**Results and Discussion**

Shown in Figure W is the Hyeto-Hydrograph at Pianan-an River for the month of March which shows the highest flow levels observed in March 14, 2021 with a flowrate of 68.2cms and highest rainfall value of 16.4mm on March 10, 2021. In Figure X is the Rating Curve at Pinan-anan for March 2021 with the highest recorded flowrate at 68.2cms and a stage of 2.49m. In contrast, the lowest recorded flowrate is 12.96cms with a stage of 1.583m. Meanwhile, the average flow of the month is 18.98cms with modal water level value is at 1.7026 m.

**Figure W.** Pinan-anan River Hyeto-Hydrograph (March 2021)

**Figure X.** Pinan-anan River Rating (March 2021)

Shown in Figure Y is the Hyeto-Hydrograph at Pinan-anan for April 2021 where the highest flow levels were observed in April 23, 2021 with a flowrate of 253.91cms and has highest rainfall value of 20.4mm on April 14, 2021. The April month Rating Curve in Figure Z revealed that the highest recorded flowrate is 253.9cms with a stage of 3.56m. In contrast, the lowest recorded flowrate is 10.63cms with a stage of 1.50m. Meanwhile, the average flow of the month is 23.61cms. Furthermore, the modal water level value is at 1.83m.

**Figure Y.** Pinan-anan River Hyeto-Hydrograph (April 2021)

**Figure Z.** Pinan-anan River Rating Curve (April 2021)

Shown in Figure AA is the Hyeto-Hydrograph at Pinan-anan for May 2021. The highest flow levels in simulation were observed in May 26, 2021 with a flowrate of 181.4cms and has highest rainfall value of 33.2mm on May 10, 2021. Shown in Figure AB is the Rating Curve at Pinan-anan for May 2020. The highest recorded flow rate is 181.84cms with a stage of 1.61 m. In contrast, the lowest recorded flowrate is 13.69cms with a stage of 1.61m. Meanwhile, the average flow of the month is 28.6cms. Furthermore, the modal water level value is at 1.70m.

**Figure AA.** Pinan-anan River Hyeto-Hydrograph (May 2021)

**Figure AB.** Pinan-anan River Rating Curve (May 2021)

Shown in Figure AC is the Hyeto-Hydrograph at Pinan-anan for June 2021. The highest flow levels in simulation were observed in June 22, 2021 with a flowrate of 196.94cms and followed by a flowrate of 131.64cms on June 1, 2021. In Figure AD is the June 2021 with the highest recorded flowrate of 196.94cms and a stage of 3.33m. In contrast, the lowest recorded flowrate is 23.85cms with a stage of 1.87m. Meanwhile, the average flow of the month is 41.85cms. Furthermore, the modal water level value is at 2.01m.

**Figure AC.** Pinan-anan River Hydrograph (June 2021)

**Figure AD.** Pinan-anan River Rating Curve (June 2021)

Figure AE shows the Rating Curve at Pinan-anan from March 2021 to June 2021. Results revealed that the the lowest flowrate was observed on the Month of April with a value of 10.63cms while the highest flowrate is 253.91cms. The mode value for water level (stage) for the four months data is 1.70m with a base flow of 31.256cms.

**Figure AE.** Pinan-anan River Rating Curve (March 2021 to June 2021)

The comparative analysis of the monthly rating curve from March 2021 to June 2021 is shown in Figure AF which is express in polynomial trend line. Results revealed the differences and distinct behavior of the rating curve for each month where sudden changes of characteristics in relation to flow. Particularly, that there is a shift of the base flow each month where (a) above 1.70m flowrates are reflected from months of March and April and (b) above 1.80m flowrates for the month of May and June. Thus, there is an expected 0.10cms fluctuations of base flow every month. Furthermore, data also show that the month of June has the highest slope of the curve which only emphasize a volatile flowrate. On the other hand, the month of April and March have less series of rainfall.

**Figure AF.** Pinan-anan River Monthly Rating Curve (March 2021 to June 2021)

Figure AG shows the comparative analysis for the March 2020 and March 2021 Rating Curve. Results of the comparison revealed that there is a 44.67% increase on its highest flowrate with 21.06cms i.e. added to March 2021 from the previous year. In contrast, comparison of the lowest flowrate between the two data show a 71.50% increase with 5.37cms i.e. added to March 2021 from the previous year. Moreover, the data shows a 60.30% or an additional 7.14cms, increase of average flow compared with the data from the previous year. Finally, there is a 12.31% or an additional 0.187m increase on the average stage of the river.

**Figure AG.** Pinan-anan River Rating Curve (March 2020 vs March 2021)

Figure AH show the comparative analysis for the April 2020 and April 2021 Rating Curve. Comparing the highest flowrate between the two months, there is a 870.6 percent increase on its highest flowrate with 227.75cms added to April 2021 from the previous year. In contrast, comparison of the lowest flowrate show a 40.05% increase with 3.04cms i.e. added to April 2021 from the previous year. Moreover, the data shows a 136.57% or an additional 13.63cms increase of average flow compared with the data from the previous year. Finally, there is a 25.01% or an additional 0.366m increase, on the average stage of the river.

**Figure AH.** Pinan-anan River Rating Curve (April 2020 vs April 2021)

Figure AI show the comparative analysis for the May 2020 and May 2021 Rating Curve. Results of the comparison for the highest flowrate revealed that there is a 157.49% increase on with 111.22cms i.e. added to May 2021 from the previous year. In contrast, comparison of the lowest flowrate show a 92.28% increase with 6.57cms added to May 2021 from the previous year. Moreover, the data shows a 107.84% or an additional 14.84cms i.e. increase of average flow compared with the data from the previous year. Finally, there is a 16.14% or an additional 0.2362m increase on the average stage of the river.

**Figure AI.** Pinan-anan River Rating Curve (May 2020 vs May 2021)

Figure AJ shows the comparative analysis for the June 2020 and June 2021 Rating Curve. Comparing the highest flow rate between the two months, there is a 32.87% decrease on with 96.42cms added to June 2021 from the previous year. In contrast, comparison of the lowest flowrate show a 160.37% increase with 14.69cms added to June 2021 from the previous year. Moreover, the data shows a 40.81% or an additional 12.13cms i.e. increase of average flow compared with the data from the previous year. Finally, there is a 28.91% or an additional 0.451m increase on the average stage of the river.

**Figure AJ.** Pinan-anan River Rating Curve (June 2020 vs June 2021)

Limitations & Recommendations

-Flow measurements are so much limited due to pandemic.

-additional of RG for meteorological measurement particularly within the basin and nearly the area.

- Provide/Gathered more sample of flow measurement in order to establish a precise rating curve (for more accurate flow measurement, a use of Digital flow meter to determine an minutes/hourly/daily velocity rate)

-establish a cross-section survey to emphasize the left and right banks of the cross-section which can indicates for a bank-full scenario. And integrated the cross-section profile with the establishment of water surface level on the given time from the surveyed.

- Establish an Hydrologic Modelling which makes an accurate measurement of flow and good information for the assessments for the observed data with respect to long terms trends.

- Erroneous of data which affect the analysis of the rating curve. Time to time, data must be evaluated if it is substantial to accurate figures of data and device must be evaluate if it still working or calibrated.

Flow measurements are limited due to the pandemic. It is recommended to gather additional Rain Gauge data for meteorological measurement particularly within the basin and nearly the area. Moreover, by gathering more flow measurement samples, it is possible to establish a more precise rating curve which in turn would give a more accurate representation of the river. (for more accurate flow measurement, use of digital flow meter to determine in minutes/hourly/daily velocity rate)

It is further recommended to establish a cross-section survey to emphasize the left and right banks of the cross-section which can indicate a bank-full scenario, integrating the cross-section profile with the establishment of water surface level on the given time from the surveyed.

Lastly, it is recommended to establish a Hydrologic Modelling that makes accurate measurement of flow and good information for the assessments for the observed data concerning long terms trends.