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# Analysis of Channel Depth, Form Ratio and Wetted Perimeter of Egbelu and Mgbuduohia Rivers of Rumuolumeni in Obio/Akpor Area of Rivers State

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*ABSTRACT*

*The study comparatively analysed channel depth, form ratio and wetted perimeter of Egbelu and Mgbuduohia Rivers of Rumuolumeni in Obio/Akpor Area of Rivers State, Nigeria. The study was anchored on system theory of minimum stream power and theory of maximum flow efficiency. Data were collected on channel depth, wetted perimeter and form ratio, using such instruments as stop watch, marine rope, global positioning system (GPS), measuring tape, floater, etc. Data were analyzed using mean, standard deviation, minimum and maximum values, range and two sample student t-test. Furthermore, channel depth was 1.52m; wetted perimeter 31.07 m; and form ratio 2.92. The mean values of the fluvial properties of Mgbuduohia River were channel depth 8.93m; wetted perimeter 59.57m; and form ratio 4.47. The results also showed that there is significant difference in channel depth, wetted perimeter and form ratio between the two rivers among the three parameters. Based on the results, the study concluded that the observed differences could be a function of differences in the input factors as well as process modification along the river channel and its basin area. The study therefore recommends periodic studies for monitoring of fluvial properties of the rivers.*

***Keywords:*** *Channel Depth, Form Ratio, Wetted Perimeter, Egbelu and Mgbuduohia Rivers.*

## I. Introduction

The understanding and explanation of the underlying fluvial processes influencing the form ratio, wetted perimeter and channel depth in any river channel varies across the river system globally today. These processes vary across climatic regions and affect channel capacity efficiency in conveying flood water and suspended sediments. Every point on earth supplies water and sediment to a drainage basin (Nwaturuogu, 2021; Oku, 2016). These provide the necessary energy input and slope quality (Adeleke & Ogungbeni 2016; Babatola & Babatola, 2013). They noted that rivers are characterize by their dynamic nature and spatial linkage, crucial geomorphic agent in surface water bodies, attracting attention due to their importance in which fluvial systems transport excess surface moisture from precipitation to interior basins or the sea, resulting in predictable landforms. Ashmore

(2013) suggests solar energy and gravity power the hydrological cycle, making fluvial systems a natural system. The river's variations in tributaries and discharge characteristics vary globally, with only 10% of the earth's land surface covered by ice being affected.

Recent research on bedrock and mixed channels has received limited attention (Dubey et al 2017; Farhan et al., 2017; Whip le 2018), but studies on river over rocks, bed forms, and alluvial system structure in bedrock channels are poorly described. Contemporary scholars are studying fluvial systems and drainage basin morphometry, resulting in theories and principles. These theories assume steady, uniform river flow and equilibrium. Drainage basins occur at various scales, with smaller sub-basins within larger ones. River systems display a tree-like pattern, with many small streams feeding into larger ones, eventually leading to a large river (Adebayo, 2016). Scholars have conducted critical studies on river systems, drainage basin morphometry, suspended sediment yield, hydraulic characteristics, and hydraulic geometry, including Horton's work cited in Guth (2017) on river ordering and erosional development. In another view, Bhattacharya and Michael (2010) in Wejinya 2021, in their studies found out that urbanization impacts on channel sediment yield depend on gradient material, land use and basin size. Large drainage basins in regions with heavy rainfall are expected to have a greater impact on channel flow, discharge, and sediment characteristics. Oyegun et al. (2016) studied urbanization's impact on channel morphometric adjustments, discharge, and sediment yield in basins. They found an increase in sediment yield during urbanization's initial phase, leading to vegetal depletion, bare surfaces, splash erosion, and increased overland flow. This highlights the importance of understanding urbanization's geomorphic processes.

The Egbelu and Mgbuduohia river basins which two decades ago were purely a rural drainage system is now traversed by series of urban structures which in some areas are at the river bank. Similarly, the basins have enhanced vegetal depletion process due to emerging urban development. The changing land-use activities is increasing the index of impervious and sediment generation and transport. However, increased impervious surfaces contribute immensely to overland flow and discharge properties of the Egbelu and Mgbuduohia basins, Hence with the geometrical increase in urban structures and land-use pattern due to urbanization, their flow or discharge properties as well as channel depth, wetted perimeter, and form ratio have been altered. Hence, the study analyzed suspended sediment yield and fluvial properties of Egbelu and Mgbuduohia rivers in Obio/Akpor Area of Rivers state.

**Aim and Objectives of the Study**

Assess the channel depth of the various segments of the two rivers.
Examine the form ratio of Egbelu and Mgbuduohia rivers and their differences.
Investigate the wetted perimeter of Egbelu and Mgbuduohia rivers and their differences.

**Hypotheses**

HO1 There is no significant difference in channel depth between the two rivers
HO2 There is no significant difference in form ratio between the two rivers.
HO3 There is no significant difference in wetted perimeter between the two rivers

The Study Area: Egbelu and Mobuduohia Rivers Basin in Obio-Akpo Area of Rivers State

This work is centered on Egbelu and Mgbuduohia river basin in Obio/Akpor Area of Rivers State. The E2belu basin as shown in Figure 1.1 is located in Obio/Akpor area of Rivers State, situated between latitudes 4041 and 40491 North of the equator and longitudes 6071 and 705 1 East of the Greenwich Meridian (GM). Similarly, Mgbuduohia basin is located between latitude 40 491 3811 and 40 5111 0711 N and longitudes 60 571 4111 and 60 591 1511 E. The Egbelu and Mgbuduohia basins (river) drains the Rumuolumeni, Egbelu, Elioparanwo, parts of Mgbouba, Rumuokwachi, and Ozuoba in Obio/Akpor. Their first order streams drains from the Mgbuodohia, Azumini canal and Ozuoba landscape moving eastward and later turns southward and westward flowing into the new Calabar River at Rumuolumeni. Obio/Akpor Local Government Area is bounded in the north by Ikwerre and Etche, in the south by Port Harcourt, in the East by Oyigbo and Eleme and in the west by Emohua (See Figure 1.1 below)

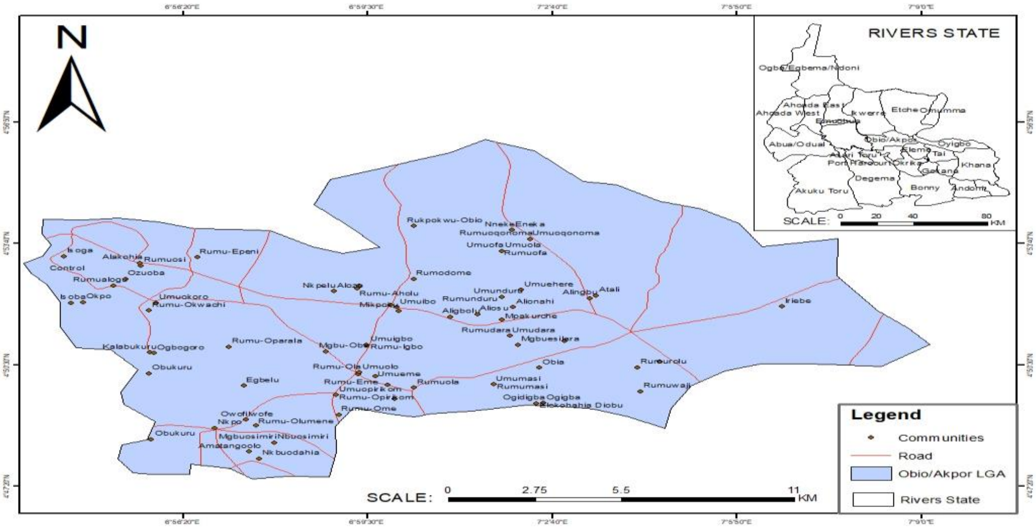


Figure 1.1: The Study Area Showing Settlements
Source: Rivers State Ministry of Land and Survey, Port Harcourt

The climate condition of the basin is dominated by the North-south trade wind of a zone of discontinuity between the dry tropical continental (CT) air mass, (North-East trade wind) and the humid tropical maritime air-masses (mT) (Oku, 2016). The relative humidity is about 85.20% for most part of the wet season. The basin experiences a double regime. These two air masses give rise to the two main climatic conditions of dry and wet seasons. The dry season runs from November through March while the wet or rainy seasons, runs from April and terminates in October. The two types of rainfall experience are the convectional and frontal rainfall. The annual rainfall varies between 2600mm to 5000mm a year (Oku, 2016). There is however, a break in rainfall, as August break separating the double maxima rainfall region. The annual temperature ranges from 28 oc to 31 Oc. The highest temperature is usually around March during the brief heat season. But the combined effects of the amount and the equitable temperature result in high relative humidity. However, Obio/Akpor Local Government Area where the Rumuolumeni and Egbelu basin is located generally has an average relative humidity of about 90.25% with a range of (Oku, 2016).

The Egbelu and Mgbuduohia basins drain into the New Calabar River at the Rumuolumeni area. It drains parts of Mobuodohia, Azumini, Ozuoba, Mgbouba, Rumuokwachi, Egbelu and Elioparanwo. The Egbelu first order streams are in the Ozuoba-Mgbuoba axis. While Rumuolumeni first order streams are in the Mgbuodohia-Azumini axis. However other first order stream category exists in the Elioparanwo and Rumuolumeni tributary strealfis. It is an all-season stream flowing during the wet and dry season all the year round. The drainage pattern especially surface runoff is westwards or south-westwards and emptying into the primary rivers. Found within these major drainage systems which are either local tributaries or flows directly into the sea like New Calabar River (Oku, 2016).

The Egbelu and Mgbuduohia basin located in the Obio/Akpor Area of Rivers state has various human and physical properties. The basin is daily increasing its level of built-up areas due to housing needs for residential and commercial use. Similarly, vegetation is being depleted as it gives way to new homes and other urban structures. Since farming is done by several local communities residing in parts of the basin, secondary vegetation is found. Few pockets of natural vegetation are found at river banks and sacred grooves. However fresh water swamp vegetation is mostly found on the wetlands which include raffia palm, climbers, and other tropical species of plants. Due to significant human activities of the Egbelu basin, the soil is exposed or vulnerable to sediment loss due to impact of splash erosion from precipitation. Human activities in Egbelu basin expose soil to sediment loss, while transportation and agriculture occupy the landscape.

## II. Methodology

The study adopted experimental research design and relied on the collection of bed sediment samples from the field for strict laboratory analysis of the parameters being examined. Scientific sampling and data collection established protocols were used to ensure that the basic tenet of experimental research design was duly observed in the entire process. An experimental research design helps researchers execute their research objectives with more clarity and transparency.

The sampling frame of the present work consists of two (2) kilometer each of the two rivers of the Egbelu and Mgbuduohia basins. The researcher used two (2) kilometers of each river before the daily tidal mark to eliminate the impact of the salt water on variables measured. Thus, these constitute four (4) kilometres of river as the area of study. The researcher generated a sampling frame of all points at 50 metres interval of all river length which gives a sampling frame of 80 sampling points. According to Oku and Wejinya (2021) a sample size of 30 points is ideal for drainage basin studies hence the researcher made use of sample size of 30 for the present study using random table numbers.

The 30 sampling points were derived using the simple random sampling technique. The simple random sampling procedure ensured that all points had equal and non-zero chance of being selected. This was achieved using the table of random numbers. The table of random numbers is an unpredictable manner from which the introduction of the bias is reduced or completely eliminated. The researcher went to the field with the necessary instruments and took observations and possible measurement on discharge and river velocity of the lower segment of river catchment area.

The researcher made use of an integrated sampler which is a bottle fitted with a cork neck with an opening which passed a straw of 0.5mm hole to allow the passage of suspended halfway to collect water samples to measure its index of suspended particles. The sample water was taken to the laboratory where the sample was poured into a beaker through a Whatman filtered paper. The resulting filtrates were oven dried, with a desiccator and sediment was weighed with a weighing balance. This formed the data set for sediment yield across the river basin expressed in mg/litre.

The discharge of the river basin was measured with the aid of measuring tape and poles. The depth as well as bank full widths were measured to calculate the discharges which were expressed in cubic meter (m3)/second. This constituted the data set for discharge of the lower segments of rivers in the various basins. The float method was used to determine the river velocity by using a stop watch to determine the time lag between two points. A floating bottle or cork was used to enable the researcher explain or generate the data set on water flow velocity.

The study used descriptive statistics for preliminary tables to display possible pattern of sediment yield and discharge velocity. The descriptive statistics include mean, range, minimum and maximum values. The hypotheses were analyzed using two samples t-test at 5% level of significance for the acceptable or otherwise of the conjectural statements earlier proposed for the study.

## III. Results and Discussion

Table 4.1 Geomorphological Characteristics and Geographical Coordinates of Mgbuduobia River Across Fifteen (15) Sampling Points

| S/n | Location | Geographical coordinates | Channel Depth (m) | Form ratio | Wetted Perimeter (m) |
|---|---|---|---|---|---|
| 1 | Sampling point 1 | Latitudes: 40- 501 3511<br>Longitude: 70 051 0011 | 5.2 | 3.07 | 44.3 |
| 2 | Sampling point 2 | Latitudes: 40- 501 3611<br>Longitude: 70 051 011 | 12.5 | 4 | 50.2 |
| 3 | Sampling point 3 | Latitudes: 40 501 3611<br>Longitude: 7` 051 0211 | 5.3 | 5.15 | 55.1 |
| 4 | Sampling point 4 | Latitudes: 40 501 3711<br>Longitude: 70 051 0311 | 8.1 | 5.45 | 61.4 |
| 5 | Sampling point 5 | Latitudes: 40 501 3811<br>Longitude: 70 051 0811 | 8.5 | 4.44 | 65.5 |
| 6 | Sampling point 6 | Latitudes: 40 501 3411<br>Longitude: 70 051 0911 | 8.8 | 3.8 | 63.3 |

| | | | | | |
|---|---|---|---|---|---|
| 7 | Sampling point 7 | Latitudes: 40 501 5511<br>Longitude: 70 051 4911 | 7.6 | 3.88 | 48.4 |
| 8 | Sampling point 8 | Latitudes: 40 501 5811<br>Longitude: 70 051 5511 | 9.5 | 4.8 | 52.4 |
| 9 | Sampling point 9 | Latitudes: 40 501 5111<br>Longitude: 70 051 5311 | 6.2 | 4.65 | 51.3 |
| 10 | Sampling point10 | Latitudes: 40 501 4911<br>Longitude: 70 051 5611 | 11.8 | 5.25 | 70.5 |
| 11 | Sampling point 11 | Latitudes: 40 501 5111<br>Longitude: 70 051 5711 | 12 | 5.5 | 71.2 |
| 12 | Sampling point 12 | Latitudes: 40 501 5011<br>Longitude: 70 051 5011 | 11.5 | 5.4 | 69.8 |
| 13 | Sampling point 13 | Latitudes: 40 501 5911<br>Longitude: 70 051 4811 | 10.5 | 4.6 | 68.6 |
| 14 | Sampling point 14 | Latitudes: 40 501 4611<br>Longitude: 70 051 4411 | 8.6 | 3.75 | 56.7 |
| 15 | Sampling point 15 | Latitudes: 40 501 4211<br>Longitude: 70 051 0311 | 7.9 | 3.45 | 54.9 |

Source: Omireh (2024)

The result in table 4.1 shows that the channel depth recorded a mean of 8.93m with a range 7.3m; the form ratio recorded a mean of 4.4 with a range of 2.38 and lastly, the wetted perimeter recorded a mean of 59.57m and a range of 26.9m.

Table 4.2: Geomorphological Characteristics and Geographical Coordinates of Egbelu River Across Fifteen (15) Sampling Points

| S/n | Location | Geographical Coordinates | Channel depth (m) | Form ratio | Wetted Perimeter |
|---|---|---|---|---|---|
| 1 | Sampling point 1 | Latitude: 40 511 0111<br>Longitude: 70 051 1011 | 0.75 | 2.2 | 23.2 |
| 2 | Sampling point 2 | Latitude: 40 511 0211<br>Longitude: 70 051 1111 | 1.02 | 2.15 | 29.60 |
| 3 | Sampling point 3 | Latitude: 40 511 0211<br>Longitude: 7` 511 1111 | 1.02 | 2.15 | 29.6 |
| 4 | Sampling point 4 | Latitude: 40 501 0211<br>Longitude: 70 051 1111 | 1.15 | 2.50 | 38.40 |
| 5 | Sampling point 5 | Latitude: 40 511 0311<br>Longitude: 70 051 1511 | 1.3 | 3.11 | 35.2 |
| 6 | Sampling point 6 | Latitude: 40 501 0811<br>Longitude: 70 051 1211 | 1.65 | 4.0 | 36.20 |
| 7 | Sampling point 7 | Latitude: 40 501 0511<br>Longitude: 70 051 1011 | 1.15 | 2.5 | 38.4 |
| 8 | Sampling point 8 | Latitude: 40 501 1211<br>Longitude: 70 051 1511 | 1.45 | 2.60 | 28.40 |
| 9 | Sampling point 9 | Latitude: 40 511 0311<br>Longitude: 70 051 2011 | 1.85 | 3.5 | 32.3 |
| 10 | Sampling point 10 | Latitude: 40 511 0511<br>Longitude: 70 051 3311 | 1.75 | 3.30 | 34.20 |
| 11 | Sampling point 11 | Latitude: 40 511 0711<br>Longitude: 70 051 2511 | 1.65 | 4 | 36.2 |
| 12 | Sampling point 12 | Latitude: 40 511 3011<br>Longitude: 70 051 4011 | 1.85 | 2.80 | 29.50 |
| 13 | Sampling point | Latitude: 40 511 3511 | 1.33 | 2.3 | 25.5 |

| | | | | | |
|---|---|---|---|---|---|
| | 13 | Longitude: 70 051 6011 | | | |
| 14 | Sampling point 14 | Latitude: 40 511 3711<br>Longitude: 70 051 8211 | 1.70 | 3.20 | 26.80 |
| 15 | Sampling point 15 | Latitude: 40 511 4811<br>Longitude: 70 051 7311 | 1.45 | 2.6 | 28.4 |

Source: Omireh (2024)

The result in table 4.2 shows that the channel depth recorded a mean of 1.52m with a range of 1.4m, the form ratio recorded a mean of 2.92 and a range of 1.85 while the wetted perimeter recorded a mean of 31.07m and a range of 15.2m.

**Descriptive Statistical Analysis for Mgbuduohia River Characteristics**

The result of the descriptive statistics of Mgbuduohia river is presented in table 4.3

Table 4.3 Descriptive Statistical Analysis for Mgbuduohia River Characteristics

| S/n | Descriptive Statistics | Channel Depth | Form Ratio | Wetted Perimeter |
|---|---|---|---|---|
| 1 | Mean | 8.93 | 4.47 | 59.57 |
| 2 | St. Dev | 2.36 | 0.80 | 8.63 |
| 3 | Range | 2.30 | 2.43 | 26.90 |
| 4 | Minimum | 5.20 | 3.07 | 44.30 |
| 5 | Maximum | 12.50 | 5.50 | 71.20 |
| 6 | Sum | 134.00 | 66.99 | 893.60 |

Source: Omireh (2024)

The result in table 4.3 revealed that Mgbuduohia River recorded shallow channel depth with a sum of 22.75m, a mean of 1.52m, a minimum value of 0.75m and a maximum value of 1.90m. Further result analysis indicated a range of 1. 15m. From the above result, the mean value implies that each of the sampling points is expected to produce a value of 1.52m.

From table 4.3, the result revealed a total form ratio of 43.76 with a mean of 2.92, a minimum value of 2.15, a maximum value of 4.00 and a range of 1.85. By the mean result of this analysis each of the fifteen (15) sampling points is expected to have a value of 2.92.

The result as contained in table 4.3 showed a total of 466.00m with a mean of 31.07m. The measures of variability of the result revealed a range of 15.10m. The result also showed a minimum value of 23.30 and a maximum of 38.40. The mean result implies that each of the fifteen (15) sampling points is expected to produce a value of 3 1.07m

Table 4.4 Descriptive Statistical Analysis for Egbelu River Characteristics

| S/n | Descriptive Statistics | Channel Depth | Form Ratio | Wetted Perimeter |
|---|---|---|---|---|
| 1 | Mean | 1.52 | 2.92 | 31.07 |
| 2 | St. Dev | 0.34 | 0.51 | 4.36 |
| 3 | Range | 1.15 | 1.85 | 15.10 |
| 4 | Minimum | 0.75 | 2.15 | 23.30 |
| 5 | Maximum | 1.90 | 4.00 | 38.40 |
| 6 | Sum | 22.75 | 43.76 | 466.00 |

Source: Omireh (2024)

The result in the above table revealed that Egbelu River recorded shallow channel depth with a sum of 14.90m, a mean of 0.99m, a minimum value of 0.20m and a maximum value of 1.70m.

Further result analysis indicated a range of 1.50m. From the above result, the mean value implies that each of the sampling points is expected to produce a value of 0.99m.

From table 4.4, the result revealed a total of 43.76 with a mean of 2.92, a minimum value of 2.15, a maximum value of 4.00 and a range of 1.85. By the mean result of this analysis each of the fifteen sampling points is expected to e a value of 2.92.

The result as contained in table 4.4 showed a total of 4660m with a mean of 3 1.07m. The measures of variability of the result revealed a range of 15.10m. The result also showed a minimum value of 38.40 and a maximum of 466.00. The mean result implies that each of the fifteen (15) sampling points is expected to produce a value of 31.07m. The channel depth displayed a sum of 14.90m, a mean 0.99m, a minimum value of 0.20m and a maximum value of 1.70m. This mean value result implies that each point sampled is expected to produce 0.99m. With respect to measures of variability, the result reveals a range of 1.50m.

**Testing of Hypotheses**

Table 4.12 A Summary of Two-sample t-test on the difference of Channel Depth Between Mgbuduohia and Egbelu Rivers

| Variable | N | Mean | SD | df | Calculated t- | Table t | Decision |
|---|---|---|---|---|---|---|---|
| Mgbuduohia River | 15 | 8.93 | 2.36 | | | | |
| | | | | 28 | 12.036 | 1.701 | H04 Rejected |
| Egbelu River | 15 | 1.52 | 0.34 | | | | |

Source: Omireh Computation (2024)

The result showed that Mgbuduohia River recorded a mean value of 8.93 with a standard deviation of 2.36 while Egbelu River indicated a mean value of 1.52 with a standard deviation of 0.34. Furthermore, the result of the two-sample t-test on the differences between the channel depth of Mgbuduohia River and Egbelu River reveals a t-value of 12.036 with 28 degrees of freedom. Based on the decision rule, since the calculated value of 12,036 is greater than the table value of 1.701 the null hypothesis is rejected while the alternate hypothesis is accepted. Therefore, the study concludes that there is significant difference between channel depth of Egbelu River and Mgbuduohia River in Obio/Akpor Local Government Area of Rivers State.

Table 4.14 A Summary of Two-sample t-test on the Difference of Form Ratio between Mgbuduohia and Egbelu Rivers.

| Variable | N | Mean | SD | df | Calculated t- | Table t | Decision |
|---|---|---|---|---|---|---|---|
| Mgbuduohia River | 15 | 4.47 | 0.80 | | | | |
| | | | | 28 | 6.327 | 1.701 | H05 Rejected |
| Egbelu River | 15 | 2.92 | 0.51 | | | | |

Source: Omireh (2024)

The result showed that Mgbuduohia River recorded a mean value of 4.47 with a standard deviation of 0.80 while Egbelu River indicated a mean value of 2.92 with a standard deviation of 0.51 .Furthermore, the result of the two-sample t-test on the differences between form ratio of Mgbuduohia River and Egbelu River reveals a calculated-t-value of 6.327 and a table t-value of 1.701 with 28 degrees of freedom. Based on the decision rule, since the calculated t value of 6.327 is higher than the table- t value of 1.701, the null hypothesis is rejected while the alternate hypothesis is accepted. Therefore, the study concludes that there is significant difference between form ratio of Egbelu River and Mgbuduohia River in Obio/Akpor Local Government Area of Rivers State.

Table 4.16 A Summary of Two-sample t-test on the difference of Wetted Perimeter between Mgbuduohia and Egbelu Rivers

| Variable | N | Mean | SD | Df | Calculated t | Table t | Decision |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mgbuduohia River | 15 | 59.57 | 8.63 | 28 | 11.417 | 1.701 | H06 Rejected |
| Egbelu River | 15 | 31.07 | 4.36 | | | | |

Source: Omireh (2024)

The result showed that Mgbuduohia River recorded a mean value of 59.57 with a standard deviation of 8.63 while Egbelu River indicated a mean value of 3 1.07 with a standard deviation of 4.36. Furthermore, the result of the two-sample t-test on the differences between the wetted perimeter of Mgbuduohia River and Egbelu River reveals a calculated t-value of 1 1.417 and a table-t value of 1.701 with 28 degrees of freedom. Based on the decision rule, since the calculated t value of I I .417 is higher than the table t-value of I .701, the null hypothesis is rejected while the alternate hypothesis is accepted. Therefore, the study concludes that there is significant difference between wetted perimeter of Egbelu River and Mgbuduohia River in Obio/Akpor Local Government Area of Rivers State.

**Channel Depth Characteristics**

The result of the study revealed that there is significant difference in the channel depth characteristics of Egblu River and Mgbuduohia River. The result is consistent with the findings of Nwaturuogu (2021) in which he found out that there is variation in the channel depth characteristics of the observed tributaries of Otamiri River in Etche Local Government Area of Rivers State. This finding also is in line with Field observation made by Nwaturuogu (2021) and came up with the conclusion that channel depth connotes the vertical distance between the surface water flow and the river bed in a watercourse which varies from upstream reach to downstream reach which agree with the result of this study.

Furthermore, the findings of this study concur with the result of Hyginus-Oku (2021) that channel depth significantly varies across selected streams in Port Harcourt metropolis of which both rivers in this study were studies. According to Hyginus-Oku (2021) this finding corroborates the earlier works of Ojo (2010) and Ikebude (2015) that channel configuration of drainage basins is unique both within and among different stream channel. In addition to the above, this result also agrees with that of Yoyokeme (2022) that found out significant difference between the river depth of Igbogene and Swali streams in Yenagoa Local Government area of Bayelsa State.

**Wetted Perimeter Characteristics**

The results of the mean wetted perimeter of Egbelu River was found to be 5 1.43 metres while that of Mgbuduohia River to be 52.75 metres. These results differ with that of Nwaturuogu (2021) that gave mean value of 283.15 metres across 32 sampling points. Furthermore, the result also reveals that there is significant difference in the wetted perimeter of the two rivers. This result also agrees with that of Nwaturuogu (2021) that observed variation in the wetted perimeter along the mean channel of Otamiri river basin in Etche Local Government Area of Rivers state. Based on this finding, Hajam et al (2013) which observed that wetted perimeter in the upper course of a river is usually narrow and there is larger wetted perimeter at the downstream reach. In the same vein, Yunus et al (2018), observed that the upper course of a stream is usually narrow and rough, however, there is large wetted perimeter at downstream reach due to the presence of boulders and rocks.

**Differences in Form Ratio Characteristics**

The study results revealed mean ratios of 4.26 and 4.42 for Egbelu and Mgbuduohia Rivers respectively four sampling points. These results differ with that of Hyginus-Oku (2021) of 3.09 for Egbelu River and 4.83 for Mgbuduohia River across four sampling points. The result also indicated a significant difference in form ratio of the two rivers, This result also aligns with the findings of Hyginus-Oku 2021) that form ratio does not vary across selected streams in Port Harcourt metro ohs. Thus, the findings of both studies are in line with the findings of Ojo (2010) and Okon and Ikebude (2015) that basin morphometry does vary across both intra and inter basins. This implies that field studies earlier done by previous scholars support the results of this study.

## IV. Conclusion

The study made analysis of suspended sediment yield and fluvial properties of two rivers in Obio/Akpor Local Government Area in order to underscore their geomorphic characteristics for sustainable river basin management in the area. The study indeed observed that the two rivers differ significantly in their fluvial properties, thus this has advanced the field of fluvial geomorphology in the study area and will significantly help the different stakeholders in the area in drainage management and dealing with environmental challenges associated with river basin, especially flooding and erosion.

## V. Recommendations

Based on the findings of the study, the following recommendations are made as a remediation to observed challenge:

*The Rivers state Ministry of Environment should endeavour to install gauging stations in strategic areas of Port Harcourt metropolis so as to measure daily fluvial properties of urbanizing streams of the metropolis with a view of checking flood hazard in the city of Port Harcourt.*

*There is need to engage in continuous monitoring of the changing form ratio of each stream by geomorphologists in the universities in Port Harcourt metropolis so as to enable them manage potential flood hazards associated with the city.*

*There should be continuous gathering of geomorphic data by the research community and relevant government agencies in order to understand the dynamics of fluvial characteristics of the urban.*

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