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RESEARCH ARTICLE

ENVIRONMENTAL IMPACT ASSESSMENT OF SHIFT IN RIVER WITH THE HELP OF GEOGRAPHIC INFORMATION SYSTEM

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ABSTRACT

The purpose of the study is to estimate the impact of the migration behaviour of the rivers Solani and Ratmau on flooding, rural and urban land use. The Migrational behaviour of rivers is studied in the region between 29° 48' N to 29° 52' N latitude and 77° 53' E to 77° 58' E longitude based on data from topographic sheet, aerial photographs and satellite images from google earth in the region under study. Net shift is detected and measured with the help of a reference line in the direction of shift with a chainage gap of 500 m. It is clear from the analysis that the shift in Confluence Point of rivers is posing a serious threat not only in terms of reducing the cultivable area but also threatening to flood.

INTRODUCTION

In the present context, the migration behaviour of the river is studied and analysed. River migration includes any changes of pattern. It is one of the means through which river tends towards the so-called dynamic or Quasi-equilibrium State. It is likely that the amount of river channel changes both directly and indirectly induced has previously been underestimated. The deliberate alteration of river channels is now known to have increased in the twentieth century. Any engineering work that modifies the river system has the potential to cause instability and adversely affect the riverine environment. Attempts to impose an unnatural condition on a river can lead to a major instability problem. Over the last 2000 years and particularly during the last 300 years human impacts had an increasing influence on drainage basins and their watercourses. Changes of river channels are significant in relation to flooding, rural and urban land use as well as in relation to the interpretation of past river development and estimation of future river behaviour. Changes in river channels are always accompanied by erosion and sedimentation. Hence the soil nearby is always subjected to a change. Land use pattern also changes. These changes therefore always involve the reworking of flood plains, soils, sedimentation, erosion etc, which are of very broad concern. This further necessitates the construction of river engineering works.

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This action then further destroys aquatic and semi- aquatic plants which only develop in shallow water along the gently sloping banks of the river which are virtually eliminated by the construction of vertical, often concrete banks.

Alterations of channel size and shape and substrate characteristics have been shown to have major impacts on benthic invertebrates and aquatic microphytes. Changes of river channel mobility and pattern significantly influence stream and floodplain habitats. All this early and recent interferences on the part of man has therefore resulted in a general and rapid deterioration of the river ecosystem. Floods, river bank erosion, slope failure, water logging and other associated serious impacts of river shifting demand serious attention towards this problem. It thus becomes necessary to study the dynamic behaviour of rivers in a systematic way so that necessary steps can be taken for construction of any hydraulic structure in future. Also understanding the ways in which river channels have changed through historical time may be important for ecologically sound management. It may be desirable for conservation purposes to restore a river channel to a condition existing prior to development. It may also be necessary for the purpose of environmental impact assessment to determine the rate of change arising from a variety of impacts [1, 2].

The conventional approach to collect information about the river characteristics has been ground based surveys which are both uneconomic and time consuming. Collection of such vast amount of data, their compilation and subsequent publication takes its own time and many a times there is a considerable time gap between the date of collection of data and their date of publication. While analysing the impacts of various activities and new facilities, planners have traditionally not employed computers to a large extent. Instead relatively simple calculations have been combined with personal judgement and experience to arrive at a "gut" feeling about what the "best decision" may be. The problem with this approach is that it limits the complexity of a decision-making framework for most of us intuitively cannot analyse more than a few variables at a time. To overcome these difficulties computerized storage-cum-retrieval systems are being developed. In the midst of worldwide revolution founded on information processing, communication, micro based computers, and a demand for environmental responsibility, the integrated approach of Geographical Information Systems and Remote Sensing is being developed as a unique, highly effective and extremely versatile technology, for evaluation, management monitoring of natural resources and environment. Remotely sensed data pro, the advantage of synoptic view and the possibility of studying the dynamic behaviour of rivers using sequential satellite data, remote sensing combined with Geographical Information Systems can effectively be used to link raster vector information and also to combine data received from other sources.

In the present study, migrational behaviour of the confluence point of Ratmau and Solani River is being assessed using remote sensing data. Ratmau River emerging from Shivalik range crosses Upper Ganga Canal at Km. 21.0 almost at right angles to the canal alignment at Dhanauri.

Study Area

The area taken for study lies between 29° 48' N to 29° 52' N latitude and 77° 53' E to 77° 58' E longitude.

Data Used

Topographic sheet number 53 G/13 (Scale 1:50,000, Survey of India, year 1971), Aerial photographs (Scale 1-26,000, year 1967) and satellite images of the year 2002 and 2011 from google earth were used.

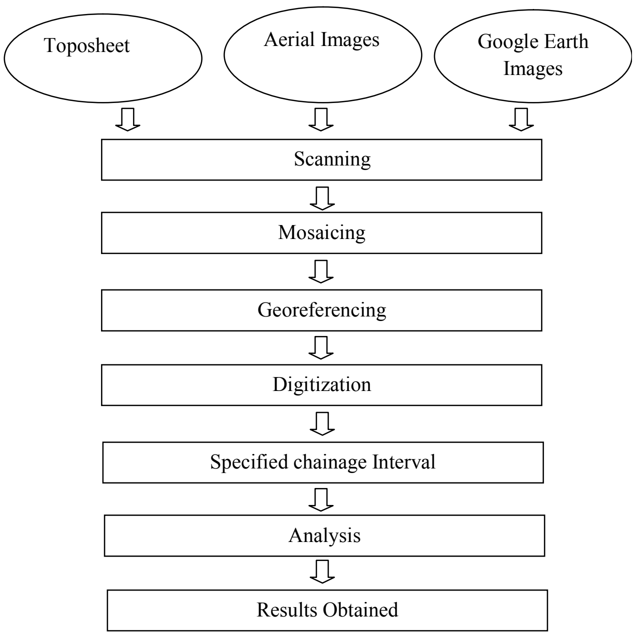

Figure 1 Methodology Used

METHODOLOGY

Certain data like toposheet and aerial photographs which are not available in computer readable form are to be first scanned converted into digital form. If certain information is available in multiple parts it has to be integrated into a single unit using a process of mosaicking e.g. Aerial Photographs. In the next step, Images are to be registered (georeferencing) to establish a correspondence of an earth feature in different data sources. To add semantics for the required features in the image one has to apply digitization process for those features only e.g. rivers, sandy area, cultivated area etc. Reference lines are also part of the digitization which represents the direction of the shift of confluence point. Chainage are to be drawn at a distance of 500 meters apart on the reference line. They will help in measuring shift in confluence point.

Observations

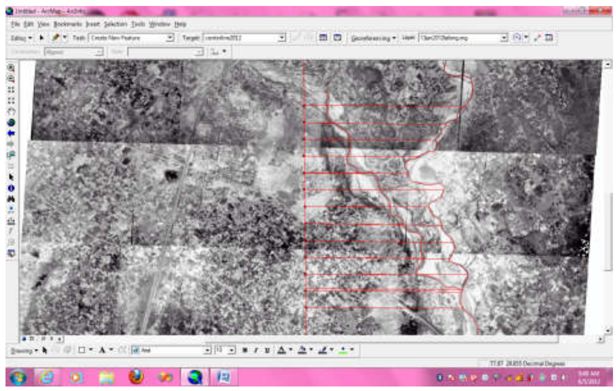

Figure 2 Mosaicked Aerial image of study area (1967), red lines represent reference line and chainage

Table 1 Distance (in Km) from reference line to central line of rivers up to confluence point from Figure 1

S.No.	Distance from reference line	
	Solani (km)	Ratmau(km)
1	0.675066	4.657754
2	0.82235	4.075433
3	1.288898	3.798987
4	1.245922	3.314344
5	1.57757	3.001446
6	2.191325	3.995968
7	2.44315	3.560375
8	2.799717	3.929457
9	3.321613	4.254868
10	3.407626	4.168946
11	3.168087	4.653933
12	4.49454	4.49454

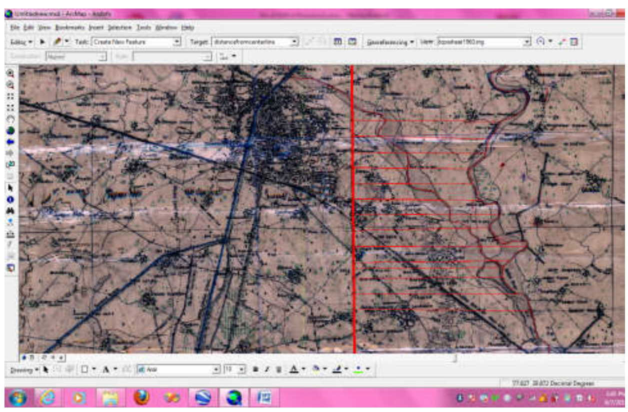

Figure 3 Toposheet of the study area (1971) , red lines represent reference line and chainage

Table 2 Distance (Km) from reference line to central line of rivers up to confluence point from Figure 2

S.No.	Distance from reference line	
	Solani (km)	Ratmau(km)
1	1.055447	4.632038
2	0.854135	4.228865
3	1.6589	4.10734
4	1.71836	3.630193
5	1.759943	3.728104
6	3.008107	3.958419
7	3.571099	4.522361
8	3.585509	4.213318
9	3.902012	5.357163
10	4.360383	4.851359
11	4.641214	4.641214

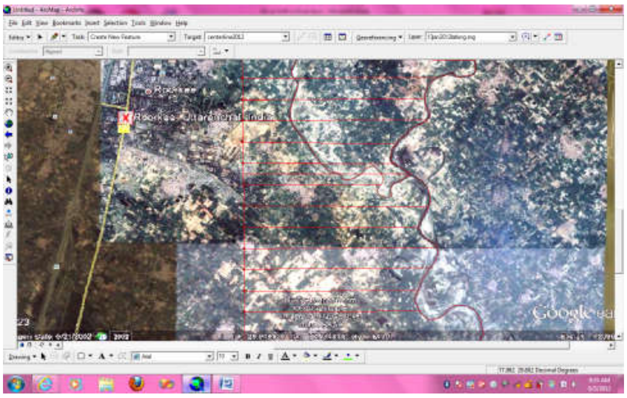

Figure 4 Satellite image of study area (2002, Google Earth), red lines represent reference line and chainage

Table 3 Distance (Km) from reference line to central line of rivers up to confluence point from Figure 4

S. No.	Distance from reference line	
	Solani (km)	Ratmau(km)
1	1.262475	5.302423
2	1.82173	4.407461
3	1.137681	4.147231
4	1.093194	4.217808
5	1.446943	3.485893
6	1.773695	3.471781
7	3.797579	3.797579

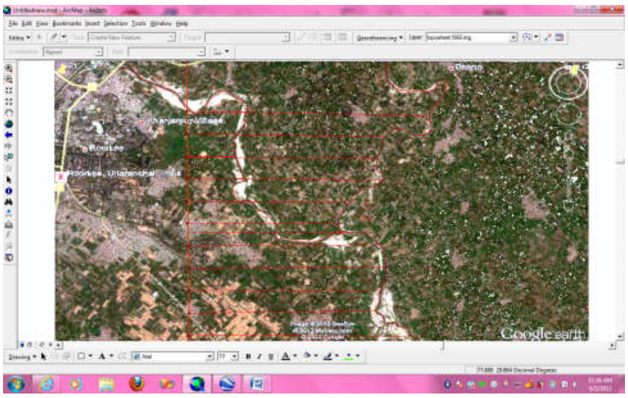

Figure 5 Satellite image of study area (2011, Google Earth), red lines represent reference line and chainage

Table 4 Distance (Km) from reference line to central line of rivers up to confluence point from Figure 5

S. No.	Distance from reference line	
	Solani (km)	Ratmau(km)
1	1.295227	5.227042
2	1.100618	4.264411
3	1.045833	4.099773
4	1.222054	4.191351
5	1.083327	3.3533567
6	1.896877	3.235172
7	3.405802	3.405802

Impact Analysis

A clear change in the river course and sinuosity has been detected. It is also clear that the confluence point of the river Solani and river Ratmau is continuously shifting upwards as shown in Figure 2, Figure 3, Figure 4 and Figure 5 above. After comparing images of the year 1967 with toposheet of 1971 there is a slight shifting of rivers confluence points in upward direction was noticed but after comparing satellite images of the year 2002 and 2011 with toposheet and aerial image the confluence point of the rivers is shifted about 2 kilometres in an upward direction as described in Table 1, Table 2, Table 3 and Table 4 above. The change in the sinuosity of the river Ratmau and Solani is also clearly visible. As it is clear from the thorough study the shifting of the river has caused an increase in the sandy area and an overall decrease in the cultivable area and also increase in residential areas has further aggravated the problem.

CONCLUSION

It is clear from the analysis that the shifting of the river is posing a serious threat not only in terms of reducing the cultivable area but also threatening to flood. If proper attention is not paid in this regard, the menace of sedimentation and flooding may assume frightening proportions which may take heavy toll on agricultural land, civil works and property a good chunk of land in the flood prone area is also left barren with their constantly being threatened by flood.

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