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Ecology and Geomorphology of Stream: A Study of Buyo Creek near Okshitpin Village Tract, Padaung, Bago Division

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Abstract

The field of watershed science is inherently multidisciplinary, involving a broad array of physical, biological and social sciences. This paper introduces to multidisciplinary study of stream ecology and geomorphology. The goal of this paper is to bring the fields of biology, ecology, geosciences and engineering to collaborate in addressing issues in river, stream and watershed management and restoration. The issues affecting the Buyo Creek are particularly acute and complex. The interests of farmers, loggers, commercial, wildlife depend upon the Buyo creek system. Watershed-scale characteristics such as geologic rock type and vegetative cover directly affect the nature of reach-scale stream habitats. Consequently, these concepts into stream monitoring and evaluation programmes in an attempt to better understand the impacts of land use and management activities on stream habitat conditions.

Introduction

There are many reasons to do a stream's ecological and geomorphic assessment, ranging from learning about the natural environment and the effects humans have had on the landscape over time, to identifying high quality aquatic habitats, to characterizing erosion and flood hazards. Data collected during stream geomorphic assessments will not only foster a better understanding of the physical processes and features shaping a watershed but will also help in making strategic decisions about how to best protect, manage, and restore watershed resources.

The stream's ecological and geomorphic assessment programme objectives are:

1) To create a data collection protocol for the physical assessment of streams and rivers that is scientifically sound and produces repeatable results, so that data can be compared not only within a watershed, but also between watersheds and regions.

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(2) To create a river assessment methodology that will help lay people understand how human activities over time within a watershed can be conducted in a manner that is both ecologically and economically sustainable.

Overall, stream ecological and geomorphic assessment will show that stream sites should not be viewed in isolation, but rather within their watershed landscapes and history of land and water use changes. For instance, channel modifications upstream or downstream of a site, conducted decades ago, may be the source of the problems observed at that site today. Maps, aerial photos, and historic information will be invaluable when combined with field observations in piecing together the story of a stream's response to the natural and human disturbances that have occurred over time.

Fluvial geomorphic science explains the physical river processes and forms that occur in different landforms and geologic and climatic settings. In applying fluvial geomorphic science, it is assumed that:

1) Although rivers are dynamic, with a form or geometry that is ever changing through erosion and depositional processes, there is a central tendency of form and process that has a predictable relationship with surrounding and watershed land forms and which may undergo significant change naturally with climate changes over time;

2) Human-related physical change to river channels, floodplains, and watersheds; and

3) The distribution and condition of stream types, especially those indicative of reach and watershed scale adjustments, influence erosion and flood hazard risk levels and aquatic habitat quantity and quality.

Channel adjustment typically involves erosion, but the terms are not synonymous. The processes of erosion and sediment deposition are ongoing and often result in changes in channel form and fluvial processes that are well within the range of natural variability. Fluvial geomorphic assessments help us understand whether the observed channel changes (such as eroding banks) are indicative of a river adjustment process, and if so, to what extent and over what period of time the adjustment will occur. Fluvial geomorphic assessments can also help us evaluate how the adjustment will likely play out under various management scenarios. With this knowledge river managers can weigh the long-term costs and risks associated with different human activities, including channel and floodplain encroachments or land use conversions at the watershed scale.

Methods

It is important for readers of this report to note that this is a field training, not a scientific study of the Buyo Creek. Participants conducted all of the work, including data gathering, synthesis and analysis. Because this was a training exercise for participants from highly variable backgrounds, data and conclusions of this report should not be used as a precise measure of the watershed. Moreover, this study was conducted during optimal conditions of the Buyo area in cool season.

In an effort to evaluate stream conditions for Buyo creek within the tributaries of the Ayeyarwady River watershed, an integrative approach was employed that evaluated a wide range of small-scale site specific parameters. This type of spatial hierarchical analysis has been shown to provide a broader understanding of how processes and conditions at one spatial scale control and affect the processes and conditions at a smaller scale (Frissell et al, 1986; Imhofetal, 1996). For example, watershed-scale characteristics such as geologic rock type and vegetative cover directly affect the nature of reach-scale stream habitats, such as the amount of sand in pools and water temperature. Consequently, resource agencies have incorporated these concepts into their stream monitoring and evaluation programs in an attempt to better understand the impacts of land use and management activities on stream habitat conditions (Davis et al, 2001; Fitzpatrick et al, 1998; Lazorchak et al, 1998).

The methods utilized in this course combined techniques with the specific intent of evaluating several factors. Those factors included stream habitat availability (channel structure and flow conditions), degree of in-stream sedimentation, water pH, and relative abundance of vegetation. Although many other limiting factors exist for time limitations associated with this class precluded further analysis.

For the field study, participants were divided into two teams and assigned to channel reach segments. Once in the field, each team completed a reconnaissance of their selected creek segments to assess the overall character of the stream habitat and the diversity of the channel morphology. Each segment was classified into geomorphic reach types based on the classification of Montgomery and Buffington (1997). Portions of the stream segments were delineated as one of six reach types based on the dominant geomorphic processes exhibited: bedrock, cascade, step-pool, plane-bed, riffle-pool and dune-ripple. Once the range of reach types present in each segment was determined, each team identified representative sample reaches of a single reach type to survey in detail. Due to time constraints, emphasis was placed on surveying sample reaches in the lower and upper segments of the creek where Okshitpin Village developed.

Assessment for Buyo Creek

Buyo creek drains the eastern slopes of the Western Mountains Range Area (Fig. 1). Buyo Creek flows from north-west to south-east along which many villages are situated such as Tattha, Bubet, Kwedaw, Kaingywa, Yinywa, Leywa, Okshitpin and Kongyi, etc. All these villages are included in Padaung Township, Bago Division. The creek flows through the Okshitpin Village and join Shwedanga Creek before draining into the Ayeyarwady River. These creeks differ from one another in that they are very dynamic in response to geology, and anthropomorphic conditions. During the rainy season the whole channel is filled with water and the water level reached to about 20 feet above the floodplain. But in summer, the water is only along the narrow active channel.

Watershed Characteristics

In the upper Buyo watershed, the dominant vegetation type is mixed deciduous forests. Presumably, historical logging took place on the forest land; however, due to limited time and access, a field visit to the upper reaches of the watershed was forgone and the status of logging and its impacts on Buyo Creek were not observed.

Current land use in the lower watershed of Buyo creek is dominated by various types of agriculture as Ya land and residential (Fig. 2). There are several cattle crossings along creek as well as a road crossing on creek.

Several distinct reach types were delineated along Buyo Creek according to channel morphology and vegetation influence. The geomorphology of Buyo Creek is dominated by alternating riffle-pool sequences interspersed with occasional runs (Fig. 3).


Taungbwe
Kwedanga C

Fig. 1. Location of sample reaches along the Buyo Creek.

The lower creek is a perennial system. There is evidence of significant erosional features and generally in-stream sedimentation is high. Riparian vegetation is established and is dominated by some tress, shrub and grasses (Fig. 4). Moderate amounts of rooted floating, floating algae and attached algae aquatic vegetation are present (Fig. 5).

Flood plain opens up and both riparian and instream vegetation disappear completely. Alternating riffle-run habitats with a mixture of small and large cobble dominates the stream morphology. Pools in this section of Buyo Creek were seldom, and occurred generally from scour around vegetation. It should be noted that during the survey period, this portion of Buyo creek began to dry up. The habitat is predominately riffle-pool habitat present in the channel. The channel system in the upper section is anabranched rather then braided due to the presence of permanent islands between channel with established vegetation.

As described above, stream characteristics change drastically from the downstream to upstream ends of the sampling areas in creek. This provided the opportunity to survey almost completely different sample reaches.

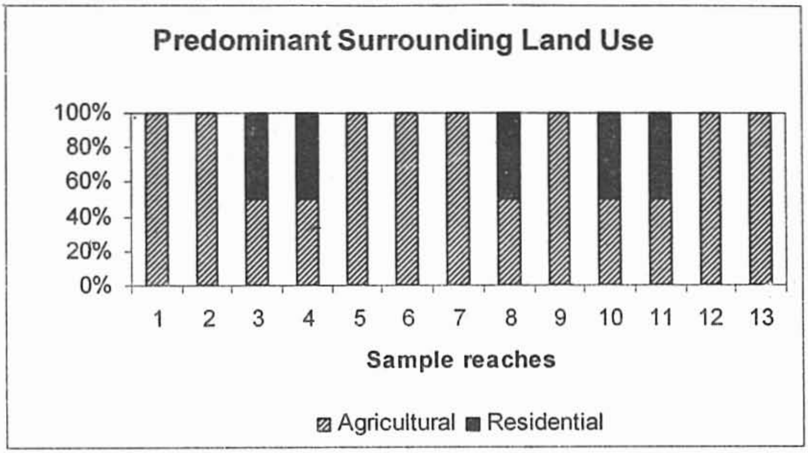

Fig. 2. Predominant surrounding land use in study areas.

Reach Characteristics

Thirteen sample reaches were chosen and surveyed along Buyo Creeks. These reaches were chosen based on the diversity of channel morphology during stream reconnaissance. A layout of these reaches can be seen in Figure 1. Reach surveys included an assessment of general habitat condition, stream geomorphology, water quality, discharge, substrate condition, and relative fish abundance.

Geomorphology

There are thirteen selected sites as study areas in the meanders and straight reaches. The channel pattern has been adjusted by itself as well as by human's activities. Nine sample reaches on upper creek and four reaches on lower creek were chosen as representative of the types of geomorphic features that may be seen within the Buyo Creek watershed (Fig. 1). Reach characterization surveys were performed to qualitatively and quantitatively describe the general conditions affecting the morphology of the reach, such as sediment input and vegetative growth. A summary of the geomorphic reach characteristics on Buyo Creek is given in.

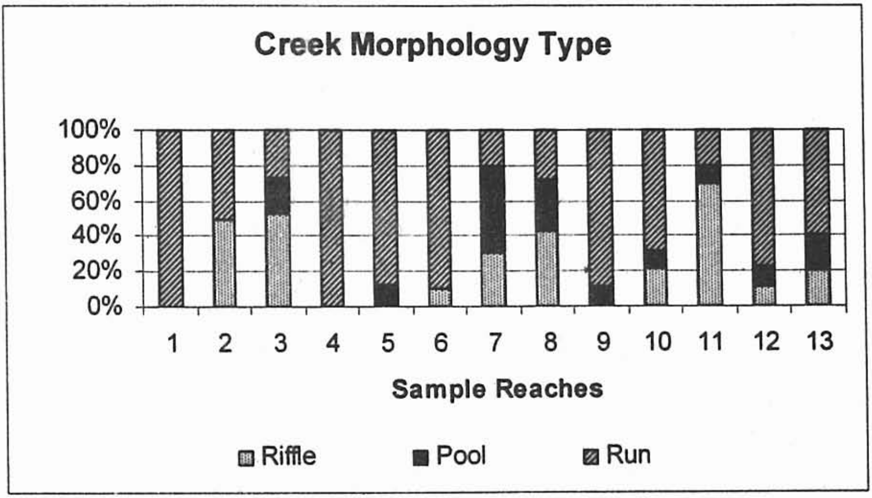

Fig. 3. Creek morphology types of Buyo in study areas.

Ten of the thirteen reaches were dominated by alternating riffle-pool sequences interspersed with pools formed by due to large woody debris and vegetation influences and had pools on the outside of meander bends in what is considered the "classic" meandering morphology (Fig. 3). Thus, steep slope banks are found at the eroded sides of meanders and on the other sides floodplains are formed due to depositional nature. Along the straight channel both sides are flood plains with slight slopes. Some obstacles to prevent the Ya-land made by human change the water flow direction. Between the original channel and present active channel some slides mass wasting are found due to down-cutting erosional process. In particular, the upper segment of Buyo Creek had high quantities of vegetation in and around the channel creating an undulating riffle-pool sequence. There was also at least one case of pool formation due to human activities. The upper portion of the Buyo valley has a spring fed to the Buyo Creek. In addition, some reaches had evidence of undercut banks, indicating a certain degree of instability likely due to a change in stream gradient which happened during the last floods.

Buyo Creek was dominated by a mixture of small and large cobbles throughout all morphology types. Occasional sands and finer grained deposits were found, but mostly adjacent to unstable banks. Buyo Creek contained a higher percentage of gravels and fines that filled the interstitial space between the cobbles.

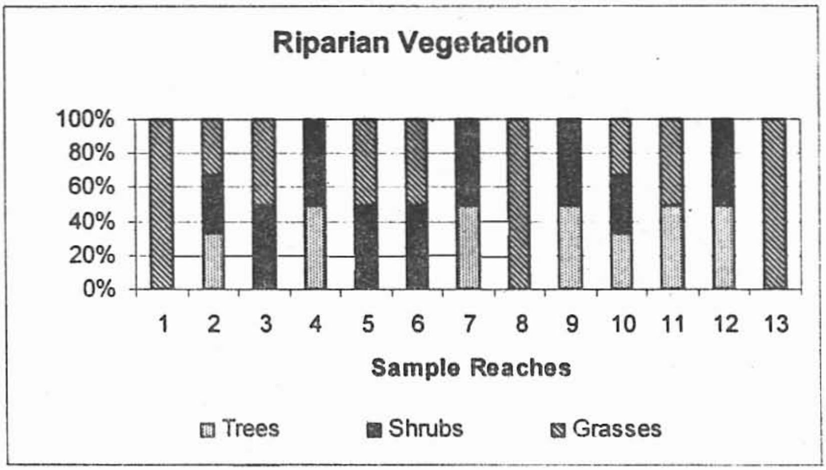

Fig. 4. Riparian vegetation of the Buyo Creek.

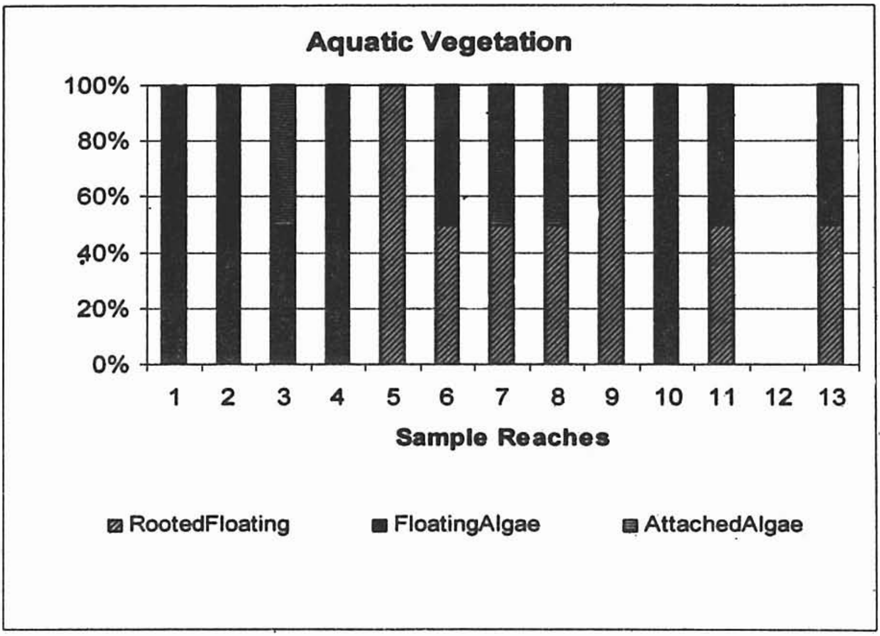

Fig. 5. Aquatic vegetation in Buyo Creek.

Hydrology

The discharge of each reach was measured using the float method, remembering that the velocity-area method tends to be more accurate in deeper water, whereas the float method is most accurate in shallow water. Results of these measurements can be seen in Fig. 6.

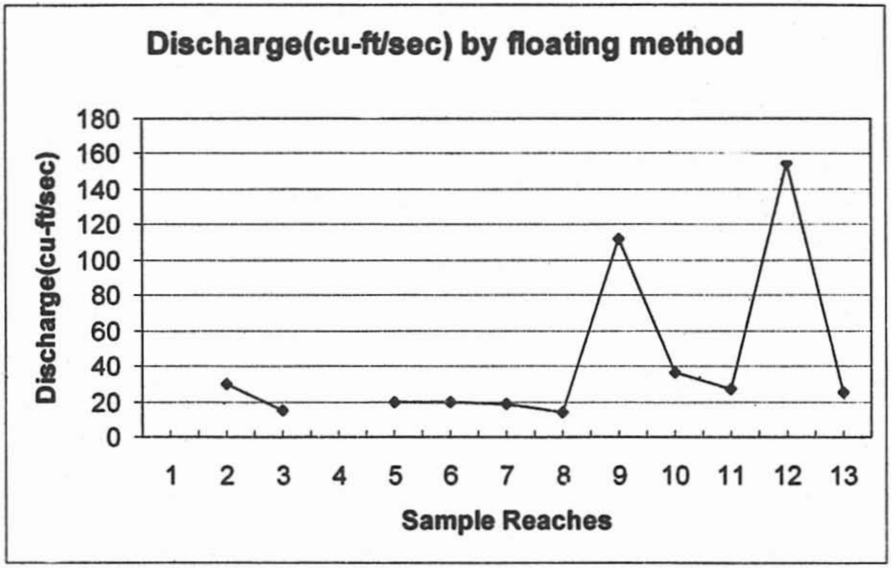

Fig. 6. Discharge of Buyo Creek in study areas measured by floating method.

According to these values, flows increase the lower reaches on Buyo Creek. This makes more sense intuitively and would account for the various influxes along the stream. Average water velocities of reaches range from 0.21 fts^{-1} to 0.61 fts^{-1}. The amounts of discharges range from 10.89 $cfts^{-1}$ to 20.55 $cfts^{-1}$. The water in each channel sites is clear except in the lower reach of the stream.

pH were collected at each of the sample reaches with hand-held meters that were placed in the water to obtain quick and accurate readings., indicating that pH does not impact water quality and that all the reaches are influenced by the same geologic conditions. The residents of the villages along this Buyo stream use some pesticide and chemical fertilizers for their agricultural activities. pH readings throughout the reaches were similar, less than pH 7 (Fig. 7) due to the unsystematically use of chemicals. To get some fish living in the stream some knowledgeless people spray poisonous dust into the stream and so some dead fish and some kind of snails are found within the lower reach of channel. The water in this channel is also polluted.

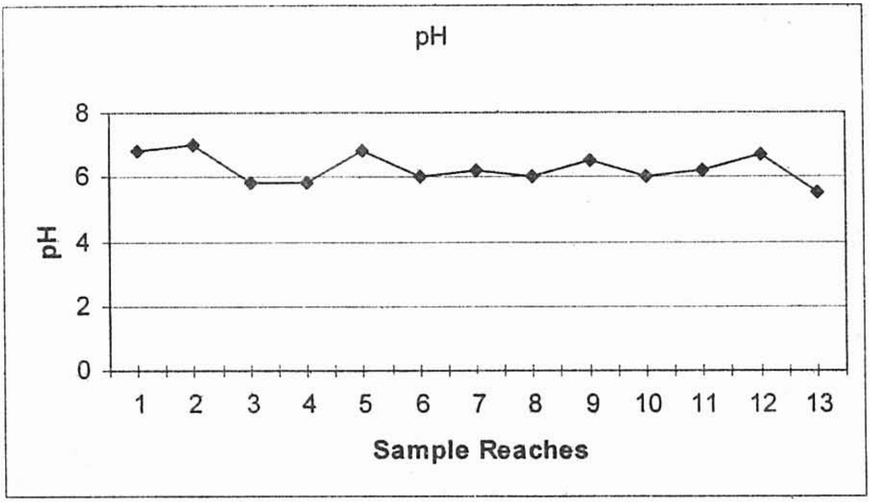

Fig. 7. pH values of Buyo Creek water in study areas.

In some residential areas along the stream there are some piles of waste materials at the stream banks. These waste materials are sliding into the channel water and this activity also damaged the water quality. However, pH readings also decreased near the residential area of Okshitpin Village. This suggests an influence of agriculture runoff or some drain from residential area.

Conclusion

In the long term for Buyo Creek it may be damaged due to the unsystematic responses of human's activities. So, by giving them knowledge about the value of any river system and also giving instructions for using chemicals used for agriculture is needed.

If they cannot be obtained the best practices for their own Buyo Creek, they will loose their effective profiles getting from this stream in the future.

So, to maintain the value of Buyo Creek as the water quality control and as erosion mitigation involve encouraging understanding of earth surface processes as well as hydrological processes by those who actually want the profit from this creek.

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