Studying Bankline Migration of the Lower Pra Basin using Remote Sensing and GIS

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Abstract

The study investigated bank erosion and accretion of the lower section of the Pra River of Ghana using a topographical map of 1974 and satellite imagery of 2007, 2015, and 2018 which was augmented by field observation and key informant interviews. Bankline changes due to erosion and accretion and the total volumetric change in river channel were measured using Remote Sensing and Geographic Information System approaches. The study showed that erosion was more pronounced in both the right and left bank as compared to accretion. The study revealed that bank width area of the lower basin of Pra River increased by 50.7 m² from 16.2 m² in 1974 to 66.9 m² in 2018 eroding large portions of land along the right and left banks of the river. In general, the number of erosional spots in selected cross sections exceeded that of deposition. Erosion took place in 13 spots out of 20 spots constituting 65% with a rate ranging between 0.2 and 3.4 m/year. This research showed the value of channel morphological analysis as it brought to the fore, a quantitative perspective to bank erosion and accretion processes of fluvial systems.

Keywords: channel morphology, bankline migration, bank erosion, remote sensing, Geographic Information System, Pra River.

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Introduction

Lateral erosion and accretion processes cause changes in river channels. Lateral movement of a river depicts the alteration of the position of a channel in response to flow discharge and sediment discharge (Islam & Guchhait, 2020; Ghosh et al., 2020; Salaam et al., 2020). Changes in channel morphology involves width-depth adjustments of channels, which alters the width of the river valley, the location of the river valley and bankline. A bankline is defined as the feature that separates the outer margin of a river channel from the floodplain (Hossain et al., 2013). Channel dynamics are inherent processes and features of rivers in the floodplain region (Hasanuzzaman et al., 2021). Bank erosion occurs when the stress of the water and sediments exceed the resistance of bank materials leading to bank erosion (Islam & Rashid, 2011) while accretion is a consequence of a reduction in flow levels of a river and obstruction. River erosion and accretion affect many human activities and produce immeasurable sufferings and adverse effects to people living along riverbanks (Deb & Ferreira, 2014; Ghosh et al., 2020; Mahmud et al., 2020). Beside the human impacts, bank erosion can affect large engineering projects such as highways, railways, bridges and buildings along rivers (Xu et al., 2011; Crosato, 2009). Many researchers around the world have studied river planform changes over time to explain the evolutionary trends, assess the triggering factors, and manage the fluvial environment (Block, 2014; Das and Pal, 2016; Mandarino et al., 2019; Saleem et al., 2020). For river management perspective, it is widely recognized that a detailed analysis of river dynamics over a period yields valuable information to understand ongoing dynamics and potential future evolutionary trends of river channels (Dufour and Piégay, 2009; Hasanuzzaman et al., 2021; Ghosh et al., 2020; Mandarino et al., 2020). The lower sections of rivers are particularly characterized by channel erosion, accretion and flooding. High fluvial discharges and flood waters influence channel morphological changes such as channel migration, braiding, meandering etc**.** These geomorphic processes result in planform evolution of channel morphologies. A better understanding of the morphological changes of alluvial rivers, particularly channel changes through erosion and accretion processes, as well as techniques to detect such changes would be useful for effective planning and management of alluvial environments (Hossain et al., 2013). Though literature on morphological changes in river channel is widespread across the world especially North and South America (e.g. Block, 2014; Cooper et al., 2017; Edmonds et al., 2022; Reid et al., 2020), Europe (e.g. Boothroyd et al., 2021; Brousse et al., 2019; Feeney et al., 2020; Fernandes et al., 2020; Haghighi et al., 2014; Mandarino et al., 2020; Mandarino et al., 2019) and Asia (e.g. Dandan et al., 2021; Hasanuzzaman et al., 2021; Hossain et al., 2013; Ghosh et al., 2020; Saleem et al., 2020). However, little of such studies exist on the African continent and Ghana for that matter.

Traditional channel change analysis relies on repeated field surveys, which are time-consuming, cumbersome, requires many resources and have a limited spatial scale (Dandan et al., 2021; Kuo et al., 2017). In very deep and wide reaches of the river, insitu measurement of bank erosion and morphometric analyses are very difficult, risky and if not impossible to carry out. Geographic Information Systems (GIS) and Remote Sensing (RS) are contemporary tools used for detecting variations in river channel forms and bank shift analyses (Ghosh et al., 2020; Mitra et al., 2020; Saleem et al., 2020). Forecasts can be made on change detection outcomes and trend analysis using GIS and RS. Morphological changes of rivers are derived from historical maps, aerial photos and in recent times, satellite images and photos from drones and other flying machines.

Previous studies on sediment yield analysis, discharge rate and bank erosion have been carried out at the middle and upper sections of the Pra River. For example, Kusimi (2018) and Kusimi et al. (2014) assessed the sediment yield and bank erosion processes and established that seasonal morphological changes in the river’s features can have a direct effect on its bankline.

Akrasi (2011) developed a predictive model for which no sediment measurements had been undertaken to model annual suspended sediment yields of the Pra River. The floodplain of the lower section of the Pra River is inundated annually resulting in bank erosion, flooding cascading into serious socio-economic impacts on the inhabitants (Asiedu & Kusimi, 2020; Coastal Resources Centre, 2013; Nyarko, 2017; Opoku, 2017). There are also several human activities undertaken along the corridors of the lower section of the Pra River that impinge on fluvial processes such as erosion and sediment deposition in the river channels. Nevertheless, channel morphodynamical studies of the lower section of the river have not yet been carried out to understand the changing pattern and shifts of the river reach at the lower section of the river where these intense fluvial processes; floods and bank erosion occur. The objective of this study is to identify and measure morphological changes in the river channel bankline of the lower section of the Pra River from 1974 to 2018 by examining topographic and multitemporal satellite images using GIS and remote sensing techniques.

Background of the study area

River Pra is one of the south-western river basins of Ghana located between latitudes $5^{o}00^{\prime}$N and $7^{o}15^{\prime}$ N and longitudes $0^{o}30^{\prime}$ W and $2^{o}80^{\prime}$ W (Kusimi et al., 2014). This study focused on the Lower Pra River Basin (LPRB), which stretches from Twifo Praso to the coast at Shama (Fig. 1). The total length of the river is 240 km whiles the lower section, which falls within the Twifo Atti-Morkwa, Mpohor Wasa East and Shama Districts is about 96.13 km from Twifo Praso to Shama. The lower basin drains an area of 6,778 km^2.

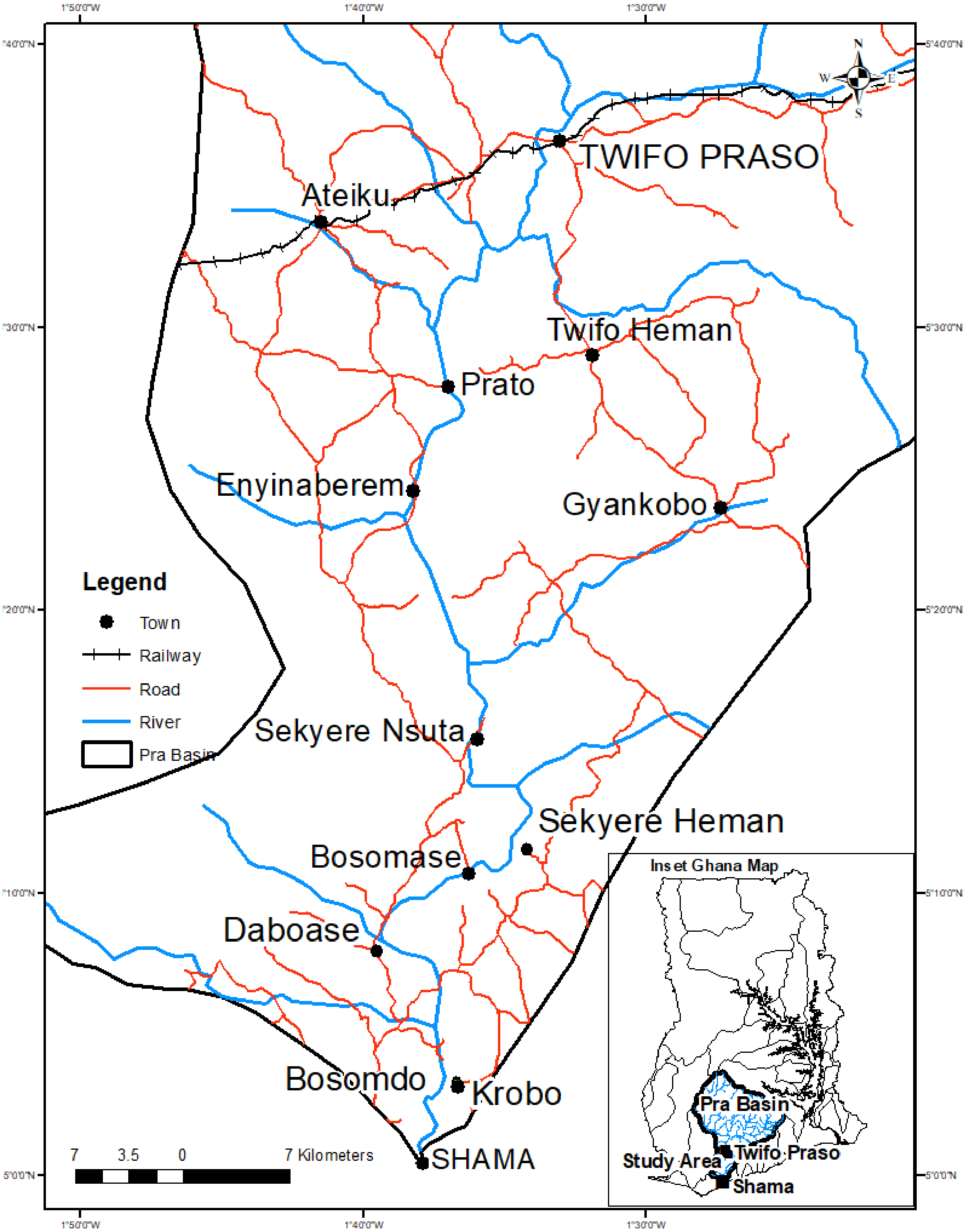

Fig 1: Map of the study area

The major townships within the research area include Twifo Praso; the District capital of the Twifo Atti-Morkwa District, Twifo Heman, Daboase and Shama in Shama District. Most communities within the catchment are rural with an estimated population of over 600,000. Consequently, economic activities are primarily agrarian with few local industries which are mostly into agro-processing of cassava and oil palm. Agricultural activities include cash and crop farming, fishing as well as animal rearing. The crops include food crops such as maize, plantain, cassava whiles oil palm and cocoa form the main cash crops. Rice and sugarcane are farmed along the banks and floodplains of the river which destabilases the riverbanks. Commerce and services sectors are rife in the large towns like Twifo Praso and Shama, while quarrying occurs in the hinterlands as a source of building materials for roads and the built environment. Other forms of occupation include crafts, trading, artisanal and formal sector workers (Ghana Statistical Service, 2014a, 2014b, 2014c).

The general vegetative cover is the moist semi-deciduous forest, which is made up of three layers. Some of the trees shed their leaves during the dry season. The fringes of the river from Beposo to Twifo Praso are mostly covered by trees of the lower layer which are closely parked with climbers amidst a few middle and upper layered trees. Mangroves are found downstream of Beposo to the mouth. However, due to the higher concentration of illegal small-scale alluvial gold mining and lumbering activities and farming along the riparian zone, the forest in the river basin has experienced rapid degradation (Kusimi et al., 2014)

The landscape is generally flat, characterized by isolated hills with altitude of about 150 m above sea level, which makes people around the river basin more vulnerable to flood when rivers exceed their thresholds (Water Resources Commission, 2015). Mean annual runoff is estimated to be 4,200 m^3yr^{-1} (Water Resources Commission, 2012).

The LPRB has two rainy seasons, April-June, and September-November. Total rainfall amounts fluctuate between 1,450 mm and 1,900 mm with a mean of about 1,600 mm. The disparities in the rainfall pattern within the LPRB increases towards the southern part of the basin. The soils in the lower section are weathered from the Tarkwaian and Birimian geological formations (Dickson & Benneh, 1995). The soil texture is clay in nature; therefore, it can retain more moisture. The primary soil type for this basin is forest ochrosols but that of the lower Pra basin are fluvisols, luvisols, lixisols, and acrisols (Adjei-Gyampong & Asiamah, 2002).

Materials and methods

This study focused on quantifying the extent of morphological changes of bankline shifting (erosion/accretion) over 44 years period. The choice of the period is based on data availability. The study involved field surveillance, key informant interviews and riverbank shift analysis using remote sensing and geographic information system approaches. In view of the thickness of the forest cover of the riverbank, seven accessible sections of the river at Twifo Praso, Sekyere Heman, Daboase, Beposo, Anlo Beach town, Shama and Bosombo-Krobo (Fig.1) were explored to see the nature of the geomorphic processes pertaining to the localities and the channel modifications. Because with the growing anthropogenic pressure on the environment, it is inappropriate to investigate channel adjustments without assessing the nature and degree of human interventions prevailing within catchments (Mitra et al., 2020). Key informants were interviewed in these communities. The key informants included the Manager of the intake station of Ghana Water Company at Sekyere Heman and Daboase, four assembly members of the localities, ten farmers whose farms are located along the riverbanks and two people whose houses are close to the riverbank were selected from each of the seven communities. These informants were selected to expatiate on the anthropogenic factors that influence bankline shifts. Interviews were carried out using an interview guide while field survailance was undertaken using field note book and a camera.

Data for the bankline shift analysis included 1974 topographical map of the lower Pra basin and Landsat EMT+ images of 2007, 2015, and 2018. The images were downloaded from (earthexplorer.com) while the topographical map was retrieved from the Ghana Survey Department, Accra. The topographical map was of scale 1:50,000 whiles the images were 30×30 m. The row and path of the images are 193 and 056. The topographical map of 1974 was scanned and georeferenced using the WGS84 datum to be of the same coordinates as the satellite images. The satellite images were acquired during the dry season. These images were suitable because during this season there is less cloud cover, and the water level of the river is relatively consistent annually which is essential for assessing the inter-year change of erosion and accretion of the river (Hossain et al., 2013). Automatic waterline extraction method in ENVI 5.3 was used to extract banklines of the images following procedures described in Kusimi and Kusimi (2021), while the topographical map was on screen digitized to generate the bank lines in ArcGIS 10.8 (Kusimi & Dika, 2012).

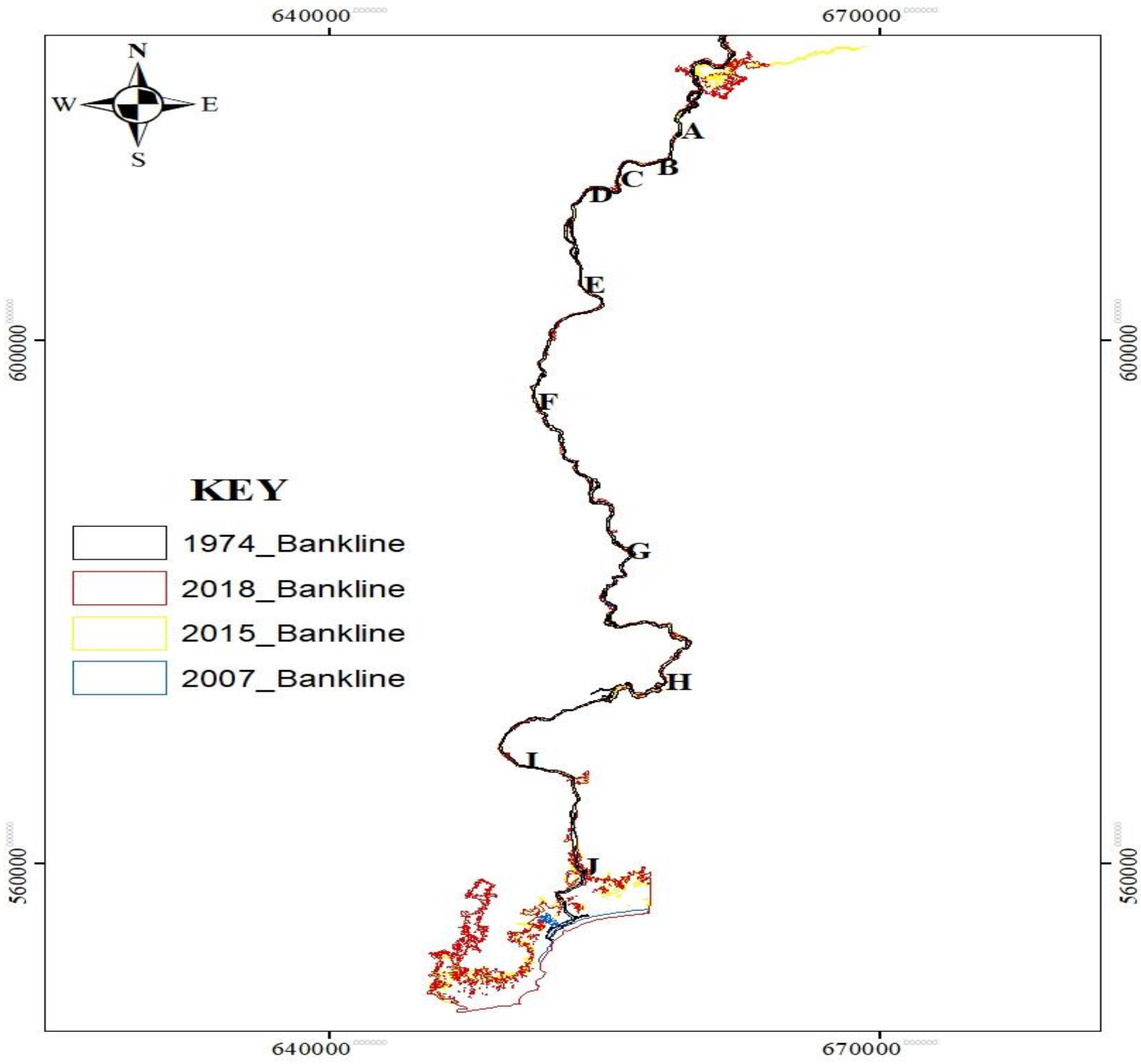

Figure 2: Extracted banklines of 1974, 2007, 2015 and 2018 of Lower Pra River.

The general shifts in banklines were done between the successive years under study (Table 1). Total erosion and accretion for the periods were also calculated following the approaches of Hossain et al. (2013) and Mandarino et al. (2019). However, to ascertain the extent of profile changes ten accessible cross sections of serious bank erosion and accretion numbered A to J in the seven towns were selected to measure bankline changes (Fig.2 and Figs.3A – 3J). To determine the changes in bankline (erosion and accretion) of channel forms, bank lines were superimposed on each other, and cross-sectional lines were drawn across the channel reaches to measure length of changes in bankline (Figs.3A – 3J). Changes in banklines of the selected reaches was done between 1974 and 2007 and between 2007 and 2018. A negative value was interpreted as accretion, while a positive value as erosion and a very low or zero value as stable areas. Total change in bankline was calculated for the selected reaches and the annual rate of change in bankline (erosion/accretion) determined using equation:

$$R = \frac{TC}{P}, \qquad (1)$$

Where R is annual rate of change (m/annum), TC is total change (erosion/accretion) and P is number of years.

Results

Bankline changes

The overlaid banklines indicate some dynamism in the channel morphology of the river (Fig.2). Banklines indicated that there had been shifts in the river's reaches from 1974 to 2018. These changing patterns in the river profile can be observed in Fig. 2. These changes result from the lateral erosion and sedimentation that have occurred within the river valley between the periods.

From 1974 to 2007, the river saw minimal change of 2.35 m but saw a remarkable shift of 30.02 m from 2007 to 2015 (Table 1). Shift in bankline between 2015 and 2018 was 18.3 m. The overall change in bank area between 1974 and 2018 was 50.7 m^2 ranging between 16.2 and 66.9 (m^2) (Table 1).

Table 1: Bankline changes from 1974-2018 (m).

Years	Area (m²)	Change (m)
1974	16.18	
2007	18.53	2.35
2015	48.55	30.02
2018	66.88	18.33

The changes at specified channel reaches are shown in Figs. 3A to 3J and the degree of changes are illustrated in Tables 2. The cross-sectional profiles indicated that certain areas of the lower Pra have experienced erosion; leading to the expansion of the channel reach while certain areas have experienced accretion resulting in an inward shift in channels. For example, between 1974 and 2007, four reaches of the right (A, G, H, and J) experienced channel accretion ranging between 18.8 and 101.9 m with a mean of 51.9 m while the remaining 6 reaches were eroded (B, C, D, E, F, and I) with a mean bank erosion of 24.4 m (Table 2). However, from 2007 to 2018 bank erosion was the dominant geomorphic process at all the right bank cross sections producing bank migrations ranging between 10 and 128.5 m with a mean of 38 m (Table 2). However, unlike the right bank, the left bank was subjected to more accretion than erosion between 1974 and 2018. Accretion occurred within 6 reaches and the magnitude ranged between 5.9 and 66 m with a mean of 33.1m while erosion happened in 4 sections and ranged from 0.8 to 32.7 m with a mean of 13.8m (Table 2). However, except cross section D where there was an accretion of about 12 m, the rest of the other profiles were subjected to bank wearing ranging from 0.5 – 156 m and a mean of 27.8 m between 2007 and 2018. Comparatively, accretion occurred in fewer sections, 4 out of 10 (40%) at the right bank however, in the left bank it was dominant, 6 out of the 10 sections (60%) between 1974 and 2007.

Table 2: Shifts in river banklines (m) between1974 and 2007 and 2007and 2018

Cross sections					Total change		Annual rate of change	
	Right bank	Left bank	Right bank	Left bank	Right bank	Left bank	Right bank	Left bank
	1974-2007	1974-2007	2007-2018	2007-2018	1974-2018	1974-2018	1974-2018	1974-2018
A	-52.14	20.26	62.5	26.09	10.36	46.35	0.24	1.053
B	51.82	-65.97	12.4	1.55	64.22	-64.42	1.46	-1.46
C	14.03	-35.74	19.2	0.53	33.23	-35.21	0.76	-0.8
D	26.31	-31.13	26.4	-12.05	52.71	-43.18	1.2	-0.98
E	3.59	1.43	21.4	7.27	24.99	8.7	0.57	0.2
F	25.88	-22.03	16.5	12.17	42.38	-9.86	0.96	-0.22
G	-101.92	32.71	55.6	4.42	-46.32	37.13	-1.05	0.84
H	-34.77	0.84	27	30.17	-7.77	31.01	-0.18	0.71
I	24.97	-37.76	10.1	10.07	35.07	-27.69	0.8	-0.63
J	-18.84	-5.9	128.5	156.18	109.66	150.28	2.49	3.42
Mean accretion	-51.92	-33.09	0	-12.05				
Mean erosion	24.43	13.81	37.96	27.61				

Negative sign means shift due to accretion (inward shift) and the positive figures mean shift due to erosion (outward shift).

However, the mean accretion at the left bank was 33.1 m in contrast with 51.9 m at the right bank between 1974 and 2007. This implies that despite the fact that fewer channel cross sections underwent accretion at the right, the intensity of the accretion in the right bank was higher than the left bank where more channel cross sections were accreting. Thus, higher channel aggradation was produced at the right bank than the left bank between 1974 and 2007. Nonetheless cross sections from 2007 and 2018 were erosional, between 0.5 and 156 m with a mean of 27.8 m between 2007 and 2018. Comparatively, accretion intensity of bank erosion in the left bank was less than (27.8 m) the right bank (38 m) (Table 2).

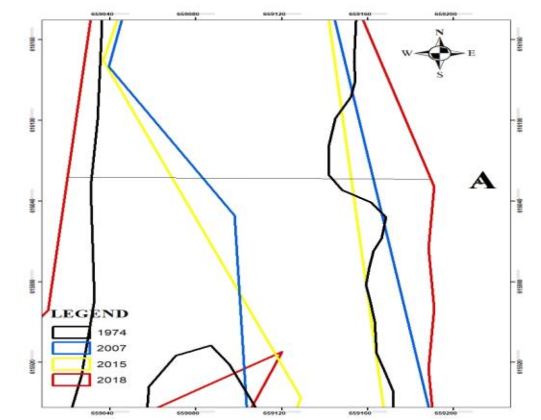

Figure 3A: Cross section at reach A

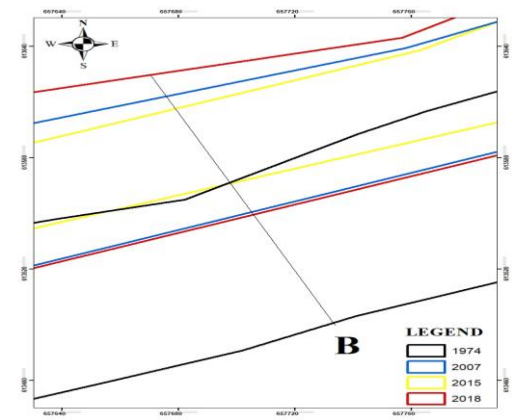

Figure 3B: Cross section at reach B

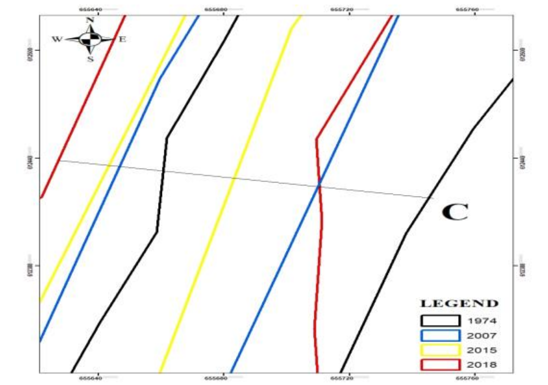

Figure 3C: Cross section at reach C

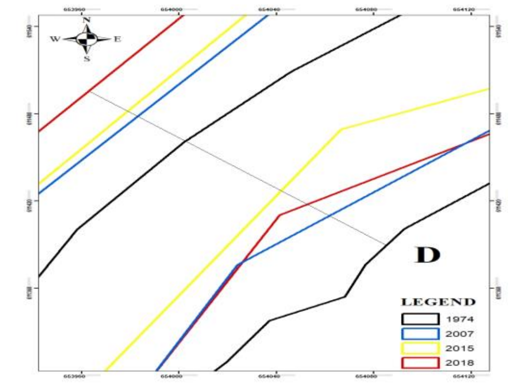

Figure 3D: Cross section at reach D

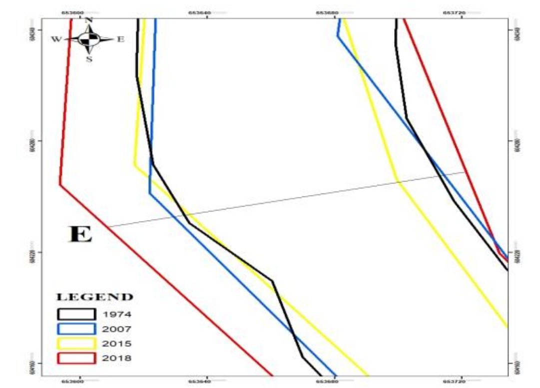

Figure 3E: Cross section at reach E

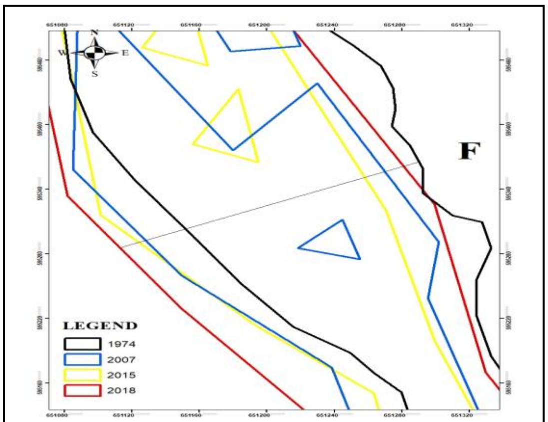

Figure 3F: Cross section at reach F

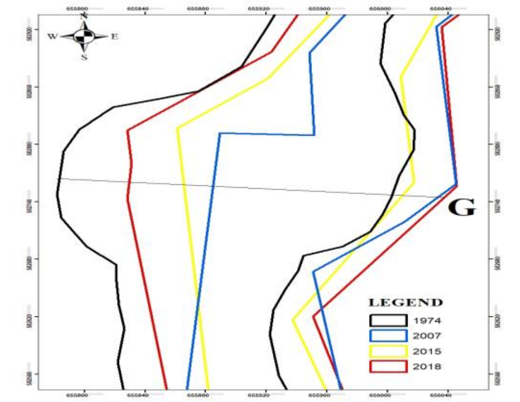

Figure 3G: Cross section at reach G

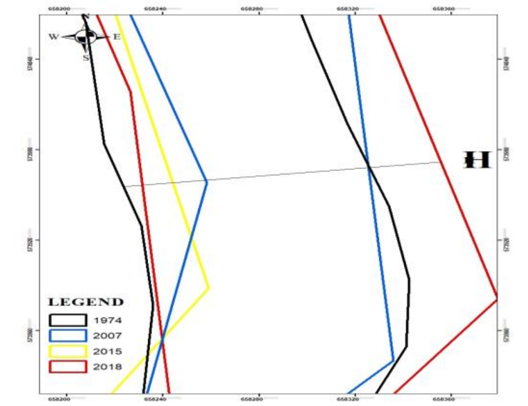

Figure 3H: Cross section at reach H

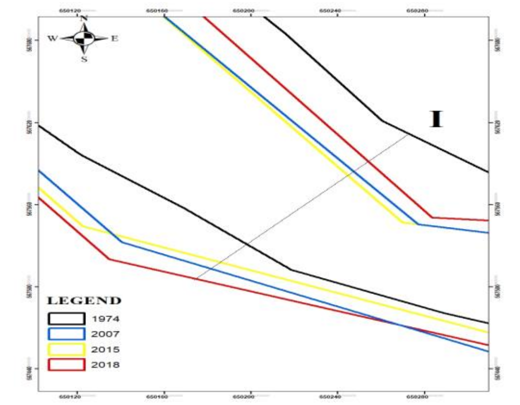

Figure 3I: Cross section at reach I

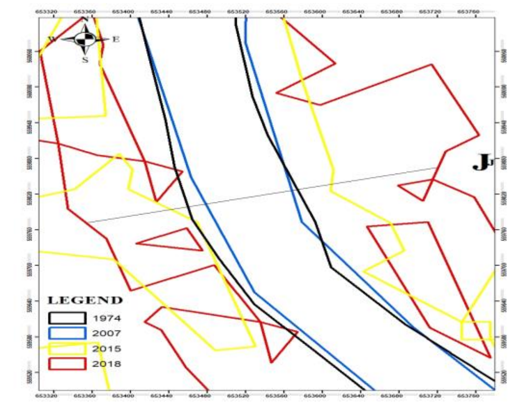

Figure 3J: Cross section at reach J

Some of the selected river reaches experienced variabilities in the fluvial processes within the staggered periods of analysis. Whereas some banks experienced both erosional and depositional processes between 1974 and 2018 the results showed others were either erosional or depositional throughout the period (Table 2). The right bank at point A accreted by 52.14 m between 1974 and 2007 and eroded by 62.5 m between 2007 and 2018 resulting in a net of 10.4 m of an eroded bank (Table 2). However, the left bank experienced erosion throughout the period of 1 m/year rate producing a bankline shift of 46.4 m (20.26 m from 1974-2007 and 26.09 m from 2007-2018). The right bank of point B was erosional within the period with a rate of 1.5 m/year resulting in a bank shift of 64.2 m (51.82 m between 1974 and 2007 and 12.4 m between 2007 and 2018), whereas the left bank accreted more than it eroded accounting for the aggradation of riverbank 64.4 m (accretion -65.97 m between 1974 and 2007 and erosion 1.55 m between 2007 and 2018) at an annual growth rate of 1.5m/year. At reach C, the right bank was erosional throughout; 14.03 m and 19.2 m within the two staggered periods respectively causing a bank migration of 33.23 m of 0.8 m/year (Table 2). The left bank faced a massive accretion of 35.7 m (1974-2007) and a marginal erosion of about half a meter (0.5 m) (2007-2018) culminating in a bank aggradation of about 35.2 m. Cross section D right bank suffered erosion of about 26 m during both periods giving rise to a total bankline migration of 52.7 m with an estimated annual rate of 1.2 m/year, whereas the left bank also underwent accretion for both periods totalling 43.2 m. Reach E however was erosional from 1974 – 2018 resulting in channel width increase of about 25 m at right bank and 9 m at the left bank. The rate of bank erosion of both banks ranged between 0.2 and 0.6 m/year (Table 2).

At cross section F, erosion was the dominant fluvial process causing a bankline shift of 42.4 m between 1974 and 2018 which was characterized by a recession rate of close to 1 m/year (Table 2). The left bank was however characterized by accretion of about 22 m (1974-2007) and erosion of about 12 m (2007-2018) giving rise to bank aggradation of almost 10 m. The right bank of point G was the most accreted reach (101.9 m) along the whole profile understudy. This occurred between 1974 and 2007. Between 2007 and 2018, the bank was however, erosional (55.6 m) but since bank erosion was less than the accretion, there was in-channel deposit of fluvial sediments of about 46.32 m (Table 2). The left bank was however subjected to bank wearing within the period (32.7 m from 1974-2007 and 4.4 m from 2007-2018) ensuing bankline increment of about 37 m. At H, the right bank accreted to about 35 m between 1974 and 2007 but got eroded to about 27 m from 2007-2018 leaving insignificant aggraded bank materials of just 7.8 m. The left bank however was erosional throughout, very low (0.84 m) between 1974 and 2007 but vast (30.2 m) between 2007 and 2018. The right bank of channel section I underwent bank erosion across the era about 25 m (1974-2007) and 10 m (2007-2018) at a rate of 0.8 m/year, while the left bank was subjected to accretion (37.8 m) from 1974-2007 and erosion (10.1 m) from 2007-2018 causing bank aggradation of 27.7 m. There were simultaneous processes of accretion and erosion across both banks of cross section J between the studied times and this section also recorded the highest bank erosion of about 156.2 m, which took place at the left bank between 2007 and 2018 (Table 2). Accretion was 18.8 m in 1974 and erosion was 128.5 m at the right bank causing bank migration of almost 110 m. At the opposite bank, bank accretion was almost 6 m between 1974 and 2007 and between 2007 and 2018 bank wearing processes also prevailed resulting in bank migration of about 150 m. The rate of bank erosion for both banks was about 3 m/year (Table 2).

Bank erosion was dominant along the right bank than accretion. Only two spots (G and H) out of the ten right bank cross sections accreted between 1974 and 2018 (Table 2). However, on the left bank the number of cross sections that experienced erosion and accretion were equal, 5 each. In totality however, the number of erosional spots exceeded that of deposition. Erosion took place in 13 spots out of 20 spots constituting 65% with a rate ranging between 0.2 and 3.4 m/year.

Field exploration and interviews revealed that between 1974 and 2007, there were accretions in certain sections of the profile due to the existence of mangroves and vegetative cover which acted as buffer against bank erosion. The interviewees (farmers and residents) also stated that there were fewer human activities that were directly impinging on the fluvial system of the river at the time. For instance, the interviewees opined that the activities of illegal alluvial mining were non-existent in the lower section of the river. However, the key informants attributed the massive erosion of the banks between 2007 and 2018 to the increased in human activities along the river corridor. Mangroves harvesting along the bank was said to be one factor because this reduces the shear strength of the riverbank leading to bank erosion. From field exploration, mangroves harvesting was observed to be prevalent from cross section H downstream to the mouth at cross section J at Shama. The issue related to mangrove harvesting was confirmed by the Assemblyman of Shama that:

> *Residents harvest the mangroves along the banks for building and roofing of houses which leaves the banks bare exposing the bank to erosion.*

Figure 4a: Riverbank erosion at Krobo
Source: Field survey, 2019

Figure 4b: Riverbank erosion at Bosomdo
Source: Field survey, 2019

The assemblyman also added that;

> *Residents are not permitted to harvest mangroves 50 m to the river according to regulations of water resources management because the mangroves protect bank soil from erosion. However, the regulations are not strictly enforced.*

Figures 4a and b show the extent of bank erosion at Krobo and Bosomdo all within Shama which has increased channel width of the river destroying farmlands, vegetation and settlements. It was also revealed from some of the key stakeholders that during the 2007 and 2018 period, illegal alluvial small scale gold mining activities were now rife within this section of the river. These activities involve the use of changfan, shovels and pickaxes to excavate bank materials for gold extraction. The excavation of riverbanks for gold by artisanal small-scale miners widened riverbanks accounting for the increased in bankline shifts during this period.

Discussion

Riverbank expands due to erosion of the bank and constricts due to accretion of riverbank. This shifting pattern creates uncertainty for inhabitants of river corridors and poses a hazard to property and infrastructure. The study has revealed that the bankline of the lower Pra basin has changed between 1974 and 2018. The migratory and shifting patterns varied spatially and temporally in relation to determinant factors. But varied natural and anthropogenic factors are the causes of bank erosion and deposition accounting for channel morphological dynamics (Annayat & Sil, 2020; Dandan et al., 2021; Mitra et al., 2020). As observed by Kusimi (2018), tropical monsoon rains flood river valleys causing bank erosion and bank failure due to the oscillatory pattern of flow discharge. He detected cantilever bank failure to be prevalent in the upper course of the river due to undercutting and bank toe erosion. Results showed that within 1974 and 2007, there was much accretion in the river valley whereas extensive erosion occurred between 2007 and 2018. Besides natural forces, results of the study showed that human activities including alluvial gold mining and mangroves harvesting are causal factors of the shifting bankline of the lower section of the Pra River particularly between 2007 and 2018. Mangrove harvesting is perilous to fluvial systems because riparian vegetation acts as a buffer/controls river's lateral migration of riverbanks and the transportation and deposition of fluvial sediments. Illegal sand mining was identified as one of the causes of channel migration of the Bhagirathi-Hooghly River, West Bengal, India (Ghosh et al., 2020). Mitra et al., (2020) also identified excessive in-channel sediment mining and rampant land use alterations of the floodplains to have altered the river channel planform of the Terai region of northern West Bengal, India. Bankline shift processes have caused hazardous exposure to local people in terms of lands, livelihoods and properties and the destruction of infrastructure (Ghosh et al., 2020; Hasanuzzaman et al., 2021; Mahmud et al., 2020). An aspect of this study that investigated the impacts of riverbank erosion on the environment and socio-economic activities revealed that riverbank erosion was causing physical destruction to infrastructure (e.g., roads) and buildings resulting in displacements which disrupts livelihoods (Asiedu & Kusimi, 2020). The socio-economic impacts included the washing away of crops and livestock along riverbanks and the increasing turbidity of the water which degrades water quality (Asiedu & Kusimi, 2020).

Conclusion

Results of the study indicated that there had been shifts in the river's bankline from 1974 to 2018. This has occasioned a change in channel morphology of the river. The specific cross-sectional analysis elucidated the extent of bankline changes. Whereas some banks experienced both erosional and accretional processes between 1974 and 2018. Others were either erosional or depositional throughout the period characterized by differences in erosion and accretion rates. Overall, bank erosion was higher than accretion. The number of erosional spots were 65% compared to 35% for accretion. The total land loss of the river corridor was about 50.7 m^2. Channel widening is causing environmental and socio-economic impacts along the riparian zone. Control of illegal alluvial gold mining by both local and central governments is needed to curtail future riverbank erosion. This research shows the value of channel morphological analysis as it brought to the fore, a quantitative perspective to bank erosion and accretion processes of fluvial systems.

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