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Flood Disaster Mitigation Study in Siddharthnagar District of Uttar Pradesh, India

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Abstract: ***Submergence of land that is usually dry due to overflow of water is flood. It is most happening and recurring disaster causing huge loss of life and property at the same time disrupting the all around growth and development of the place. Flood being a natural disaster could not be prevented from happening, but identifying the areas prone to disaster could help in minimizing its impact. Rapti river is the principal water body of Siddharthnagar district. From 1998 to 2017, in the span of 20 years district Siddharthnagar witnessed flood 12 times. 2017 flood was no less than 1998 flood which was the century's worst flood disaster. It affected 617 villages of the district among which 421 villages were marooned affecting 3, 72, 798 number of population and 35, 991.669 ha. of sown agricultural land. This paper is an attempt to study the year 2017 floods of the district Siddharthnagar and recognize areas vulnerable to frequent flooding so that besides minimizing the impact of flood, available human and physical resources could be used efficiently by the machineries involved in the rescue, relief and rehabilitation process.***

Keywords: Flood, Rapti river, Siddharthnagar district, year 2017

1. Introduction

Recurring floods in the rivers of Uttar Pradesh State annually affects about 2.7 million hectares of land, more than 21.1 millions of people in addition to causing damages of worth INR 4.3 billions. More than 30 percent of the total geographical area of eastern, western and central regions of Uttar Pradesh State is prone to flooding. Repetitive floods not only derail the poverty alleviation efforts but also bring down the growth of the State economy. Floods besides affecting the progress of the people and certainty of ongoing investments, also discourages future expenditure plan in the region. Rapti and their tributaries (Burhi Rapti, Banganga, Kunhra-Ghonghi, Jamuaar, Tilar, Rohini, Mohaw, Chandan, Ami and Gurra) are flooded almost every year. These are highly flood-prone, bringing frequent floods in eastern part of the state causing huge loss of physical human and animal resources. More than 9060 villages and 1.8 million hectare of land has been affected by flood in Rapti basin. Many marginal embankments have been constructed in the Rapti Basin keeping in view the ferocity of flood hazard. Even the Rapti river and its tributaries are extensively wrapped yet flooding in the basin continues to occur. This has made imperative the call for a comprehensive approach involving both structural and non structural measures in the basin.

2. Study Area

Siddharthnagar district (**Fig 1**) is situated in eastern part of the state, eastern tarai zone of Uttar Pradesh. The district lies between 27^0 N to 27^0 28' N and 82^0 45' E to $83^0$10'E. It is part of Purvanchal region of Uttar Pardesh. It is surrounded by Maharajganj on the east, Basti and Sant Kabir Nagar on the south, and Balrampur on the west. The area of the district is 2895 Sq. Km.

It is south of Nepal Himalaya. The area is known as Tarai. The most of land are fertile, main crop rice, wheat, Sarson & potato. Kalanamak variety of rice very popular. The District agriculture depends upon rain water and weather; most of season gets good weather & rain water. The forest cover area is 2396.92 hectare which accounts for only 0.87% of total district area.

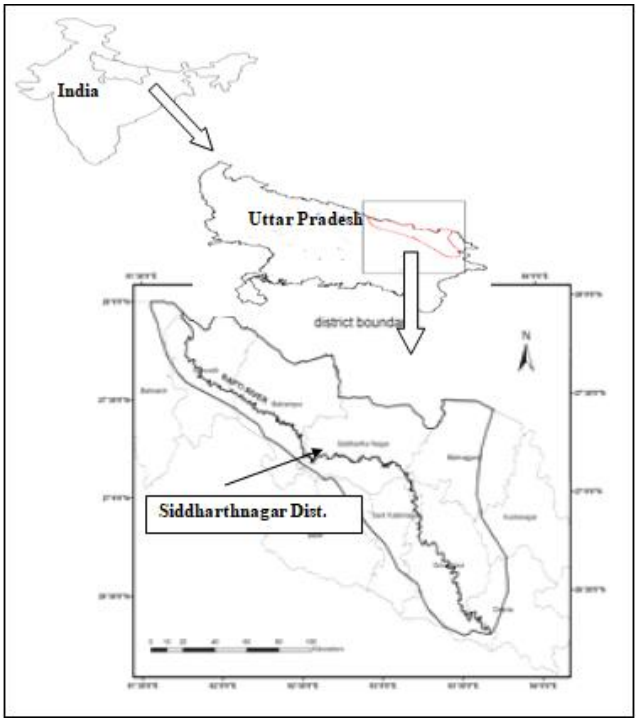


Figure 1

3. Administrative Setup

The district was created on December 29th 1988. The seat of district administration is Naugarh. For administrative purpose the district has been divided in to 5 tehsils, 14 Blocks. The 05 tahsils are namely, Itwa, Naugarh, Dumariyaganj, Bansi and Shohratgarh and the 14 Development Blocks are namely, Barhni Bazar, Shoharatgarh, Jogia Khas, Birdpur, Naugarh, Uska Bazar, Lotan, Bansi, Mithwal, Khesraha, Bhanwapur, Itwa, Khuniyaon and Domariyaganj (**Table 1**). The rural area is

2837.9 Sq. Km. and urban area is recorded 57.1 Sq. The total population of the district is 25, 59, 297 out of which 23, 98, 606 is rural and 1, 60, 691 is urban population.

Table 1

S.N.	Block Name	Population (Rural)
1	Jogia	132316
2	Bansi	152352
3	Uska Bazar	108819
4	Bhanwapur	211290
5	Itwa	183589
6	Barhani	145957
7	Khuniyaon	214464
8	Naugarh	169801
9	Domariaganj	274809
10	Mithwal	211562
11	Shohratgarh	134704
12	Birdpur	164892
13	Khesraha	193251
14	Lotan	100800
	Total	2398606

Source: Census of India 2011

4. Geomorphology

Siddharthnagar district is part of the Indo-Gangetic plain in North India. It slopes gradually from north-west to south-east. The elevation of the district varies from 290 ft to 261 ft above the mean sea level. The middle part of the district is deep in the east area.

On the basis of geology, soils, topography, climate and natural vegetation, the district is subdivided into the following three regions:

1) Tarai
2) Rapti Flood Plain
3) Uparhar Plain

1) Tarai

This region is situated in the northern part of the district touching boundary between India and Nepal and its extent in the south is delimited by the Rapti River. Numerous streams with shifting course are the main physical characteristics of the region. The main rivers flowing here are Burhi Rapti, Banganga, Jamuaar, Budhiyar, Telar, Kunhra-Ghonghi etc. Besides, there are numerous small rivulets which originate from the main river and after draining for some distance again join the mother stream. Such type of drainage characteristics are observed in Tarai tract only. In the western part of this region the ground rises gradually and forms a water divide zone of the Rapti and Burhi Rapti. The eastern part is crossed by numerous streams. In order to protect from erosion flood water of the Kunhra-Ghonghi river an embankment has been constructed along its course (**Fig 2**). There is a chain of natural levees parallel to the Burhi Rapti which indicates its old course. A marked variation in the slope of the area is also observed. Towards the east of the Burhi Rapti, the slope is from north to south where as on the western side of it fallows the course of Burhi Rapti towards south. There are number of large size depressions or Tals in the region.

2) Rapti Flood Plain

The region is situated on both sides of the river Rapti in the form of Strip. The north - south extent of this plain is delimited by the flood limit of the Rapti river. In western side this plain is narrow and there is a sudden change in the elevation of surface. In the eastern side the raised surface has a number of Jhils or Tals and the area is widened. There are numerous tracts of the changing course of the Rapti river which is notorious for its flood. Such old channels exist in the form of small rivulets and drain parallel to the main channel. Burhi Rapti, Kunhra, etc. are the other rivers which join the Rapti in to left bank whereas right bank streams are absolutely absent because of the raised surface. High embankments have been constructed along the Rapti to protect the neighbouring area from flood water. Besides, there are a number of oxbow lakes, Jheels and Tals by the sides of the river.

3) Uparhar Plain

The region covers the southern part of the district. The plain is locally known Uparhar which is formed by the older alluvium and as such has a raised surface which touches the newer alluvium surface of the Rapti river bank. It is fertile and rich in agriculture.

5. Drainage

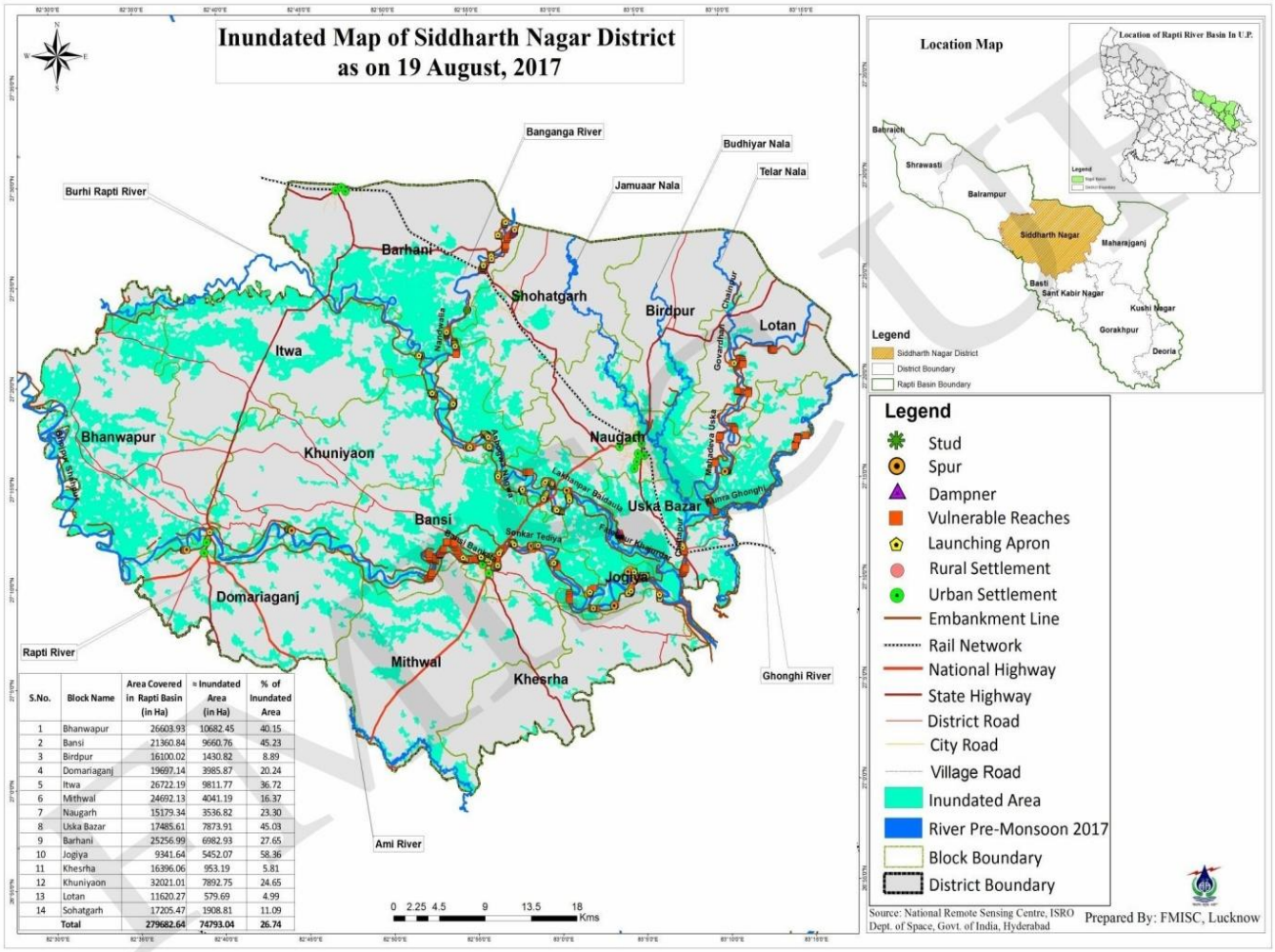
Siddharthnagar has an alluvial plain, densely populated and in most parts highly cultivated though the level is only broken by the shallow valleys of the Rapti and Burhi Rapti, which generally run in a west to easterly direction, the surface of the region has a gentle slope from the north and west to the south and east. The mean elevation is about 290 feet above the mean sea level. The length of the River Rapti in the district is 207.56 km. and that of Burhi Rapti is 88.50 kms.

6. Rainfall

Table 2

Rain (mm)	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
2014	4.0	3.0	0.0	0.0	11.0	130.5	199.3	280.6	197.2	135.9	0.0	0.0
2015	18.5	0.0	12.8	22.0	6.0	161.9	160.4	300.5	13.2	11.5	0.0	0.0
2016	0.0	0.0	0.0	0.0	40.0	145.2	336.9	38.0	129.7	29.7	0.0	0.0

Source: Indian Meteorological Department



S.No.	Block Name	Area Covered in Rapti Basin (in Ha)	Inundated Area (in Ha)	% of Inundated Area
1	Bhanwapur	26603.93	10682.45	40.15
2	Bansi	21360.84	9660.76	45.23
3	Birdpur	16100.02	1430.82	8.89
4	Domariaganj	19697.14	3985.87	20.24
5	Itwa	26722.19	9811.77	36.72
6	Mithwal	24692.13	4041.19	16.37
7	Naugarh	15179.34	3536.82	23.30
8	Uska Bazar	17485.61	7873.91	45.03
9	Barhani	25256.99	6982.93	27.65
10	Jogiya	9341.64	5452.07	58.36
11	Khesrha	16396.06	953.19	5.81
12	Khuniyaon	32021.01	7892.75	24.65
13	Lotan	11620.27	579.69	4.99
14	Sohatgarh	17205.47	1908.81	11.09
	Total	279682.64	74793.04	26.74

Figure 2

Source: FMISC, Lucknow

7. Flood maps and observation

The above mention rainfall data (**Table 2**) clearly indicate that district has surplus and increasing trend of precipitation during monsoon. Heavy rainfall in a monsoon period is one of the main reasons for flood in the district. Relatively high intensity of rainfall causes serious flood and water logging problems. The region is a flat plain. During the rains the main stream is unable to carry the entire water and hence the off shoots originating there from join the main stream in later course. The water during rains flows in the form of sheet rather than gully. The area between Banganga and Burhi Rapti is called Kachhari. It is inundated in most part of the year. Excessive rainfall during the monsoon season connects the drainage system of the whole area and which in turn swells up causing the rivers to overflow creating havoc and devastation in the region.

Flood maps prepared by FMISC, Lucknow (**Fig 2**) based on the analysis of satellite data Radarsat-2 SAR on August 19, 2017 shows major inundated areas, water accumulated in low lying areas, wet areas, rainfall induced floods and isolated patches of waterlogged areas of the Siddharthnagar district. On studying the flood map of Siddharthnagar district on 19 august 2017 (**Fig. 2**), following well marked inundated regions can be identified in the map viz near the confluence of Jamuaar Nala and Kunhra river, strip along Burhi Rapti, area between Banganga river and Burhi Rapti river called Kachhari, area between Burhi Rapti and Rapti river near their confluence and another strip along Rapti river. 26.74 % of the area of Siddharthnagar district was found inundated on 19 august 2017 (FMISC, Lucknow) . The extent of total inundated area is 74793.04 ha. Maximum inundation in terms of percentages is found in Jogia block which is to the extent 58.36%. Next most affected block is Bansi (45.23 %) followed by Uska Bazar (45.03%), (**Table 3**). Maximum inundation in terms of area is found in Bhanwapur block which is found to be 10682.45 ha. followed by Itwa (9811.77 ha.) and Bansi block (9660.76 ha.).

Table 3

S.N.	Block Name	Area covered in Rapti Basin (In Ha)	Inundated Area (In Ha)	% of Inundated Area	Population (Rural)	% of corresponding population
1	Jogia	9341.64	5452.07	58.36	132316	77219
2	Bansi	21360.84	9660.76	45.23	152352	68908
3	Uska Bazar	17485.61	7873.91	45.03	108819	49001
4	Bhanwapur	26603.93	10682.45	40.15	211290	84832
5	Itwa	26722.19	9811.77	36.72	183589	67413
6	Barhani	25256.99	6982.93	27.65	145957	40357
7	Khuniyaon	32021.01	7892.75	24.65	214464	52865
8	Naugarh	15179.34	3536.82	23.30	169801	39563
9	Domariaganj	19697.14	3985.87	20.24	274809	55621
10	Mithwal	24692.13	4041.19	16.37	211562	34632
11	Shohratgarh	17205.47	1908.81	11.09	134704	14938
12	Birdpur	16100.02	1430.82	8.89	164892	14658
13	Khesraha	16396.06	953.19	5.81	193251	11227
14	Lotan	11620.27	579.69	4.99	100800	5029
	TOTAL	279682.64	74793.04	26.74	2398606	616263

Source: FMISC, Lucknow and Census of India 2011

8. Risk and vulnerability assessment

Jogia, Bansi, Uska Bazar and Bhanwapur blocks are at higher risk in terms of damage and losses. Vulnerability in terms of percentage of inundated area ranges from 40% to 60%. At the same time percentage of vulnerable population is around 2, 79, 960. Itwa, Barhani, Khuniyaon, Naugarh and Domariaganj blocks are at moderate risk to flood and vulnerability ranges from 20% to 40% and the number of population vulnerable to flood is 2, 55, 819 Mithwal, Shohratgarh, Birdpur, Khesraha and Lotan blocks are least affected by flood with vulnerability percentage ranges from 0% to 20%. Vulnerability in terms of population is 80, 484. (**Table 4**).

Table 4

Blocks of district at risk (in terms of damage and losses-)	Vulnerability in terms of (Percentage of inundated area)	Vulnerability in terms of (Population)
Mithwal, Shohratgarh, Birdpur, Khesraha and Lotan	(0-< 20) %- low	80, 484
Itwa, Barhani, Khuniyaon, Naugarh and Domariaganj	(20- <40)%- medium	2, 55, 819
Jogia, Bansi, Uska Bazar and Bhanwapur	(40- <60)%- high	2, 79, 960

9. Flood mitigation measures and Conclusion

One can imagine that absolute protection from flood damage is not physically possible even in future as well because of unpredictability of several natural forces that may bring an unprecedented situation. The reduced run-off would help the chronically flood affected areas. For this purpose construct on of flood detention reservoirs, small check dams on the tributaries to reduce run-off to point of concentration, and sufficient arrangement for fighting flood at vulnerable points with adequate support of flood forecasting and warning system. Embankments have been constructed as remedial measures for the protection of a chronically flood affected area, however due to inadequate maintenance they have been subjected to frequent breaches. Flood management practices in the state have focused on traditional methods of hardware systems, mainly consisting of 2162 km. of marginal embankments, 13, 825 km. drains, and 66 tow and protection works till 2008-09, providing protection to about 1.95 million ha at a total cost of INR 21 billions (FMISC, Lucknow). These structural solutions that have been in the centre of flood management in the past decades are not well maintained and the threat of floods remains as high as ever to the economy and livelihoods of the people in U P. There is a need of paradigm shift from flood control to flood management and following the combination of risk-avoidance and risk-reduction activities so as to bring balance in hardware investments such as embankments with software solutions such as improved flood forecasting and warning systems based on recent global advances in satellite-based climate and flood forecasting.

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