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Landform Characterization and Geo-hazards in the area between Someswari and Ghoneswari Rivers, Netrokona district, Bangladesh

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Abstract

Detailed field checkup of different geomorphic, geologic features and geohazards was carried out in the study area between the rivers Someswari and Ghoneswari. The area belongs to the Garo Hills in the southern piedmont plains of Shillong Massif. Previous studies coupled with Google Earth imagery were used for delineating the boundary of these landform units. Frequently occurring hazards of the study area are flash flood, channel migration, earthquake, river bank erosion, siltation and sand blanketing. From the previous work and the present study it has been evident that there exists a close inter-relationship between landforms and specific hazards. Based on alluvial morphology and pedogenic developments in the surface, three major landform units were identified which are: Low Hillocks, Alluvial Fans and Flood Plain. Of these three units, low hillocks are the oldest and flood plains are the youngest. Someswari River is the main feeder channel forming the vast segmented alluvial fan which ultimately controls the configuration of existing landforms as well as the major part of the study area. Present geomorphic features are the results of the interplay between neotectonics and sedimentation. From geohazard perspective, the low hillocks can be categorized as the most stable landform thus the safest as where flood plain is the most vulnerable landform. Flash flood can be regarded as the most prominent geo-hazard in the area along with channel shifting, siltation and river bank erosion. However, the huge sediment is carried across the area towards the southern low lands by flash flood acts as major determining factor for the landscape development of the study area. Thus, although the processes of flash floods, channel migration, river bank erosion, siltation and sand blanketing may be perceived apparently as hazards, for this type of area these are essential geomorphic process by which landforms are perennially enriched.

Key Words: Hillocks, Segmented alluvial fan, Flash flood, Sand blanketing, Geo-hazards.

Introduction

The evaluation of landform characteristics is highly important from land-use planning, development and management perspectives. The landform characteristics of a particular area is merely the manifestation of the combined effects of various geological and natural processes which when exceed certain threshold limits are generally perceived as hazards. The present study consists of field investigation to evaluate the landform characteristics and to assess pertinent hazards occurred in the southern piedmont plains of the Shillong massif between the rivers of Ghoneswari and Someswari forming the eastern and western margins respectively (Fig.1).

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Towards the south the piedmont plain gives away into depressional wetlands thus forming a pathway for transportation of the huge sediment-water complex originating from the highs of the Shillong Massif. The Shillong Massif is an elevated landmass which is separated from the plainlands of the Bengal Basin on the south by the Dauki Fault Zone which makes this area a geologically and tectonically complex one. However, the present study involves the western part (from 25°05′ to 25°10′ N latitudes and 90°40′ to 90°49′ E longitudes) of about 200 km long, east-west stretching foothill area of Shillong Plateau. Surface geological explorations for georesources were carried out in the past but other important aspects as landform characteristics and hazard assessment studies are rather scant. This study attempts to establish intra-relationships between landform and geohazards from infrastructural development, social safety and environmental aspects.

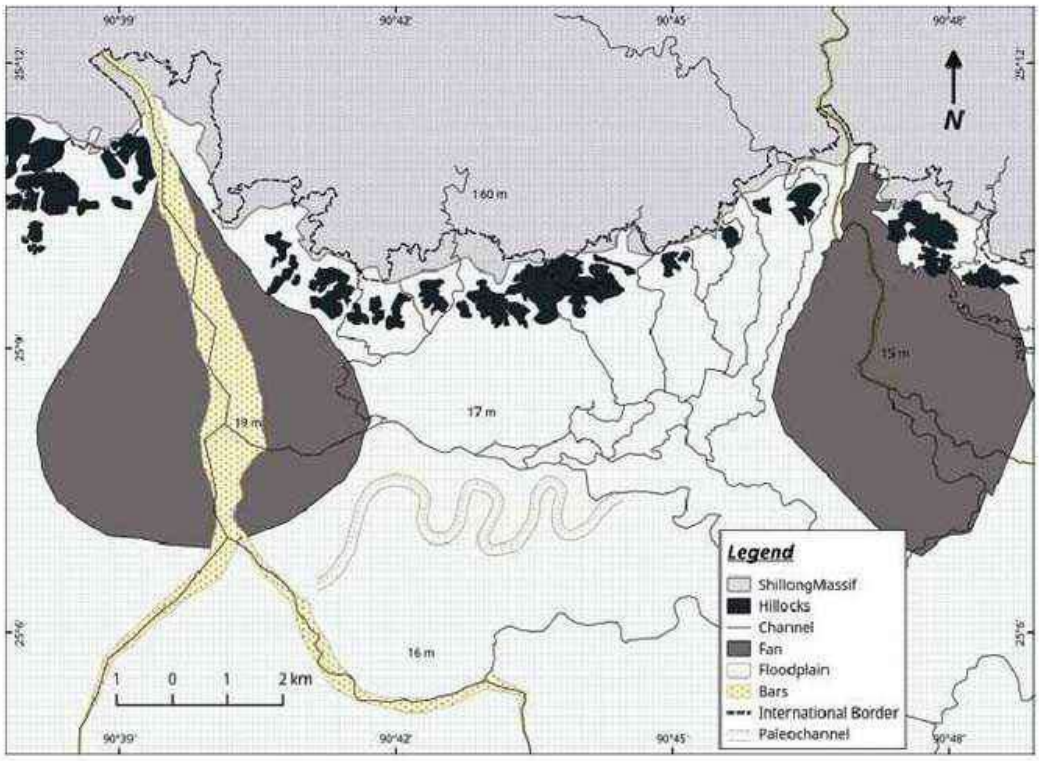

Fig.1. Major landforms in the study area (Surface elevation is shown in m).

Methodology

The present research is based primarily on observation of surficial expression of landforms, natural outcrops, cut surfaces of rock bodies and sediments on river beds which were documented during field investigation. Different key aspects such as sediments and soil types, landform patterns, hazard characteristics were identified by close inspection, previous studies and information obtained from local people. The field work was carried out during November, 2014. This time of the year generally

possess dry condition and water level in river beds stays low, leaving the area dry to its maximum limit. Features such as river migration pathways, paleochannels, sand blanketing and vegetation cover of the area are most clearly observed. Photographs form an important part of this study as direct evidences portraying the points of arguments. Alluvial morphology and pedogenic developments are used for the characterization of landforms. Google Earth™ images were used as a base layer for delineating the boundaries of different landforms presented in a map made in the open source GIS program "qgis" on Linux platform.

Results and Discussion

Landform Characterization

BRAMMER (1996) broadly categorized the southern foothill area of the Shillong Massif as northern piedmont plain which comprises of coalesced alluvial fans, mainly having silty or sandy deposits near the hills, grading into clays in basins adjoining neighboring flood plains on the south. Geomorphologically, the area is an undulatory one, with the E-W trending hillocks of northern upland zone and plains fringing the southern, western and the south-western borders.

Based on alluvial morphology and pedogenic developments geomorphic expressions in the surface, three major landforms are deciphered; these are: (a) Low Hillocks, (b) Alluvial Fan(s) and (c) Flood Plain, which are described in detail. Variation of relief and drainage characteristics help to distinguish each landform in different aspects.

a) Low Hillocks: Low hillocks are the oldest landforms of the study area consisting of medium to highly compacted sandstone, pebbles, siltstone, lenses of claystone and coarse sand of various color were observed during field investigation (Fig. 2).

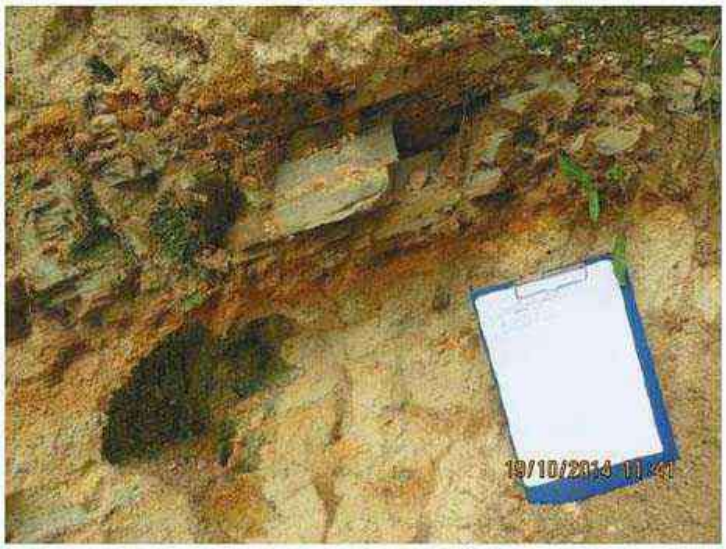

Fig. 2. Image showing low hillocks lithologies consisting of sandstone, shale. A generalized lihtolog of the low hillocks is provided in the following table:

Table 1. Generalized litholog of the low hillocks landform of the study area

Units	Description
Shale	Light Gray (N7) colored. Thickness approximately 30 cm.
Sandstone	Grayish brown (5 Y 3/2) to Pale Yellowish brown (10 YR 6/2) colored Sandstone, brown mottling. Thickness approximately 20 cm.
Shale	Light Gray (N7) colored Shale. Thickness roughly 30 cm.
Sandstone	Yellowish Gray (5 Y 7/2) to Dark Yellowish brown (10 YR 4/2) colored Sandstone, brown mottling. Thickness approximately 50 cm. Base not seen.

The relative ages of hills are described based on soil maturity, sediment characteristics and their surface expression. Grayish black soil mixed with rocky material were found in the Garo hills (low hillocks) and the texture of the surface soil was generally sandy loam followed by crystalline deposit of mineral stone and white sand stone having brownish mineral particles (East Pakistan Soil Survey Report, 1960). These hills are covered by thick vegetation of subtropical trees and cultivated forests. Moderate to strongly weathered surface were found in few portion of these hillocks. Hills of the area do not form continuous range but are separated by recent alluvial valleys (ALAM 2006). The stability of the landform is evident by the fact that reported landslide occurrences are not very common in the area as compared to the Chittagong hill tracts in the south-eastern part of the country. The V-shape valleys (Fig. 3) between the hillocks imply the most recent orogen or mountain building process still is in progress. As the landscape matures, V-shape valleys become more established. V-shape valleys are a feature of relatively young river landscape also controlling the drainage distribution of the study area. Someswari River had eroded vertically down and leaves behind steep valley sides that are then affected by weathering process. Upstream of the Someswari River has a steep gradient with features such as rapids and waterfalls in Meghalaya area of India (ANON 2012).

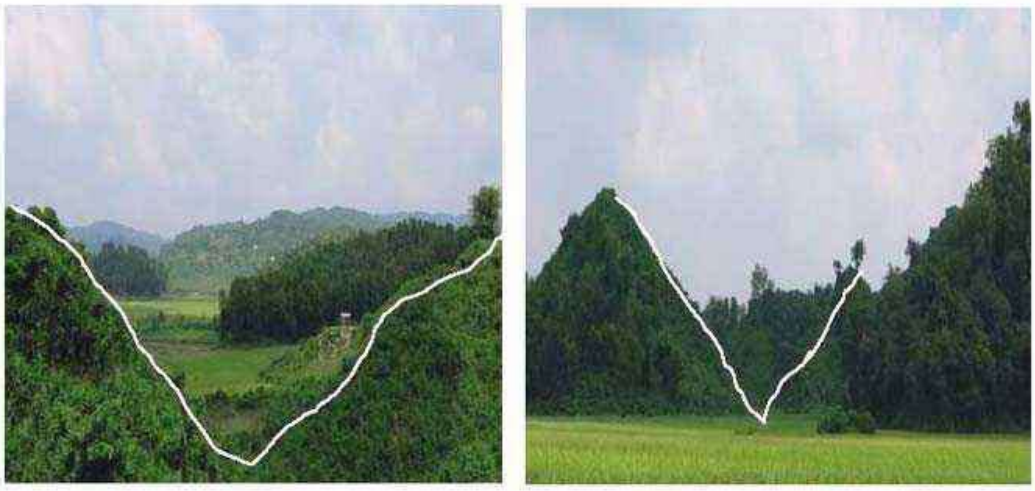

Fig. 3. Low hillocks represents V-shape valley

b) Alluvial Fans: Both Someswari and Ghoneswari rivers had created alluvial fans. According to ALAM (2006), the highest elevation of the alluvial fan was 30m, found in the western part of the study area. Tectonic influence played a vital role for the present configuration of the study area. During the field observation two sequence namely active channel and abandoned channel sequence were found inalluvial fan unit.

Table 2. Generalized litholog of the alluvial fan landform of the study area

Units	Description
Coarse Sand	Light olive gray (5 Y 6/1) to Light brown (5 YR 6/4), colored coarse to very coarse sand. Little silt is present. Coal fragments found. Poorly-sorted, fining upward cycle starting with disorganized pebbles and terminating with thinly bedded sandstones. Quartz 80-85%, feldspar 2-4% and mica 1-2%. Thickness approximately 2.7-3.1 m.
Pebbly Sand	Laterally persistent, thin bedded, pebbly sands; ripple marks and small scale cross-bedding are present; Pebbles diameter are 8-56 mm. Thickness roughly 0.6-0.7 m.
Granular Sand with Clay	Deposits of granular sand with occasional cobble to pebbly horizons passing upward into a structure-less bed. Fresh bluish gray clay horizon was found. Thickness roughly 0.5-0.6 m. Very fine sand and trace silt found in this sequence. Base of the sequence was not seen.

Someswari River is one of the largest fans forming drainage of the Shillong plateau. By the combined effect of several factors, particularly of: (a) climate, initially more humid (during the Pleistocene), implying greater hill slope soil development, leading to slope failure and hill slope debris-flow activity and (b) aging of the catchments involving the progressive removal of soils (HARVEY 1984, 1990; CALVACHE *et al.* 1997; VISERAS *et al.* 1999). Fans that have developed at tectonically very active mountain fronts, where the mountains are rising with respect to the adjacent basin at a rate of several millimeters per year, tend to accrete vertically. They develop plan-view morphologies of an open fan (VISERAS *et al.* 2003). Entering the Plain land the Someswari River becomes a braided one with well developed bars and natural levees forming a fan (ALAM 2004). Alluvial Fans are the youngest landform of this study area. Here soil forming process is very recent.

c) Flood Plain: Flood plains have occupied major part of the study area. These are formed by the influence of Old Brahmaputra and present Someswari River sediments. Each flood plain shows individual geomorphic characteristics in remote sensing images (ALAM 2006). In the flood plain deposits of different grades of soil particles are found to exist alternately in the vertical and horizontal plains. Generally there is the predominance of coarser material in the lower strata (DOA 1960). The character of the soil of the floodplain is changing every year due to the activities of the rivers which are directly responsible for their deposition. Thus the texture of soil varies from place to place depending on the different grades of silt that are being deposited every year during the monsoon. Flood plains are the intermediate landform unit compared with other landforms of this area deciphered based on soil

development. The north and north-western fringes of the investigated area form a part of the Brahmaputra plains and are covered by thick alluvium. It comprises clay, silt, very fine to fine sand.

Alluvial Fan Morphology

The morphology of an alluvial fan is a function of variables including size of drainage basin, contributing sediment to the fan, geology of the source area, relief of the source area, climate and vegetation of the source area and tectonic activity. Profiles of alluvial fans in cross section are generally concave but often contain significant breaks in slope that mark boundaries between relatively straight-line fan segments. In fact, most alluvial fans are segmented and younger fan segments may be identified from older segments based on relative soil-profile development, weathering of surficial clasts and erosion of the surface (KELLER 2002). The morphology of a segmented alluvial fan may be used as an indicator of active tectonics, such as faulting, uplifting, tilting and folding along and adjacent to the mountain front. According to ALAM (2004), three minor lineaments oriented along NWW-SEE, NW-SE and NE-SW were deciphered on both sides of the Someswari River. NW-SE lineament passes through the piedmont and alluvial plains. This study of the fans in Someswari River shows that tilting had produced segmented fan. Alluvial fan on the valley is shifted to the east as remnant terraces (two levels for Early and Late Pleistocene age), consequently the location of the fan depocenter is moved down-fan. Therefore, fan head incision had occurred, and younger fan segments were located far away from the mountain front and fan apex, which represents the tectonic activity in the area.

The Someswari & Ghoneswari River Fans were originated from main elongated catchment areas. The fans had formed through the escarpment of the Dauki fault, which had cut across the neck of the fan and separates the catchment area from the fan body. The main streams of the catchment area were of first order and they showed highly incised valleys; they flow through Tertiary folded Tipam and Dupi Til formations. This catchment area had created large alluvial fan which covers vast area. The entrenchment of older alluvial fan surface had resulted from rejuvenation of a marginal fault with a higher rate of river down cutting or climatic influence (BULL 1964).

Drainage Characterization

The study area can be termed as Someswari-Ghoneswari Interfluve which belongs to the Brahmaputra drainage system. Regionally the entire area is drained by no. of perennial and non-perennial rivers. The drainage system of the study area is controlled by the structure and neotectonic activity within the polygenetic activity. The drainage pattern includes mainly terraces, valleys, alluvial cones, braided, dendritic and trellis drainage pattern being manifested by both endogenic - exogenic forces. These are also supported by unusual modes of formation of the riverine topography primarily under fluvial environment. The fluvial landforms as well as

drainage channel patterns have reflected several morphological characteristics being enabled with land use pattern (Fig. 4).

Major Drainage: The topography controls the drainage system as it divides the study area into two watersheds namely the Jamuna system in the west and Meghna/Surma system in the east.

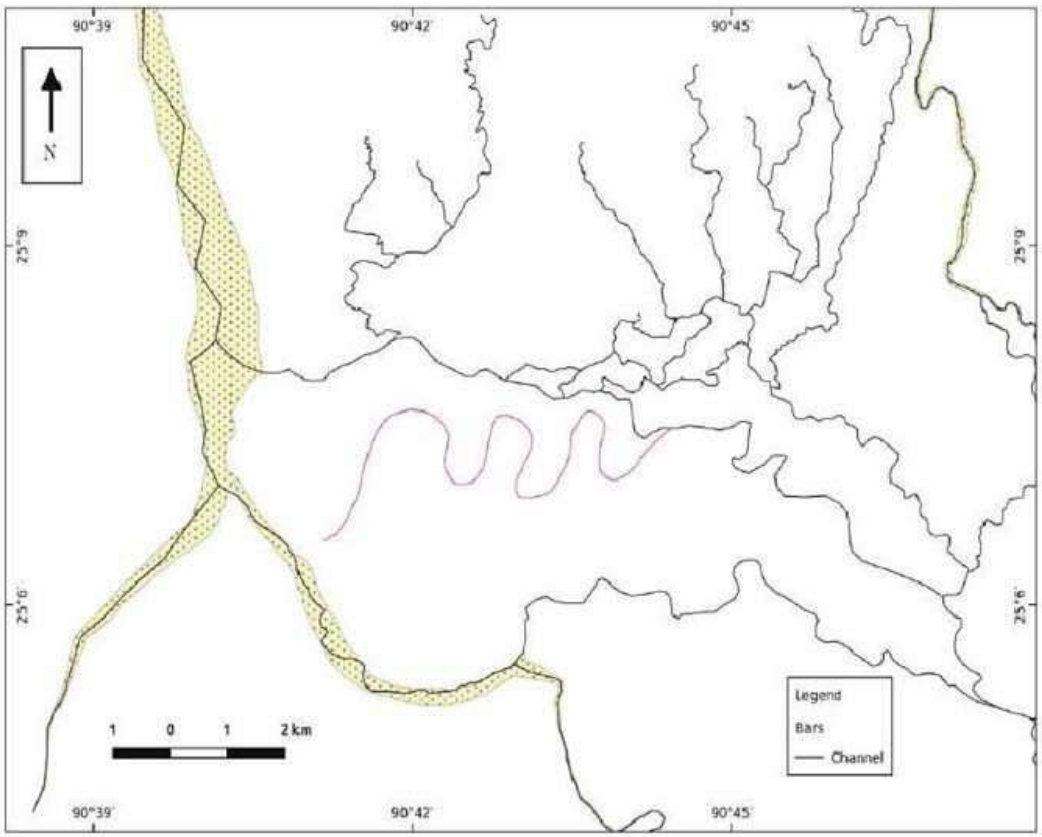

Fig. 4. Drainage distribution map of the study area

a) Someswari River: The Someswari River is the main drainage channel of the study area. The River Someswari influences geomorphology, landform pattern of the study area as well as sedimentation the most. Frequency of the flash flooding events of this river is very intense. Flash flood event was not observed directly during field survey, signature of flash flooding was evident in the river bank and surrounding areas. The river courses of Ranikong (boarder of India) to Birisiri constitute the upper region while the Shibgonj and Birisiri to Jariya-Ganjail constituted the lower region of the river. The river is 113.0 km long and in Bijoypur area it is about 800 m wide and depth is 8.00 m. Catchment area is 1197.0 sq. km. In Bijoypur area, dry season (March) discharge is 7.78 cm^3/s and wet season discharge 844.86 cm^3/s (BWDB, 2005). ALAM (2004) described that the river flows approximately towards south to join the Kangsa River and the combined flow takes an easterly course. The upper

regime of the Someswari River is braided, middle part is low meandering, and lower part is straight. Its older abandoned courses are also meandering. Someswari River has a long record of channel shifting; its different geomorphic expressions provided the proof of natural levee formation, bars position and size (Fig. 5) changing history as well as course shifting.

Fig. 5. Sand bars of the River Someswari

b) Ghoneswari River: The Ghoneswari River has its origin in the highlands of the central parts of the Shillong Plateau and enters Bangladesh through the Lengura Mouza of Lengura Union of Kalmakanda upazila of Netrokona District. It forms the major drainage in the eastern part of the study area and follows an overall southerly course across the Lengura Union like all the other rivers in this area. This river is approximately 50 m in breadth with slightly meandering nature. The meander bars are consisting of mostly by coarse sand. During the winter the water level of the river falls to its lowest and the bars get exposed occupying major portion of the channel (Fig. 6). However, during the monsoon the river gets swelled up and floods the banks with sediment overflow to cause adverse affects in the adjacent farm lands.

Fig. 6. Upstream view (on the left) and downstream view (on the right) of the Ghoneswari River

Minor Drainage: Besides these two major streams the area is drained by numerous smaller streams originating from the northern Shillong Plateau. The Rohiter Tila Chara is one of those streams that best represent their characteristics and discussed here accordingly.

Rohiter Tila Chara: The Rohiter Tila Chara enters in the eastern part of Durgapur Upazila, Netrokona district. It is one of the small scale drainage originated from Shillong Massif. The channel is merely 10 to 20 m across and heavily laden with sediments. The channel is almost filled up with sediment and thus the course is widened but is very shallow. This is one of the many small scale channels that drain the area between Someswari and Ghoneswari River.

Other Features: Along with these geomorphic features there are numerous paleochannels and depressions that characterize the landform and soils.

a) Paleochannels: There are numerous Paleochannels identified based on field experience, vegetation covering, present settlement and water influx. Most of the paleochannels, if joined together, appear like past courses of the modern drainage. These features are most likely the remnant of River Someswari deciphered based on natural levee development, size and shape of the valley and natural outcrop succession of old levee. Absence of large trees in valley thalweg may be used as a tool to establish the existence of paleochannels. It should be mentioned that paleochannels are continuously modified through human interference which causes difficulties to identify both in field and Google Earth Imagery.

b) Depressions: Some depression lies west of the study area. Frequent channel shifting, crossing of the older channels by younger channels, sudden widening of channels makes the complex drainage pattern of the study area (ALAM 2006). Saucer shaped depressions and swamps were found during field investigation.

c) Soils: Soils on different geomorphic unit are related to their position on the relief and to the age of different landscape (SAHA 2011). The landscape of the study area is variable with significant differences in relief and in drainage conditions.

Besides drainage condition, the soil characteristics of the flood plain are dependent on the nature of alluvium deposited by the rivers. Different soils horizons are marked along the profiles, different pedogenic characters color, structure, pedality, clay cutan, horizon boundary, solum thickness, B horizon development were recorded. Weakly developed soils are found in the flood plain which is identified A/C horizonation or only minor development of AB or B-horizons. Moderate to strongly developed soils are found in the hillocks of the study area which are characterized by intense surface weathering, strong pedality, moderate alteration of minerals and ferruginous coloration. (Fig. 7) From the Soil Resource Development Institute (SRDI 1997) soil classification map two major types of soil were found in this study area and these are: Old Piedmont Plain Soil, part of the Northern Piedmont Plain Soil. Red pebbly Soil and Red sandy Loam in the hilly slopes and Clayey Loam in the plains are the common soil types. The soils are acidic in nature and comparatively rich in organic matter. Because of the higher rainfall and lack of groundwater influence, these soils are more acid in reaction (BRAMMER 1996). From the thick vegetation cover on low hillocks it can be inferred that the soil development is comparatively older in respect to the youngest flood plain.

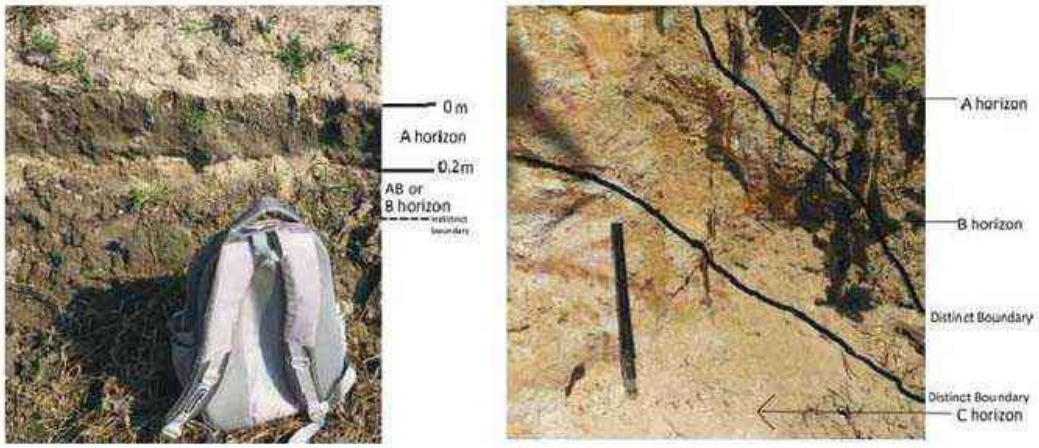

Fig. 7. a) Weakly developed soil profile near the Ghoneswari River floodplain
b) Strongly developed soil profile in the hillocks of the study area

Hazard Characteristics

ALAM (2006) provided a comprehensive account of the natural hazards of the northeastern part of Bangladesh. Among the hazards flash flood, channel migration, river bank erosion, earthquake, siltation and sand blanketing can be regarded as most important for their frequent occurrence. Flash flood can be regarded as most prominent for its strength and agility. The rest others are mostly the results of flash floods.

a) Flash Flood: Flash floods are caused by heavy rainfall in a short period of time over a relatively small area (BWDB 2014). In the study area flash floods are directly linked to the amount of rainfall received in the catchment area in the Shillong

highlands. The altitude of the Shillong Massif ranges from 50 to 1950 m (ALAM 2004) receiving the world's highest rainfall of about 12930 mm per annum (ROY & TOMER 2001). Flash floods are characterized by a sediment-water complex flowing with great energy and agility. Although flash floods are issued with high energy, they are short lived and the damage is only localized which is a special characteristics of these types of floods in the northeast and eastern parts of the country (ISLAM 2006). The most adverse affect of these flash floods are on the agriculture and they leave no chance to prepare for the harvest of the crop. Thus, flash floods directly affect the main economic activity in this region. Detail study on the characteristics of the flash flood may yield valuable insight on the controlling factors of their origin.

This area forms pathways for the huge sediment originated in the northern highland region that drains into the southern low lying areas. The main transporting agent is the rain water (ALAM 2004). The sediment is derived from the sedimentary rocks and igneous-metamorphic complexes of the Shillong massif. The sediment is mostly sand, silt and clay in this part of the study area (ALAM 2004). The most adverse affect of the flash flood is siltation on the farmlands that causes harm in two ways: firstly, it destroys the crop and secondly, it reduces the fertility of the land (Fig. 8). Thus the economic loss is high.

Fig. 8. An example of sand blanketing on farmland

b) Land Erosion: Land erosion is another adverse affect caused by flash flood. As the land is mostly formed of loose sediments of alluvial fan deposits it is prone to erosion in the alluvial plain areas. However, the hills are devoid of the adverse affects of the hazards mentioned above and may be considered as the least vulnerable or highly suitable for development. These hills are owned either by the Forest Department or the local people who make houses on them long ago. Although landslide is very common in the hilly areas of the southeastern Chittagong

Hill Tracts but it occurs rarely in the study area. This may due to the fact that the hillocks of the study area are in the mature state of the landform evolution & are heavily vegetated with subtropical trees and cultivated forests (ROY & TOMER 2001).

c) Channel Migration: Channel migration is another common phenomenon in the study area which sometimes manifests with sudden occurrences such as overnight channel shifting the Someswari River during the 1960s in Shibganj bazar area, Durgapur, Netrokona (ALAM 2004). The study area is characterized by alluvial fans where fan forming multiple processes played pivotal role for changing the channel morphometry. It is important to note that the general flow direction of the sediment-water complex is from north to south and channel migration generally occurs more or less of the flow direction. According to ALAM (2004) from 1951-52's topographic map it is evident that Someswari River course flew eastward of Birisiri during the early 1950 where as the eastward flowing Someswari river changed its course suddenly to the west to follow a straight course towards the south. Rapid Eye Image of 2012, LANDSAT images of November 1991, February 2000, December 2005, January, 2011 and SPOT images of January, 1990 shows that Channel migration is frequent in Someswari River.

Conclusion and recommendations

Three major landforms have been identified namely low hillocks, alluvial fan and flood plain based on field investigations and Google Earth image analysis. Geomorphologically this area can be demarcated as undulatory province where hillocks are the oldest and most stable landforms. The configuration of the landforms is controlled mainly by alluvial fan deposits and these are the youngest landform of the study area. Tectonics played a vital role for drainage distribution along with the geomorphic shape of the study area. Paleochannels and depressions of the study area infer oldest drainage patterns and landform characteristics. Someswari and Ghoneswari Rivers are the dominant drainage courses of this area. Someswari River alluvial fan can be termed as segmented alluvial fan.

The general flow direction of these huge sediments in the area is towards the south. The surplus water and sediments derived from the northern Shillong Massif and adjacent hillocks are transported initially towards the southern low lying areas or haors and eventually flow to the Bay of Bengal further south. The complex mass is very important for the haor ecosystem as source of nutrition and habitat for aquatic plants and animals. However, the phenomenon of flash flood charged with sediment and high energy water causes problems to the habitat and livelihood of the local people in the study area. Thus, proper mitigation strategies involving database development of the meteorological data, sediment yield, river training and sediment management might allow establishing healthy balances between the development activities and environmental sustainability.

Major infrastructure development should take the periodic occurrence of flash flood into consideration. The hillocks are the suitable landforms of the area in this regard. It

should be of prime importance for their reservation and reinforcement by forestation and other means to prevent weathering erosion as they are the only lands allowing substantial vegetation growth and offering sanctuary for the people living in the area. Landform and hazard characteristics would require careful investigation by detailed survey for land use planning and sustainable development activities in the area.

The acquired knowledge should be disseminated among the stakeholders such as the planners, policy makers, local authority and most importantly the mass people. The engagement of the local people for the proper utilization of suitable landform will ensure long term sustainability of the area and livelihood.

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References

ANON, 2012, Ground water information Booklet, West Garo hills district, Meghalaya, India.

ALAM, A.K.M.K. & ISLAM, M.B., 2004, Response of the Someswari River (Bangladesh) to Neotectonics, *Bangladesh Geoscience Journal*, **10**, 27-37.

ALAM, A.K.M.K. 2004, Geology of Mahadeo Fan, Mid-Northern Part of Bangladesh, *Bangladesh Journal of Geology*, **23**, 71-82.

ALAM, A.K.M.K., 2006, Satellite Remote Sensing for Geohazard Mapping in the mid-northern part of Bangladesh, In: The Second International Symposium on Geo-information for Disasters Management; Indian Society of Remote Sensing; Goa, India; 25-26 September, 2006.

BULL, W.B, 1964, Geomorphology of segmented alluvial fans in western Fresno County, California. U. S, Geological Survey professional paper, 352-E, Washington, DC, 89–129.

BRAMMER, H., 1996, The Geography of the Soils of Bangladesh, University Press Limited, 1-277.

BWDB, 2005, Rivers of Bangladesh, Hydrology, Dhaka, 273 p.

CALVACHE, M.L., VISERAS, C., FERNA'NDEZ, J., 1997, Controls on fan development—evidence from fan morphometry and sedimentology, Sierra Nevada, SE Spain, *Geomorphology*, **21**, 69 -84.

KELLER, E.A. & PINTER, N., 2002. Active Tectonics; Earthquakes, Uplift and Landscape, 2nd edition, Prentice-Hall, 362 p.

Department of Agriculture, Govt. of East Pakistan, 1960, Soil Survey Report of Netrokona Subdivision in the District of Mymensingh, Agricultural Chemistry Section (Soil Survey Scheme), 1-40.

ISLAM M. S. 2006, Environmental issues related to agriculture, Banglapedia: National Encyclopedia of Bangladesh, Asiatic Society of Bangladesh.

HARVEY, A. M., 1984, Aggradation and dissection sequences on Spanish alluvial fans: influence on morphological development, *Catena*, 11, 289 -304.

HARVEY, A.M., 1990, Factors influencing Quaternary alluvial fan development in southeast Spain. In: Rachocki, A.H., Church, M. (Eds.), Alluvial Fans: A Field Approach. Wiley, New York, 247-269.

ROY, P.S. & TAMOR, S. 2001, Landscape cover dynamics pattern in Meghalaya, *International Journal of Remote Sensing*, **20**(28), 3813-3825.

SRDI, 1997, General Soil Map of Bangladesh, http://www.srdi.gov.bd/maps/general-soil-map/.

SAHA, R.K., KHAN, S.H., AKHTER, S. & HUQUE, A., 2011, Study of Clay minerals of Shitalakhya-Dhaleswari Interfluve, *Bangladesh Journal of Geology*, **29-30**, 88-99.

VISERAS, C., FERNA'NDEZ, J. & SORIA, J., 1999, Quaternary alluvial sedimentation on the SW border of Sierra Nevada (Betic Cordillera, Spain): allogenic control on facies architecture. In: Clemensen, L.B. (Ed.), 19th Regional European Meeting of Sedimentology. Geological Institute, University of Copenhagen, Copenhagen, 272 -273.

VISERAS C., CALVACHE, M.L., SORIA J,M. & FERNA'NDEZ, J., 2003, Differential features of alluvial fans controlled by tectonic or eustatic accommodation space. Examples from the Betic Cordillera, Spain, *Geomorphology*, **50**, 181-202.

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বাংলাদেশের নেত্রকোনা জেলার সোমেশ্বরী এবং গনেশ্বরী নদীর মধ্যবর্তী এলাকার ভূ-দূর্যোগ এবং ভূমিরূপ বৈশিষ্ট্য নিরূপন

রাজিব কুমার সাহা, মোহম্মদ ওমর ফারুক খান

সারসংক্ষেপ

শিলং স্তুপ পর্বতের দক্ষিনাঞ্চলীয় পাদদেশীয় সমভূমিস্থ গারো পাহাড় এবং তদসংলগ্ন এলাকায় প্রবাহিত সোমেশ্বরী এবং গনেশ্বরী নদীর মধ্যবর্তী অঞ্চলের বিভিন্ন ভূ-প্রাকৃতিক, ভূতাত্ত্বিক বিশেষ দিক এবং ভূ-দূর্যোগের পুঙ্খানুপুঙ্খ বহিরঙ্গন সমীক্ষা পরিচালনা করা হয়। পূববর্তী গবেষনা এবং গুগোল আর্থ চিত্র ব্যবহার করে ভূমিরূপ এককের সীমানা নির্ধারন করা হয়। এই এলাকার নিয়মিত সংঘঠিত দূর্যোগগুলো হলঃ পাহাড়ী ঢল, নদীর গতিপথ পরিবর্তন, ভূমিকম্প, নদী তীর ভাঙ্গন, পললায়ন এবং বালুকাচ্ছাদন। পূর্ববর্তী সমীক্ষা এবং বর্তমান পর্যবেক্ষণ হতে প্রতীয়মান হয় যে, এই এলাকার ভূমিরূপ এবং নির্দিষ্ট দূর্যোগসমূহের মধ্যে পারস্পরিক আন্তঃসম্পর্ক বিদ্যমান। পালনিক অঙ্গসংস্থান এবং মৃত্তিকার চারিত্রিক বৈশিষ্ট্যের ভিত্তিতে তিনটি প্রধান ভূমিরূপ চিহ্নিত করা হয়েছে; যেগুলো হলঃ নিচু টিলা, অ্যালুভিয়াল ফ্যান এবং অববাহিকা। এই তিনটি এককের মধ্যে নিচু টিলা সমূহ প্রাচীনতম এবং অববাহিকা সর্বকনিষ্ঠ। সোমেশ্বরী নদী এই এলাকার প্রধান মাতৃ নদী যা বিস্তৃত খন্ডায়িত অ্যালুভিয়াল ফ্যান গঠন করে বিদ্যমান ভূমিরূপকে বৈশিষ্ট্যময় করেছে এবং একই সাথে গবেষণা অঞ্চলের ভূমিরূপ গঠনে ভূমিকা রাখছে। সমসমায়িক ভূমিরূপের বৈশিষ্ট্য হচ্ছে নিও- টেকটোনিকস এবং পললায়নের মিশ্র প্রতিক্রিয়ার ফল। ভূ-দূর্যোগ প্রেক্ষাপট বিবেচনায় নিচু টিলা এ অঞ্চলের সবচেয়ে সুস্থিত ভূমিরূপ এবং নিরাপদ, বিপরীতে অববাহিকা সমূহ সবচেয়ে অরক্ষিত ভূমিরূপ। নদীপথ পরিবর্তন, পললায়ন এবং নদী তীর ভাঙ্গনের সাথে সাথে পাহাড়ী ঢলকে সবচেয়ে প্রবল ভূ-দূর্যোগ হিসেবে বিবেচনা করা যায়। দক্ষিনাঞ্চলীয় নিচুভূমি অভিমুখী পাহাড়ী ঢলের সাথে পরিবাহিত বিপুল পরিমান পলল এই এলাকার ভূমিরূপ গঠনে প্রধান নির্ধারক হিসেবে কাজ করে। সুতরাং, পাহাড়ী ঢলের মত প্রক্রিয়াগুলোকে আপাতদৃষ্টিতে দূর্যোগ হিসেবে বিবেচনা করা হলেও এতদঞ্চলের প্রেক্ষাপটে পাহাড়ী ঢলের সাংবাৎসরিক আবর্তন অত্যাবশ্যকীয় ভূমিরূপ গঠনকারী প্রক্রিয়া হিসেবে ভূ-কাঠামো গঠন করছে।