DATA:

Figure A shows the Meteorological Data from the Pina-anan Rain Gauge(RG). The hourly data from January 27, 2020, to June 30, 2020, for Pina-anan RG from the telemetry station of Tagoloan HPP is located at Impasugong Bukidnon with latitude 8.328403° and longitude 125.017313°. The highest rainfall experienced by the river was on May 30, 2020 (3:00 pm) with a precipitation value of 25.2 mm, and March 6, 2020 (6:00 PM) with a precipitation value of 22.5 mm

**Figure A.** Meteorological Data (Pina-anan RG)

Figure B shows the Water Level from the Pina-anan Rain Gauge(RG). The hourly data from January 27, 2020, to June 30, 2020, for Pina-anan RG from the telemetry station of Tagoloan HPP is located at Impasugong Bukidnon with latitude 8.328403° and longitude 125.017313°. The highest recorded water level is measuring June 18, 2020, with a value of 3.71m with a mode value of water level of 1.5m.

**Figure B.** Water Level (Pina-anan )

Figure C shows the Water Level and Precipitation of Pinan-anan. The highest recorded precipitation occurred on March 6, 2020, at 22.8mm with a water level measurement of 2.227m and 25.2mm of precipitation with a water level measurement of 1.70m on May 30, 2020. There was a series of rainfall from June 9 to June 19 with the highest rainfall value of 16.6 mm on June 11, 2020, which generated the highest water level of the month with a value of 3.56m on June 18.

**Figure C.** Water Level & Precipitation at Pinan-anan

Shown in Figure D is the Tagoloan Rating Curve. The graph shows the previous data of the relationship between the stage and Flow for 2015 -2020 which generates a rating curve for the last 5 years (2015-2020) with (R = 0.7211) which represents the proportion variance between the relationship of the water level and flow. The graph shows the previous data of the relationship between the stage and flow from 2015 to 2020 which generates a rating curve that represents the last 5 years. Flow against water level revealed a regression value of 0.7211. The observed annual data revealed varying flow and water levels concerning climatic conditions. This corresponds to the highest and the lowest flow with consideration that there are data outliers from 2015 to 2016.

**Figure D.** Tagoloan Rating Curve 2015 to 2020.

Figure E shows the Tagoloan Rating Curve from 2018-2020. The highest correlation between the stage and flow was found between the year 2018-2019 (R² = 0.49). generally, has been considered to be the most representative data for estimation of Tagoloan Hydrograph for the preceding months. The graph shows a variance of 88% of its correlation for the last three years of water level & flow measurement.

**Figure E.** Tagoloan Rating Curve (2018-2020)

Figure F shows the Flow Measurement Timeline of the Pina-anan Rain Gauge station. Due to the pandemic, a flow measurement was taken during Feb 4 and Feb 11 for the year 2020 whereas only two samples were formulated during the year 2020. There are restrictions to the accuracy for the formulation of the rating curve due to the limitation of the data particularly in the flow measurements especially when a series of rainfall events had been observed for the preceding months.

**Figure F.** Flow Measurement Time Line(Pina-anan )

*Feb 11,2020 10:49 AM & 10:49 AM*

*Feb 4,2020 10:50 AM & 11:03 AM*

Theory /Methodology

Rating Curve is expressed as an equation of the following form in the Agency’s hydrometric archive system;

*Q* = *C* (*h* + *a*) *β*

where *C*, *a* and *β*, are coefficients that do have a physical significance as they were originally derived from hydraulic theory. The coefficient C increases as river cross-sectional area and slope increase, but decreases as roughness increases. It can be shown that for simple geometries the *β* coefficient is constant where *β* coefficient should remain unchanged. *a* is related to the elevation of the bed, and should also remain unchanged whereas the rating can be simplified into a power type of equation of

*Q* =*aSb*

where *a* and *b* are parameters that are fit using a power regression, *S* is stage height in meters and *Q* is the discharge in m³/s.

**Figure G.** Rating Curve 2018 -2020

Taking logarithms of the power type equation results in a straight line relationship of the form.

log(*Q*) = log(*a*) + *b* log(*S*)

Fit a linear line to the log-log data as shown in Figure H.

**Figure H.** Rating Curve 2018 to 2020 (log-log)

The sets of discharge (Q) and the effective stage *S* are plotted on the double log scale, they will represent a straight line. Coefficients Aand B of the straight-line fit are functions of *a* and *b*. Since values of *a* and *b* can vary at different depths owing to changes in physical characteristics (effective roughness and geometry) at different depths, one or more straight lines will fit the data on a double log plot.

Extract the coefficients

Therefore, the rating curve is expressed into a power equation of

Figure I shows the correlation of Observed vs Simulated Flow from 2016 to 2020.Correlation of the observed flow on 2016-2020 and simulated flow has an average error of 0.121 and RMSE of 1.90. This implies that the equation can be somehow used to simulate the hydrograph based on the observed water level from the telemetry. Since it has a limitation of the data and is based on the given data, there are rapid changes of its coefficients and parameters as time goes by.

**Figure I.** Correlation Observed vs Simulated Flow (2016-2020)

**Rating Curve**

The investigation of the rating curve used two sample-flow measurements from the preceding months. Presented in Figure J is the plot of the water level (WL) and the simulated flow base from the derive power equation (i.e. following months). The results revealed that the simulated hydrograph base from the derived equation is proportional to the water level at the given time. The highest flow levels were observed on June 18, 2020, with a flow rate of 293.36 cms which has also the highest water level of 3.71m. In contrast, the lowest water levels were observed on May 3, 2020, & May 8, 2020, which has a flowrate of 7.12cms and a stage of 1.34 m.

**Figure J.** Hydrograph at Pinan-anan (Jan 27,2020 1:00 AM - Jun 30,2020 11:00 PM)

Result and discussion

MARCH 2020

Shown in Figure K is the Hyeto-Hydrograph at Pinan-anan for March 2020. The highest flow levels in the simulation were observed on March 6, 2020 with a flowrate of 22.8 cms and has highest rainfall value of 22.8mm of the month

**Figure K.** Hyeto Hydrograph at Pinan-anan (March 2020)

Shown in Figure L is the Rating Curve at Pinan-anan for March 2020. The highest recorded flow rate is 47.14 cms with a stage of 2.25m. In contrast, the lowest recorded flowrate is 7.59 cms with a stage of 1.36m. Meanwhile, the average flow of the month is 11.84 cms. Furthermore, the modal water level value is at 1.52m

**Figure L.** Rating Curve at Pinan-anan (March 2020)

APRIL 2020

Shown in Figure M is the Hyeto-Hydrograph at Pinan-anan for April 2020. The highest flow rate simulation was observed on April 20, 2020, with a flow rate of 26.16 cms and has highest rainfall value of 6mm on April 18.

**Figure M.** Hyeto-Hydrograph at Pinan-anan (April 2020)

Shown in Figure N is the Rating Curve at Pinan-anan for April 2020. The highest recorded flow rate is 26.16 cms with a stage of 1.92 m. In contrast, the lowest recorded flowrate is 7.59 cms with a stage of 1.36m. Meanwhile, the average flow of the month is 9.98 cms. Furthermore, the modal water level value is at 1.46m.

**Figure N.** Rating Curve at Pinan-anan (April 2020)

MAY 2020

Shown in Figure O is the Hyeto-Hydrograph at Pinan-anan for May 2020. The highest flow rate simulation was observed on May 12, 2020, with a flow rate of 70.62 cms and has highest rainfall value of 25.2 mm on May 30.

**Figure O.** Hyeto-Hydrograph at Pinan-anan (May 2020)

Shown in Figure P is the Rating Curve at Pinan-anan for May 2020. The highest recorded flow rate is 70.62 cms with a stage of 2.51m. In contrast, the lowest recorded flowrate is 7.12 cms with a stage of 1.34 m. Meanwhile, the average flow of the month is 13.76 cms. Furthermore, the modal water level value is at 1.46m.

**Figure P.** Rating Curve at Pinan-anan (May 2020)

JUNE 2020

Shown in Figure Q is the Hyeto-Hydrograph at Pinan-anan for June 2020. The highest flow rate simulation was observed in June 11,2020 with a flowrate of 293.36 cms and has highest rainfall value of 16.6 mm on June 11.

**Figure Q.** Hyeto-Hydrograph at Pinan-anan (June 2020)

Shown in Figure R is the Rating Curve at Pinan-anan for June 2020. The highest recorded flow rate is 293.36 cms with a stage of 3.71m. In contrast, the lowest recorded flowrate is 9.16 cms with a stage of 1.44 m. Meanwhile, the average flow of the month is 29.72 cms. Furthermore, the modal water level value is at 1.56m.

**Figure R.** Rating Curve at Pinan-anan (June 2020)

Figure S shows the Rating Curve at Pinan-anan from March to June 2020. The lowest flow rates were observed in May with a flow rate value of 7.12 cms and the highest flow rate value was observed in June with a reading of 293.6 cms. Base on the meteorological data, the month of July has accumulated a rainfall value of 287.40mm and an average value of rainfall of 0.09 which shows that June is described as the rainy season from the 4 months.

**Figure S.** Rating Curve at Pinan-anan, March to June 2020

The rating curve, shown in Figure T, is expressed into a polynomial trend line to showing the differences in the distinct behavior of the rating curve for the 4 months. It indicates there are prompt changes of characteristics that happen within the area. It shows that there is an increase of base flow for every month whereas 1.28% flow rate from May to June. The graph shows June with the highest curve grade which emphasizes the volatile flow rate within the month. Moreover, the month of April has the least amount of rainfall among the 4 months.

**Figure T.** MonthlyRating Curve at Pinan-anan

Limitations & Recommendations

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.