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MORPHOMETRIC ANALYSIS OF THE SUMANPA RIVER CATCHMENTAT MAMPONG-ASHANTI IN GHANA

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ABSTRACT

The study determined and analysed morphometric characteristics of the *Sumanpa* catchment in the Forest-Savannah Transitional zone of the Ashanti Region of Ghana. Quantitative morphometric parameters were determined using remote sensing and GIS techniques to assess the requirements for ecological and hydrological conservation, planning, development and management of the catchment landscape. Results indicated that the total length of stream segments was highest under the first order streams and decreased as the stream order increased. The catchment has an area of 38 $km^2$with channel closeness of 0.934 km km^{-2} indicating permeable sub-soil. The catchment has a relief of 137m and a total length of stream network of 36.51km out of which 61% was ephemeral, 38.9 % was second and third order streams. The catchment has 44 % of its area located on slopes between 5-10^o with generally good vegetation cover. There are 31 streams linked to a 3rd order trunk stream forming a trellis drainage pattern. The catchment's morphometric features suggest a general fragile topographic condition which needs strategic approach for soil and water conservation measures and urban landuse planning.

Keywords: catchment, morphometry, drainage density, remote sensing, geographic information system.

INTRODUCTION

Land comprises all elements of the physical environment to the extent that these influence potential for landuse. Thus land not only refers to soil but also includes the relevant features of geology, landforms, climate and hydrology, fauna and flora (Young and Dent, 1996). The fundamental purpose of land evaluation is to predict the consequences of change. Land evaluation becomes necessary where a landuse change is contemplated. Prediction is needed for the suitability of the land for different forms of production, the inputs and the management practices needed and the consequences of such changes upon the environment (Young and Dent, 1996). Land capability classification enables a piece of land, especially on a farm, to be allocated rationally to the different kinds of landuse required. Capability is the potential of the land for use in specified ways, or with specified management practices (Young and Dent, 1996).

A catchment, as defined by Esper (2008) is an ideal unit for management of natural resources like land and water and for mitigation of the impact of natural disasters for achieving sustainable development. The hydrological response of a river basin can be interrelated with the physiographic characteristics of the drainage basin, such as size, shape, slope, drainage density and length of the streams, etc. (Gregory and Walling, 1973).

Morphometry is the measurement and mathematical analysis of the configuration of the earth's surface, shape and dimensions of its landforms (Reddy *et al*., 2002). The quantitative analysis of morphometric parameters is of immense utility in river/stream catchment evaluation, prioritization for soil and water conservation, and natural resources management at micro level. Geology, relief, and climate are the key determinants of running water ecosystems functioning at the catchment scale (Frissel *et al.,* 1986). Morphometric descriptors represent relatively simple approaches to describe catchment processes and to compare catchment characteristics which enable an enhanced understanding of the geological and geomorphic history of a stream catchment (Strahler, 1964).

The simplest of stream/river catchment parameters are those that summarize spatial characteristics. Although such data are extremely important, the values do not lend themselves to detailed quantitative analysis of the stream/river catchment. Spatial parameters prove valuable, however, in determining whether catchments are sufficiently similar for direct comparison. In addition, spatial variables are used to calculate a wide variety of more sophisticated parameters. Morphometry is essentially quantitative, involving numerical variables whose values may be recovered from topographic maps. The importance of morphometric variables is their usefulness for comparisons and statistical analyses. Morphometric analysis with the help of drainage pattern in a catchment, according to Strahler (1964, cited in Nishant *et al.,* 2013) is an important indicator about the processes and the degree of impacts of landform development. According to Horton (1932), it is an ideal unit for understanding the geo-morphological and hydrological processes like run-off pattern of streams.

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While for some scholars, it is 'purely descriptive or genetic' which enables spatial analysis of geometric variables to analyse and interpret the landforms (Al Muliki and Basavarajappa, 2008, cited in Nishant *et al*., 2013). Earlier some studies show the use of remote sensing techniques for morphometric analysis (Pankaj and Kumar, 2009). Analysis of various catchment parameters namely; ordering of the various streams and measurement of area of catchment, perimeter of basin, length of drainage channels, drainage density (*Dd*), drainage frequency, bifurcation ratio (*Rb*), texture ratio (*T*) and circulatory ratio (*Rc*) will help in catchment prioritization, landuse planning and conservation (Kumar *et al*., 2000).

The terms Geographic Information Syatems (GIS) and Remote Sensing (RS) generally refer to the use of aerial sensor technologies to detect and classify objects on Earth (both on the surface, and in the atmosphere and oceans) by means of propagated signals. RS makes it possible to collect data on dangerous or inaccessible areas, provide information on natural resources such as crops, landuses, soils, forests, etc. on regular basis, including monitoring deforestation in arctic regions, and depth sounding of coastal and ocean depths. RS also replaces costly and slow data collection on the ground, ensuring in the process that areas or objects are not disturbed. The collection of remotely sensed data facilitates the synoptic analyses of earth-system function, patterning, and change at local, regional, and global scales over time (Wilkie and Finn, 1996). By utilizing RS technologies and implementing GIS mapping techniques, Land Use and Land Cover Change (LULC) of designated areas can be monitored and mapped for specific research and analysis of spatial information within stream numbers (CSIRO, 2001).

The main objective of the Study was to determine and analyse some morphometric characteristics of the *Sumanpa* stream catchment and relate them to soil and water conservation concerns. To achieve the above broad objectives, the following specific objectives were set:

- Delineate the *Sumanpa* stream catchment using GIS,
- Use GIS to determine and assess some terrain and morphometric parameters of the catchment and
- Analyse the morphometric characteristics of the catchment in relation to soil and water conservation.

MATERIALS AND METHODS

Catchment location

The catchment lies within the wet semi-equatorial forest zone and the forest savanna transitional zone of the Ashanti Region with a population of 44, 380 at 4.2% growth (SWDA, 2010). The catchment highlands and lowlands are at 457m and 290 m above sea level respectively. It is bounded by the Municipal Assembly, Mensah Saahene Junior High School, Kontonkyi Guest House, the Mampongcemetery, Ammaniampong Senior High School, the College of Agriculture Education - Mampong, Tadeeso, Bimma and Daaho Bosofour from the main Kumasi–Mampong-Ashanti trunk road (Figure-1). The main occupation of the people is agriculture and the major crops produced are cocoa, oil palm, cassava, maize and vegetables. In the dry season farmers predominantly cultivate vegetables.

Climate and vegetation

The catchment experiences double maximum rainfall. The peak rainfall periods are May-June and September-October with dry periods between July-August and November-February. The climate is typically tropical, with total annual rainfall between 1270 mm-1524 mm and an annual average of 1300 mm. Temperatures are uniformly high throughout the year ranging from 25-32^{o}C with a daily mean maximum temperature of 30.5^{o}C. The potential evapotranspiration (PET) is estimated at 1450 mm/y (MSA, 2006). The average humidity during the wet season is typically high (86%) and falls to about 57% in the dry period (MSA, 2006).

Geology and topography

The main geological formation is the consolidated sedimentary formations underlying the Volta Basin (including the limestone horizon) which characterizes the catchment area's ground structure (WARM, 1998). The study area location (Figure-1), topography (Figure-2) and slopes distribution (Figure-3) maps were prepared using the ArcView GIS. The catchment's slopes were classified into 0-2^o, 2-5^o, 5-7^o and 7-10^o classes. A topographic map (sheet 0702D3) of scale 1:50 000, in feet, with a linear scale in metres, published in 1973 by the Survey Department of Ghana was obtained from the Survey Department in Kumasi, Ghana. This was digitized to produce the catchment topographic maps, morphometric characteristics and delineate the catchment boundary by means of identifiable ridges between the *Sumanpa* and neighbouring catchments (SWDA, 2010).

Catchment soil

Very shallow, eroded, exclusively well-drained, rocky lithosols, mainly sandstone outcrops occur in summits and upper slopes of moderately undulating land (*Yaya* Series); moderately shallow humus, redish brown, well-drained, loose, ironstones concretions overlying weathering sandstone rock on gentle upper slopes (*Pimpimso* Series). These soils occur in association with very deep to moderately deep, humus, red, well drained (*Bediesi* Series) and moderately well-drained, yellowish red (*Sutawa* Series), fine sandy loams to clay loams found on gentle upper and middle slopes. The lowland soils comprise very deep to deep, brownish yellow imperfectly to poorly drained, loamy and very deep to deep, poorly drained, grey, loose loamy sands found on broad valley

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bottoms (Bejua Series). The soil which normally occurs on the upper middle slopes was from the Voltaian sandstone of the Afram plains. It is classified as *Chromic Luvisol* by the FAO/UNESCO legend (Asiamah *et al.*, 2000).

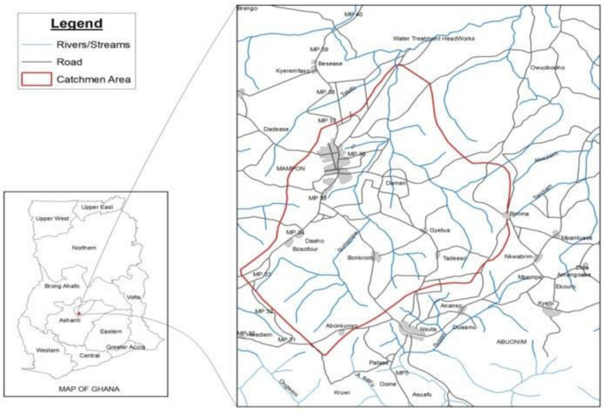

Figure-1. Location of the catchment area of the *Sumanpa* stream in the Mampong-Ashanti Municipal area.

Catchment delineation and characteristics

Morphometric analysis of a drainage system requires delineation of the stream and its tributaries which was done digitally in GIS (ArcGIS) system on 1:50, 000 scale (feet) topographical map on drainage lines as represented over the Survey Department's (Ghana) topographical maps (1:50, 000). Digitization work was carried out to cover entire analysis of catchment morphometry. The order was given to each stream by following a stream ordering technique of Strahler (1964). Attributes were assigned to create the digital data base for a catchment layer of the stream.

Catchment area and drainage density

Catchment area and shape have important influence on absolute values of runoff amount and peak flows and is an essential parameter in runoff formulae that predict hydrological characteristics. Stream order, frequency, density and bifurcation ratio were derived and tabulated on the basis of areal and linear properties of drainage channels using Arc View GIS. GIS based morphometric analysis of the *Sumanpa* catchment mainly provides a quantitative description of the drainage system and its appropriateness for hydrological consideration in the catchment development and conservation.

Drainage density is defined as the ratio of the total length of streams of all orders within the catchment to its catchment area. It is a measure of the closeness of the stream channels (Reddy, 2007) and is expressed as:

$$D_d = \frac{Total\ Length\ of\ Streams\ in\ the\ Catchment (L)}{Catchment\ Area\ (A)} \quad (1)$$

Where,

L is in kilometres (km) and A is in square kilometres (km^2).

The total length of the stream network was determined using Arc View GIS.

Perimeter length (P)

Perimeter length is the linear length of a catchment area's perimeter. This was measured with a digitizer and confirmed with the twine method (Reddy, 2007).

Stream network and order (U)

Tracing stream paths

The stream order is a classification reflecting the degree of branching or bifurcation of the stream channels within a catchment (Reddy, 2007). The smallest recognizable stream is called the first order and these channels normally flow during the wet season (Chow *et al.*, 1988). The first order streams do not have any tributary. A second order stream forms when two first order streams join and a third order when two second order streams are joined and so on (Strahler, 1964). Where a channel of lower order joins a channel of higher order, the channel downstream preserves the higher of the two orders and the order of the river basin is the order of the stream draining its outlet, the highest stream order in the basin (Chow *et al.*, 1988).

The importance of streams in quantitatively describing a catchment area cannot be overstated, as many morphometric variables are directly or indirectly calculated using stream lengths. It was assumed that all channels in the stream network were streams. Stream/channel length is an important morphological variable. All the stream channels were traced from the topographic map by identification. The trunk stream through which all catchment discharge of water and sediments pass through was designated the stream segment of the highest order.

Catchment elevation, relief ratio, elongation ratio and length

Relief ratio is the difference in altitude between the highest and lowest points, in the catchment, divided by the maximum catchment length (Reddy, 2007). The topography of the catchment varies from flat, relatively gentle and undulating to an altitude of 427 m above sea level in the north-eastern part of the catchment, near New Daaman and the lowest of 320 m above sea level at the confluence to the Kyiremfa River near the Ghana Water Company Limited's reservoir (head works). The maximum catchment length measured along the main stream from the divide to the confluence was divided by the difference in altitude between the highest and lowest points in the catchment (457m-320m) determined from the topographic map from which the relief ratio was determined.

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Schumm (1956) defined elongation ratio as the ratio of diameter of the circle of the same area in the basin to the maximum catchment length. The elongation ratio for all catchment according to Schumm (1956) also varies from 0.43 to 0.83 which indicates high relief and steep ground slope.

Slope and slope length

The determination of the slope gradient is of high importance in highlighting the tourism potential and landuse and capability classification as well as soil conservation and management programmes of the catchment area. The slope and its distributions were determined using ArcView GIS. Slope classes of 0-2^o, 2-5^o, 5-7^o and 7-10^o were thus determined. The slope distribution map and a cross-section along the longest slopes across the stream are presented in Figures 3 and 4 respectively. The weighted inclined surfaces are presented in Table-5.

RESULTS AND DISCUSSIONS

Vegetation

The vegetation of the eastern part of the catchment is gradually being reduced to sav*a*nnah grassland by annual bushfires while the western part is completely urbanized. The forests are seen in the southern and the eastern parts of the catchment. Riparian vegetation has suffered serious degradation from urbanization as the stream traverses the town (Mampong-Ashanti).

Catchment area, stream order and drainage density (D_d)

The significance of drainage density is recognized as a factor determining the time travelled by water from the farthest divide to the gauge station (Schumm, 1956). Langbein (1947) recognized the significance of drainage density varying between 0.55 and 2.09 kmkm^{-2} in humid regions with an average density of 1.03 kmkm^{-2}. According to him density factor depends more on prevailing climate, type of rocks, relief, infiltration capacity, vegetation cover, surface roughness and run-off intensity index. The stream's catchment area was determined as 38k m^2 by the Arch View GIS. The total length of stream network was 36.51km and the drainage density obtained for the catchment was 0.934 km km^{-2}indicating low drainage density indicating that the catchment run-off processes are dominated by infiltration and subsurface flow aided by good vegetation cover (Nyadawa and Mwangi, 2010). The hydrologic response of the *Sumanpa* Stream network is directly related to its drainage density. This value, according to Nag (1998), indicates permeable sub-soil and relatively low relief (137 m). The catchment has 31streams linked with 3rdorder streams and a trellis drainage pattern.

Stream Length (Lu) and length ratio (R_l)

The mean stream length is the characteristic property related to the drainage network and its associated surfaces. Generally, the higher the order the longer the length of streams as noticed in nature (Horton, 1945). The Stream has 16 first order streams, ephemerals, with a total length of 22.31 km (61 %), 9 second order streams with a total length of 5.66 km (15.5 %) and 4 third order streams with a total length of 8.54 km (23.4 %) and a total, comprising all three orders, of 36.51 km. It implies that a little over 61 % of the stream network (first order) in the lean season was ephemeral and a little below 39 % of the stream length was perennial (Table-3). With the decreasing groundwater recharge trend (Kotei *et al.*, 2013), the perennial length may decrease further upstream and may be shorter in the dry season. The drainage pattern of the *Sumanpa* catchment has a mean stream length ratio of 2.30 (Table-1).

Table-1. Calculative value of stream length ratio and mean stream length ratio.

Stream length ratio (R_l)		**Mean stream length ratio** (R_l)
1st Order: 2nd Order	2nd Order: 3rd Order	
3.940	0.663	2.30

Table-2. Calculative value of Bifurcation ratio and mean Bifurcation ratio.

Bifurcation ratio		**Mean bifurcation ratio**
1st Order: 2nd Order	2nd Order: 3rd Order	
1.78	1.50	1.64

Table-3. Linear aspect of the catchment drainage network.

River basin	**Stream order** (U)	**Number of tributaries** (N_u)	**Total length** (km)
Sumanpa Stream Catchment	1	16	23.17
	2	9	5.88
	3	6	8.87
Stream segment is 3rd order			

Bifurcation ratio

The bifurcation ratio (Rb) is the ratio of the number of stream segments of a given order to the number of segments of next higher order. Bifurcation ratio is an index of relief and dissection (Horton, 1945) and the values stand between 3.0 and 5.0 for a catchment in which the geological structures do not distort the drainage pattern (Strahler, 1964, cited in Nishant *et al.*, 2013). Not only are the numbers and lengths of particular stream orders important, but their ratios are quite instructive as well. In a

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trellis network, long main stem streams are fed by many low order streams. The R_b of the first and second order streams was 1.78 and that for second and third order 1.50. The catchment's mean bifurcation ratio obtained was 1.64, outside Strahler's range, (low) suggesting the catchment's undistorted geological structures (drainage pattern) and relatively high permeability and hence low erodibility and can be used as index of hydrograph shape (Pankaj and Kumar, 2009). This permeability may be hampered by the shallow nature of the catchment soil and less structural control on the catchment development (Asiamah *et al.*, 2000). The value indicates the catchment may experience delayed time to peak hydrographs and it is a good property for planning evacuation or communicating flood forecasts. Aerial aspects include form factor, elongation ratio, stream frequency, drainage density and circularity ratio. The results of this analysis are summarized in Table-2.

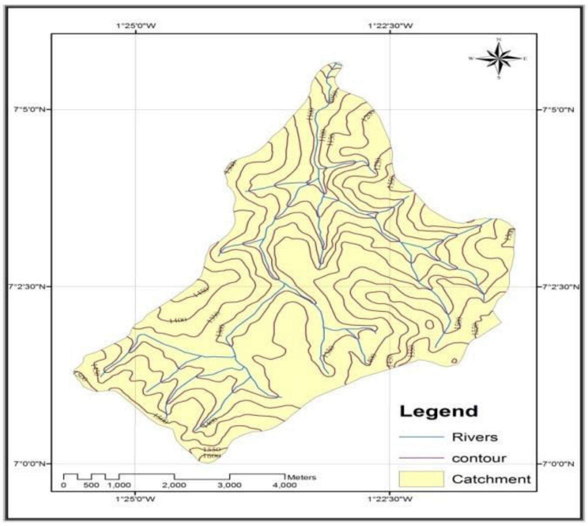

Figure-2. Topographical and stream network map of sumanpa catchment area.

Form factor (Ff)

The ratio of the catchment area to the square of its length is called the form factor. It is a dimensionless property and is used as a quantitative expression of the shape of catchment form (Panhalkar *et al.*, 2012). According to the authors, the form factor varies between 0.14 to 0.48. The analysis shows that the catchment has a high value of F_f (0.34) indicating a more circular form and which will have a delayed hydrograph peak (low) flow for longer duration as can be found in Fig. 5.Such flood flows, according to Rajora (1998) may be difficult to manage compared to elongated catchments and the value may be interpreted as having low flooding potential.

Relief ratio

The relief of the stream catchment range from 320 m at the stream outlet to the Kyiremfa River to 457 m at the uplands, resulting in an average maximum catchment relief of 137 m with a catchment length of 10.55 km (10550 m) at third order giving a catchment relief ratio of 0.013 (dimensionless) indicating low gradient, the steepness of the catchment which is strongly related to its hydrological characteristics. This factor contributes to the long lag time and low peak hydrographs which do not favour field flooding and can be used as an index of hydrograph shape.

Elongation ratio (Re)

Analysis of elongation ratio, according to Singh and Singh (1997) indicates that the areas with higher elongation ratio values have high infiltration capacity and low runoff and therefore high erodibility. They further stated that a circular river/stream catchment is more efficient in the discharge of runoff than an elongated catchment. Strahler (1964) published that values of elongation ratio generally vary from 0.6 to 1.0 over a wide variety of climate and geologic types. The catchment's elongation ratio was determined as 0.66 indicating a less elongated catchment with average relief to enhance groundwater recharge.

Circularity ratio

Circularity ratio is dimensionless and expresses the degree of circularity of the catchment (Miller, 1953). It is influenced by the length and frequency of the streams, geological structures, land use / land cover, climate, relief and slope of the catchment. The circularity ratio of the *Sumanpa* catchment is 0.15 which shows the catchment is less elongated with high erodibility, a condition which promotes groundwater recharge.

Stream frequency (Fs)

The stream frequency is defined as the total number of stream segment of all order per unit area (Horton, 1932). It varies from catchment to catchment and the maximum indicates large number of stream availability. The S*umanpa* catchment has a stream frequency of 0.815 stream km^{-2}; approximately one stream per unit area indicating low relief, high infiltration capacity and a dense stream network which will promote irrigation farming.

Drainage texture (Dt)

Drainage texture is defined as the total number of stream segments of all orders per perimeter of the area and depends upon natural factors like climate, rainfall, vegetation, rock and soil type, infiltration capacity, relief and stage of development (Horton, 1945). The drainage texture for the *Sumanpa* Stream catchment was 1.41 (Table-4) indicating verycoarse drainage textures. This may increase due to rapid urbanization and deforestation in the catchment.

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Table-4. Areal aspects of the catchment.

Morphometric parameters	Symbol	Value
Area (km^2)	A	38.0
Drainage density (km km^{-2})	D	0.934
Stream frequency (Stream segments km^{-2})	F_s	0.815
Stream length (km)	N	36.51
Mean slope (^{o})	S_m	5.65
Mean slope length (km)	(SL_m)	1.3
Compactness coefficient	Cc	1.01
Relief ratio	R_r	0.016
Drainage texture	D_t	1.41
Elongation ratio	R_e	0.66
Form factor	F_f	0.34

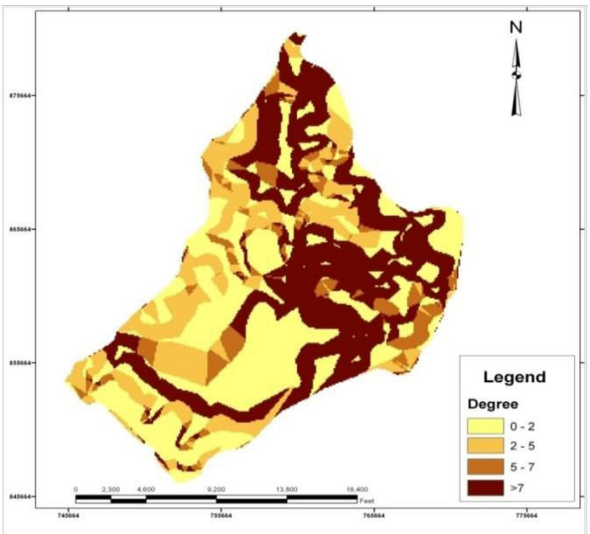

Figure-3. Slope distribution map of the *Sumanpa* catchment.

Catchment relief, mean slope length and slope distribution

Slope as defined by Moore and Wilson (1992) is a basic element for analyzing and visualizing landform characteristics and plays a significant role in studies of catchment units, landscape units, and morphometric measures. When used with other variables, slope can assist in runoff calculation, forest inventory estimates, soil erosion, wild life habitat suitability and site analysis (Wilson and Gallant, 2000). Slope is a very crucial element for Land capability Classification (LCC).

The effect of topography on erosion in the Revised Universal Soil Loss Equation (RUSLE) is accounted for by the slope and slope length (*LS)* factor. Water erosion increases as slope length increases, and is considered by the slope length factor (L). Slope length is defined as the horizontal distance from the initiation point of overland flow to the point where either the slope gradient decreases enough that deposition begins or runoff becomes concentrated in a defined channel (Wischmeier and Smith, 1978). Most of the slopes in the catchment are convex (Figure-4). Under field conditions, effects of slope length on runoff volumes and erosion are confounded by the interacting effects of slope gradient, slope aspect, slope shape and the changes in soil physical and hydrological properties along the hillslope due to differences in soil forming factors. The highest slope distribution weight (36.1 %) in the catchment is represented by inclined surfaces below 2° (Table-5). Slopes with values between 7°-10° have significant weight (35.5%), almost equal to that of the 0-2^o slope, in the catchment. Slopes between 5^o and 10^o also have significant weight of 44% which may influence land evaluation and capability classification since a limiting factor can raise a class higher and thereby restricting certain operations and or uses within the class. The highest slope in the catchment measures 10^o. The mean catchment slope obtained from the Arc GIS is 5.65^o with a mean slope length of 1,300 m under good vegetation cover and a highly permeable sub-soil to keep the drainage density low.

Catchment slope distribution map can be used in land evaluation, capability classification and integrated catchment management. Land evaluation is the process of estimating the potential of landuse for alternative kinds of use including productive uses such as farming, livestock production and forestry, together with uses that provide services or other benefits, such as water catchment areas, recreation, tourism and wild life conservation (Dent and Young, 1996).

Table-5. Slope distribution of the *Sumanpa* catchment

Slope (^{o})	Area (km^2)	Percentage (%)
0-2	13.718	36.1
2-5	7.637	20.1
5-7	3.147	8.3
7-10	13.503	35.5
Total	38.005	100

Integrated landuse planning for catchment management will help in the development of the whole catchment in accordance with its potentialities and capabilities for different uses. In the broader perspective such a planning will have to consider total development of all kinds of resources of the catchment, namely land, water, climate, plants, animals and man. The catchment management involves management of the land surface and vegetation so as to conserve and utilize, judiciously, the water that falls within the catchment and to conserve the soil for immediate and long-term benefits to the farmer, his community and society (Tripathi and Singh, 1990).

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The catchment has a maximum relief of 137 m which is high enough to influence runoff volume and speed.

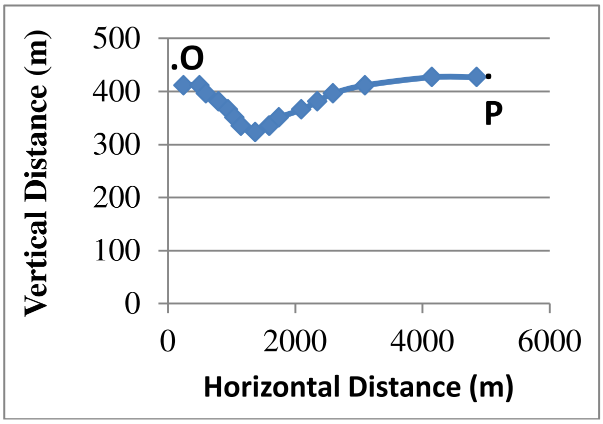

Figure-4. Cross-Section of one of the longest slopes in the catchment (Source: Kotei *et al.*, 2013).

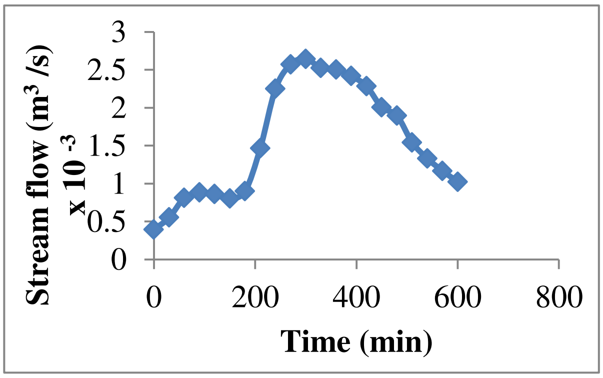

Figure-5. Unit hydrograph of the *Sumanpa* stream (Source: Kotei *et al.*, 2013).

CONCLUSIONS

The morphometric characteristics determined and analysed were the catchment area, drainage density, catchment length and perimeter, stream length and length ratio, stream network and order, elevation, relief, elongation, circularity and bifurcation ratios, slope distribution and length, form factor, stream frequency and drainage texture. The characteristics have been analysed and related to hydrologic and soil and water conservation concerns in the catchment.

The catchment area was delineated and the morphometric characteristics assessed by Arc View GIS techniques. The morphometric assessment helps elaborate primary hydrological diagnosis in order to predict approximate behaviour of the catchment if correctly coupled with geomorphological and geological data (Esper, 2008).Hence, morphometric analysis of the catchment is an essential first step toward basic understanding of the catchment dynamics.

A significant weight of 44% of the catchment area is located on 5-10^{o}slope range with generally good vegetation cover. Over 61 % of the stream is ephemeral (first order) and a little below 39 % of is perennial. With the decreasing groundwater recharge trend and increasing trend in the catchment's evapotranspiration and the rate of urbanization (Kotei *et al.*, 2013b), the ephemeral length may increase and the perennial length decrease further, a condition that may affect sustainable baseflow. The catchment has thirty-one (31) streams linked to a trunk stream of 3rd order forming a trellis drainage pattern. The lower values of shape parameters are indications of higher risk of erodibility (Nooka *et al.*, 2005).

The catchment's morphometric features determined suggest a general fragile topography which needs strategic approach for soil and water conservation measures especially in the urban-sub-catchment to preserve the land forms fromfurther erosion and lowering of groundwater recharge.

The morphometric data and analysis could be used for prioritization by studying different linear and aerial parameters of the catchment watershed even without the availability of soil maps (Biswas *et al.,* 1999). The linear parameters such as drainage density, stream frequency, bifurcation ratio, drainage texture, length of overland flow have a direct relationship with erodibility; the higher the value the more the erodibility. Land morphometry represents the topographic representation of land by way of area, slope, shape, length etc. and these parameters affect catchment streamflow hydrograph through their influence on concentration time. This study can be extended to other catchments in Ghana and in the sub-region.

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