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Physical Profile of Calbiga River, Samar, Central Philippines

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Abstract

Physical profile is significant reference to in addressing areas at risk due to fluvial processes and in establishing the physiographic maps especially in protected areas. Calbiga is one of the major rivers inside the Samar Island Natural Park (SINP). The source of Calbiga river was traced at the foot of Mt. Huraw of San Jose de Buan, Samar. The area is at the center of the Samar Island with an elevation of 850 meter above sea level (MASL). The river stretches 36.4 kilometers, with an average span of 44.57 meters, and average depth of 2.6 meters. The average height of the river bank is 7.67 meters, with rage of 5 - 10 meters. Generally, the substrate was sand. On fluvial dynamics, the average water velocity is 0.20 mps with the average water flow of 18.64 m^3/sec. The floodplain ranged from 10 - 15 meters and 5 to 7 meters high. The river control measures are making a positive impact, though it could be reviewed to address the low elevation of the midstream. Rehabilitation measures at the watershed should be considered, parallel to the policy implementation of Disaster Risk Reduction Management (DRRM) measures.

Keywords

Calbiga River, Samar Island Natural Park (SINP), Physical Profile of Rivers, DRRM Planning

1. Introduction

Rivers are very dynamic but a fragile body of water. Extensive anthropogenic activities mostly for livelihood in the terrestrial ecosystem are unconcealed. Due to proximity and interdependence, rivers are easily disturbed by anthropogenic activities in the terrestrial ecosystem. As such, the interplay of these two ecosystems shapes the river. In previous years, flooding was experienced only during strong typhoons, but recently, it has been observed frequently and the scale of coverage increasing, as an impact of climate change (Monjardin et al., 2019). This fluvial process changes the landscapes and river channels by various factors (Bizzi & Learner, 2012; Ferguson, Lewin, & Hardy, 2022). The frequent occurrence of flooding and other disasters has brought to the attention of our policy makers. However, policies should be stronger if it is supported with scientific data. With the many rivers in the Island, profile of which are limited to none.

The Samar Island Natural Park (SINP) is the largest terrestrial protected area that covers 333,300 hectares. The buffer covers the three provinces of Northern Samar, Samar, and Eastern Samar. Calbiga River is one of the major rivers inside the SINP. Physical profile is a significant reference to identify Channel Migration Zones (CMZ) and other hydrologic processes that would change the landscape, especially protected areas. Furthermore, results of the study are inputs to planning in addressing areas at risk due to fluvial processes and in establishing the physiographic maps of the rivers, which is an input to planning and development of the LGUs, especially on Disaster Risk Reduction and Management. Hence, the study aims to describe the physical profile of the rivers, including the location of the watershed or the headwaters, visualize the cross-section profile of the river, and to describe the physical characteristics of the river.

2. Methodology

2.1. Preliminaries

The location of the river was searched in the Google Earth map. The headwaters and the river mouth were traced along the stretch of the river to identify the municipalities with jurisdiction on the river for purposes of communication and preliminary engagements as protocol.

2.2. General Procedure

The profile of the river was determined through a field survey in June 2022, following the standard procedures, guided with reference map from the Google Earth. Data collected were interpreted with a line drawing. Information on floodplains and flood height were collected from the key informants of the community.

2.3. Identification of Sampling Sites

With reference to the headwaters at the highest elevation and the river mouth, the river segments—upstream, midstream and downstream were identified. The upstream refers to the highest elevation, the midstream and downstream were located. The upstream refers to the highest elevation, the midstream at the center, and the segment which is located at least three kilometers from the river mouth is the downstream. The headwaters is the segment nearest to the river source with no established population, and is assumed to be less disturbed part over the remaining stretch of the river.

With the Global Positioning system (GPS) device, two stations of 200-meters with at least three kilometers interval was randomly established in each segment. A total of 1200 meters were established in six sampling points along the river as shown in Figure 1.

2.4. River Profiling

Within the 200 meters sampling station, the following parameters were collected. The physical profile of each river segment was based on the average readings.

River width. The river width was measured based on the distance covered by the 20 GPS readings from both sides of the river margins. The readings taken at every 10 meters starting from the highest elevation to downstream direction was plotted in the Google Earth map. The width per sampling area was based on the average width.

River depth and sediment substrate. The river was measured using a digital echo sounder. Readings were taken from three points, both sides and the center at points zero "0" meters, 100 meters and 200 meters. The reading from the digital echo sounder was validated by the 5 kilograms inverted plumb bulb tied to a metered rope, until it touches the bottom. The bulb has a 1 × 2 centimeters pocket at the bottom, packed with soap to collect the samples. Wherever possible, sediment substrate is collected by scraping the bottom samples with a screw-capped container of 50 grams capacity.

Water velocity and water flow rate. A 50 - grams fabricated float with a metered 50 meters rope was deployed for two minutes in three trials. Readings was translated into water velocity, using the standard formula.

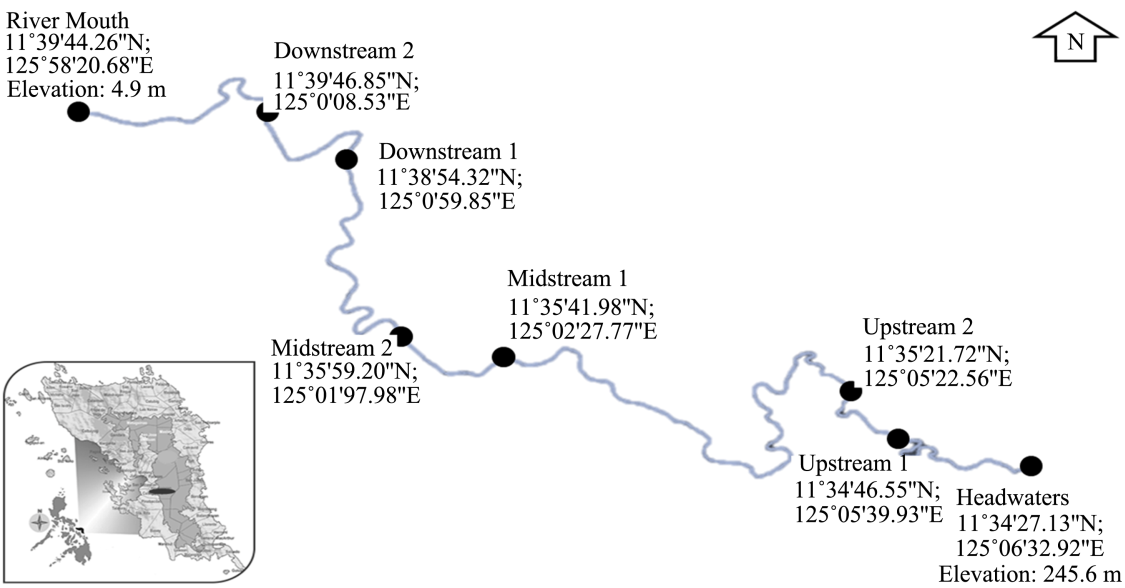

Figure 1. Location of the river showing in six sampling points of the three segments. (Inset: Philippine map) Source: Google Earth.

Floodplain and flood height. Floodplain was identified based on the horizontal regions reached by the flood with reference from the river margin, while flood height refers to the vertical reach of the flood with reference to the height of the river bank, in cases there is an excess volume of the water. This information was revealed by the community through a focused-group discussion and based on the observations in the area, i.e. height of trashes left in the trunks along the river and the water marks.

3. Results and Discussion

The source of Calbiga river was traced at the foot of Mt. Huraw of San Jose de Buan, Samar. The area is at the center of the Samar Island with an elevation of 850 meters above sea level (MASL). The river stretches along the same municipality, highlighted by the Lulugayan Falls in the upstream of the meandering river.

The river has an estimated stretch of 6.4 kilometers with an average span of 44.57 meters and 2.6 meters average depth, as shown in **Figure 2**. The average height of the river bank is 7 meters, with a range of 5 to 15 meters with sand substrate. On fluvial dynamics, the average water velocity is 0.20mps with an average water flow rate of 18.64 m^3/sec. while the plain ranges from 5 to 15 meters.

The upstream segment is non-wadeable at an average depth of 1.28 meters. The velocity was strong that continuously contribute to the 30-meter waterfalls. The increase in water velocity and turbulence which could be attributed by the elevation, is due to the steep gradient of the river bed (Han et al., 2020). The elevation and depth could influence the higher water velocity through the downstream, despite of the increasing river width. Furthermore, the high velocity contributes to the 10-meter floodplain. Runoff velocity is positively and exponentially correlated with D50index sediments (98.5 μm) (Ramos et al., 2016; Han et al., 2020). The downstream segment has the widest and deepest part of the river. The width and depth at the river downstream increased due to the inflow from the river. The width and depth at the river downstream increased due to inflow from the tributaries and groundwater sources that increases the water volume of the surface area of the channel. Furthermore, a river channel with an increased surface area tends to reduce the water velocity due to increase of friction that supports the low water velocity of the downstream segment.

The meandering shape and elevation are attributes to the flow rate (discharge). It facilitates erosion and sedimentation, though it promotes diverse riparian ecosystem (Ferguson, Lewin, & Hardy, 2022), especially in steep watersheds subjected to frequent heavy rains despite heavily vegetated conditions (Oguchi et al., 2001).

The river has a unique feature that can be attributed to the occurrence of flooding in the area. The midstream has a lower elevation than the downstream which caused the high floodplain over the two segments. Moreover, the sandy substrate is highly susceptible to erosion. High susceptibility may influence spatial variations in bank erosion processes and rates, including downstream

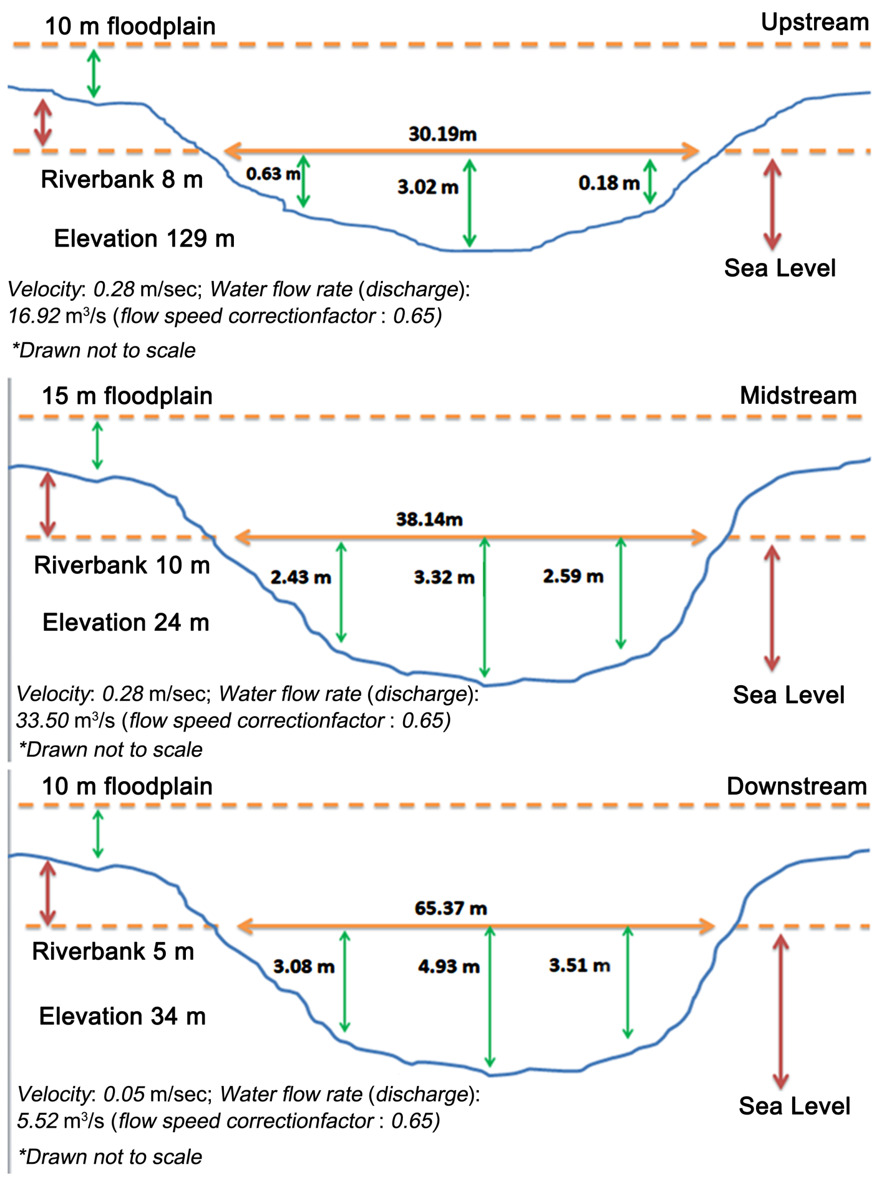

Figure 2. Cross sections of the upstream, midstream and downstream of Calbiga River. (*Drawn not to scale*).

changes in the effectiveness and significance of sub-aerial erosion (Couper, 2003). The deepest part of the river channel was observed at the downstream segment which can be attributed to the high flow rate discharge of the midstream. However, erosion was not that evident due to some river and flood control measures implemented by the Local Government Units (LGU).

4. Conclusions and Recommendations

Erosion is occurring in the area. The flood plain will increase continuously considering the velocity and flow rate of the water. Rehabilitation measures such as massive reforestation at the watershed area and along the riverbank can be considered in planning and prioritization of project implementation. Organization of the River Management Council (RMC) is seen as one of the measures for a collective and unified action to address issues parallel to the implementation of DRRM measures.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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