

Having a co-efficient of determination (r^2) of 10.89%. This implies that an insignificant 10.89% variation in channel morphology is explainable by bed load sediment yield of the channel Chinda creek. This means that bedload sediment yield correlates with channel morphology of Chinda creek positively, having a correlation co-efficient of +0.330.

This findings implies that both suspended and bedload sediment yield is positively correlated with channel morphology, the relationship is not statistically significant in the channel under investigation. This means that their relationship is insignificant. This could also be seen graphically below, as in most sample points in the channel there is an evident variation between the cross sectional area and the sediment yield.

Conclusively, the study has proved that sediment transport, that is suspended load sediment yield and bed load yield in Chinda creek has no effect on the channel morphology of the creek this is because an insignificant relationship exists between the two independent variables and the dependent variable.

The result of the study also revealed that the movement of sediment from one point of the channel to another point in totality cannot assume that it is the only factor responsible for channel form change, but that several other factors have significant roles to play in the changes that occur in a river channel.

Arising from the above, the study recommends that more studies should be done to identify the factors that contribute to channel form change especially in forested streams.

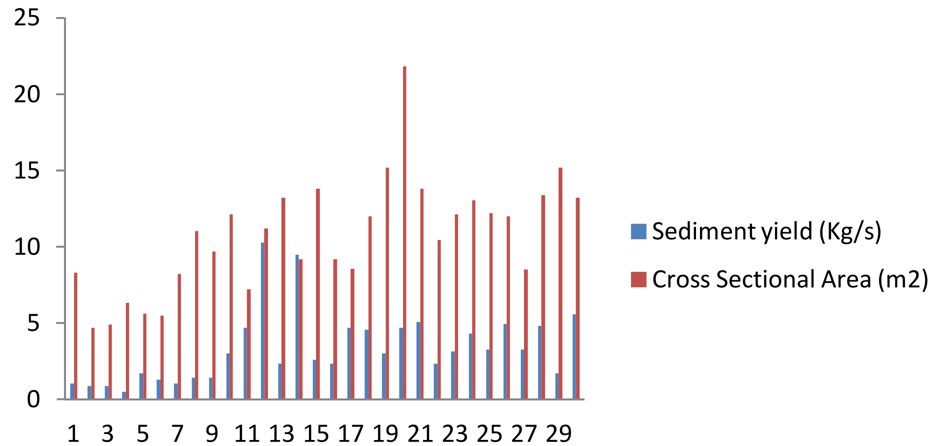

fig 1: Sediment yield and Channel cross sectional Area

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