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Analysis of Seasonal Variation on River Hydromorphology in Pelus River, Perak, Malaysia

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Abstract: Pelus river were located in cascading area which some party took this area as one of the potential area for new hydro-plant area. Pelus River discharges into the Perak River about 10 km downstream of Chenderoh and the gradients in the upper courses are steep where some river can drop to >50 m. Total catchment size for Pelus catchment area is estimated about 328.1794 km^2. The long of main Pelus River is estimated at 22.11 km. The relationship between rainfall and water level were positively strong where R^2= 0.84925. The rating curve show the correlation between water level and discharge are positive strong with R^2= 0.9976. It is clearly identify that rainfall has given strong impacts on the discharge of Pelus River. Therefore, the main purpose of this study is to study the river profile characteristic of Pelus River which to achieve the expected outcomes that are to produce the alternative way such as using hydrology navigation to control optimum river characteristic if any development occurs the river basin. The need to analyze the impact of seasonal variation in river morphology is due to most of the sediment transported by the rivers through the inlet in the high flow season. River discharge analysis is important in order to know the linked with channel efficiency, water supply, flood control or the way in which people in Pelus area use the river.

Key words: Pelus River, catchment, river profile, river discharge, longitudinal profile

INTRODUCTION

Now a days, Malaysia is trying to balance up the vigorous development and environmental sustainability. In other hand, it shows that environment balance is part of the important play in each of development principle. Rivers are a main focus of human interaction with the natural environment such as agricultural and industry (Harper *et al*., 1995). River longitudinal profile or long profile is changes of river's gradient and the relationship of height of the river above the sea level at various points as it flows from its source to its mouth (Western *et al*., 1997). The longitudinal profile survey is important for measuring the slope of the water surface, channel bed, floodplain and terraces. The elevations and positions of various indicators of stream stage and other features are recorded and referenced to the benchmark. During the high-low, the strong current thus will change the hydraulic and morphology characteristics of the river (Petts and Maddock, 1994). There is a need to identify measurable characteristics of stream channel morphology that vary predictably throughout stream networks and that influence patterns of hydrological changes. Objectives for this study are:

- To characterize the river cross sectional and longitudinal profiles of Pelus River in different seasons
- To determine the relationship of the channel hydraulic characteristics and the flow regime in different seasons
- To propose recommendations to be maintained for effective channel functions

MATERIALS AND METHODS

Study area: Sampling stations were chosen at different flow regimes, either at low, moderate or high which in different seasonal. The samplings were conducted during two seasons; dry seasons (Jun, 2014) and wet season (August, 2014). There are 8 stations (Fig. 1) along Pelus River. From all of these stations, the cross-section method will be held using the Wading method. The sample station appointment characteristic are the straight most river reach based on the hydrological map, points that have fewer obstacles, less pools and riffles and point that can represent the actual condition of the unregulated river (Rosgen, 1994).

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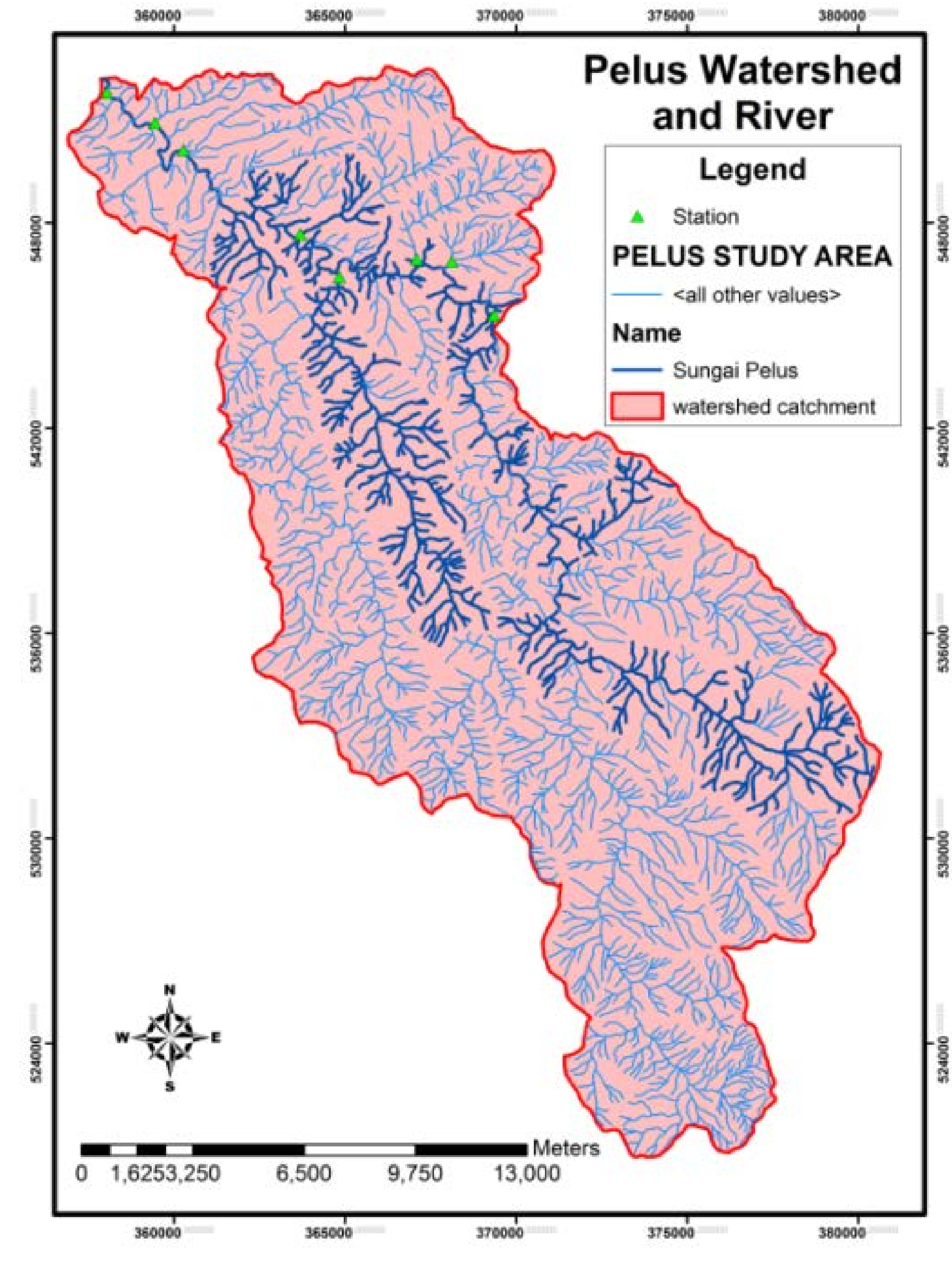

Fig. 1: Pelus river catchment area and sampling stations

Wading method is applied to find the hydrology measurement of all the chosen stations. In this method, the stream channel cross section is divided into numerous vertical subsections In each subsection, the area is obtained by measuring the width and depth of the subsection and the water velocity is determined using a current meter. The discharge in each subsection is computed by multiplying the subsection area by the measured velocity. The total discharge is then computed by summing the discharge of each subsection (Richter *et al*., 1996).

Cross sectional measurement: This fieldwork involved the cross-section measurement in order to get the velocity (v), overflow water level and the discharge data (Q). The measurement that been conducted in-situ way are the width of the river (b) and the depth of the river (D) in order to calculate the cross-section of the river (A) and the velocity is needed to calculate the discharge (Q) that been studied. The total of every discharge will be calculated by:

$$\text{Discharge (Q)} = \text{Area (A)} \times \text{Water velocity (v)} \quad (1)$$

Secondary data: The rainfall data were taken at the Kg. Lintang station for 31 year (1983-2014) data while water level data were taken for 30 year. Station Kg Lintang located at the downstream of the Pelus River which is the nearest station Pelus River catchment. Secondary data were analyzed by using descriptive statistical analysisto gain the total annual rainfall and water level. Daily water level data were using to calculate the total discharge of the river by using the correlation of primary data which the sample point nearest to the water level station in Kg. Lintang which is Station 8.

RESULTS AND DISCUSSION

Longitudinal profile: The long profile represented the energy levels of the water way, with zero toward the end of the area determined. The long profile likewise would be fascinating to match against the speed of the stream, to check whether the level zones have least speed and the lofty territories have the most elevated speed. From sampling data, the longitudinal graph was plotted for both sampling time (Fig. 2). Longitudinal profile was taken based on season to know whether the river energy level affected by season changes or influenced by any other causes.

The longitudinal were taken based on the mean sea level as the elevation form that represented the constants elevation reference for each station. Certain profiles present slope discontinuities as Fig. 2 shows, the elevation of station 1 to station 2 has big differences (with station 1= 455.24 km and station 2= 223.33 km) compared to the rest stations elevation which have constant differences in elevation. The steepness slope of station 1 to station 2 eventually affects the channel shapes and subtracts transportation since water is the major driver in river and so, water flow influenced the by the slope steepness (Korsgaard, 2006).

Cross section profile: Cross sectional analysis were made in order to estimate the capacity of bankfull discharge (m^3/s) which is the measure of water streaming in the channel when the water level is at bankfull based on velocity and cross sectional region. Velocity can be determined by the main factor which is channel slope and this is shown in the longitudinal profile overview (Fig. 2). Based on the study area, the cross sectional profiles have been plotted for the each sampling stations as shown in Fig. 3.

Cross-sectional survey has been made to get the shape of the study channel based on the seasonal changed which dry season and wet season. The seasons were determined by 35 years rainfall data collected which can relate to the monsoon season in Malaysia. Figure 3 show the cross sectional profile that produced from the primary data collection for both season. Based on station 1 which is located at the upstream of this channel, the width of the channel is smaller than station 2. The changes in shape and pattern of this channel occurred almost naturally due to shape that been plotted in Fig. 3. Station 2 cross section profile show the drastic changes of the river bed between 2 seasons as the first sampling which during the dry season is 224.04 m in MSL elevation (227 m) while second sampling which during the wet season is 223.33 m. The differences between these two readings with different time sampling in two months changed almost 10 m in MSL elevation reading.

Wet season or indirectly named as the inter-monsoon season the precipitation occurred more compared during the dry season. As time changes from dry season toward the inter-monsoon season, the precipitation occurred helps in increasing the water capacity of the river basin The wash away by the increasing of velocity due to the influenced by slope which helps in transporting the fluvial sediments of the river bed and increasing the depth of the river bed. Sediment is transported by stream as suspended sediment which is continually suspension and as the bed load moves by rolling, sliding bounding along the bottom. The amount of sediment being transported is highest during the period of heavy rainfall because of the erosion produced by the higher velocities and turbulence of the channel as it moves from the steep upstream. Therefore, there is a major change in station 2 riverbed reading due to the increasing of water velocity which from 0.86 m sec^{-1} during first sampling to 1.15 m sec^{-1} during second sampling.

Rainfall and water level: The relationship of rainfall data and water level based on the correlation graph for year 2008 (Fig. 4) were positively strong where the R^2 = 0.84925. This shows that the river is strongly recharged by the amount of precipitation of the catchment area. As the rainfall in 2008 is increase the water level also increase according to the amount of surface runoff towards the river.

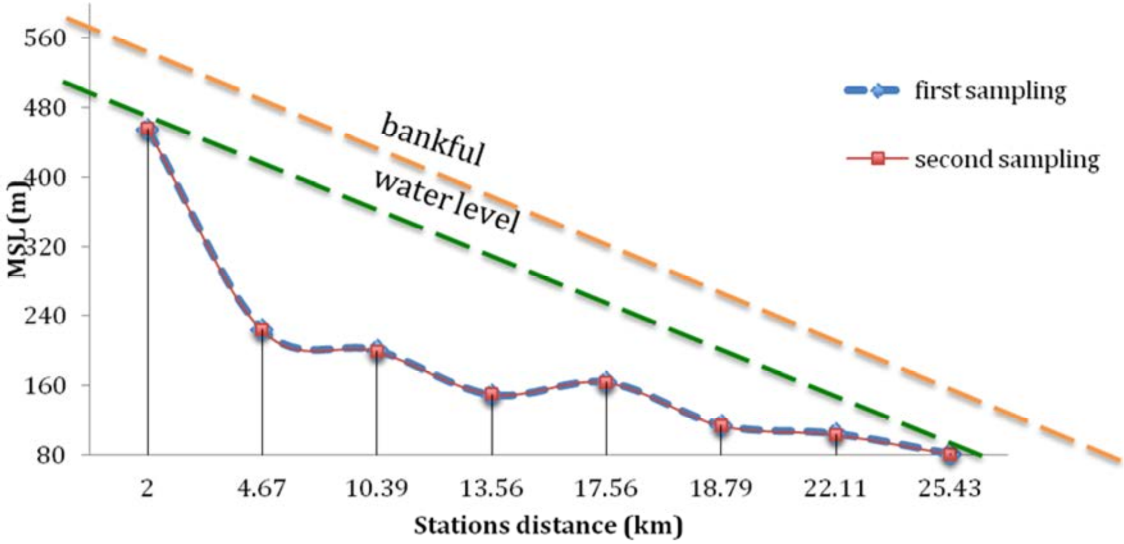

Fig. 2: Longitudinal profile

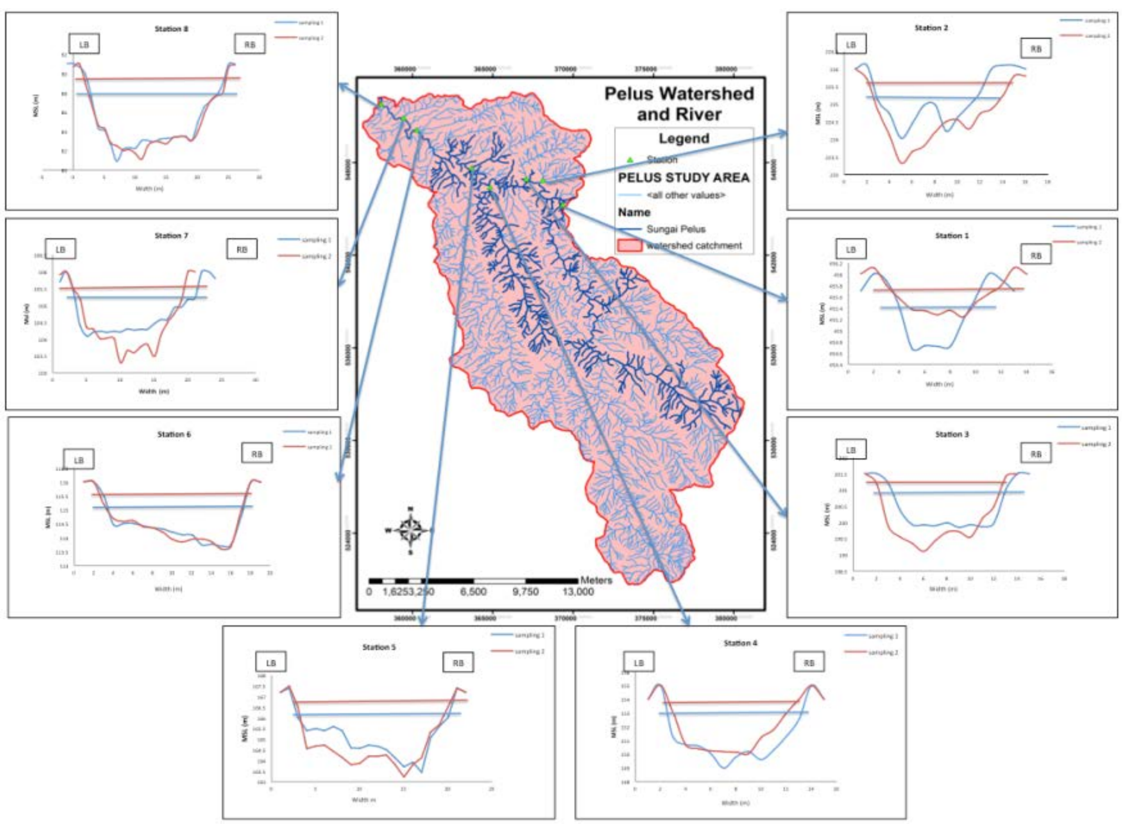

Fig. 3: Cross section of sampling points

Rating curve: The definition an application of rating curves require and understanding of stream hydraulics and considerable experience (Tharme, 2003). The rating curve theory and details of application are to know the

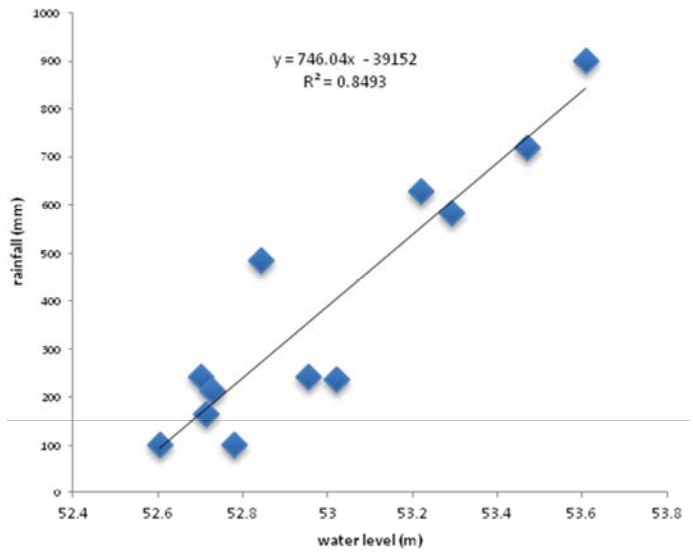

Fig. 4: Correlation of rainfall and water level for year 2008

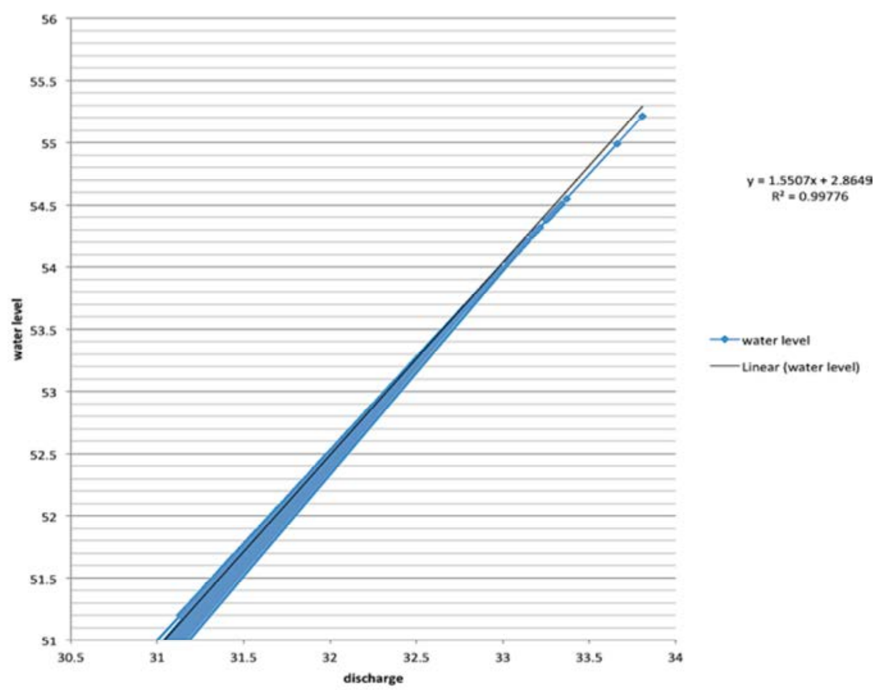

Fig. 5: Rating curve

various channels and flow condition of the stream (Zaprowski *et al*., 2005). More commonly the stage discharge relation will change either gradually or abruptly in response to such factors as aquatic growth, erosion or deposition by floods and other natural or man-mad changes in the channel.

The equation of the graph gained from the primary data, the correlation of the discharge and water level of the nearest sampling point to the water level station at Kg. Lintang which is station 8, with $y = 1.5507x+2.8649$. From the equation the rating curve of 30 year data were plotted. Based on Fig. 5, the rating curve shows that the correlation between water level and discharge are positive strong with $R^2 = 0.9976$. Discharge is strongly influenced by the water level where by based on the Fig. 4 shows that water level is strongly influenced by the rainfall. Therefore, it is clearly identify that the rainfall has given strong impacts on the discharge of Pelus River.

CONCLUSION

Based on this study, it can be state that, there is significant different cross section between dry season and wet season which influenced by amount of precipitation so do the surface runoff. Dry season which is during first sampling (Jun, 2014) has shallow and wide cross section while wet season which is second sampling (August, 2014) has shallow and narrow cross section. Most of the changes that occurred at the watershed area due to the natural even there are some part that been touch by human activities which contributed to increase the volume sediment loading and erosion at the area, yet, the contribution of human activity is not much changed the natural factor of the river. However, it is critically important to maintain the river morphology and characteristic to prevent the big ecosystem changes and worst case scenario. The river basin strategy must be formed by combining water resource planning, land used planning and environmental planning of the basin into and integral one with full consideration of measure to mitigate natural events or disaster and to facilitate comprehensive use of resources involved, keeping the ecosystem in state of good circulation. Thus, emphasis must be laid on integrals view of the whole basin and the current future demandsof economics development of the river.

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