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Assessment of Diara land under Bhagalpur district using remote sensing and GIS tools

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Abstract: The Diara land is found in between the natural levees of the river and formed due to its meandering and course changing behavior. The topography of Diara land is mostly undulating and intersected with numerous dead and disconnected channels, Remote sensing and Geographical Information System (GIS) is a reliable technique to prepare a comprehensive inventory of land use pattern of an area. The present study was carried out to prepare a complete digital map of diara land of Bhagalpur district using spatial software (TNT Mips). On the basis of visual interpretation of the satellite image and physiographic pattern of the land escape, polygons were digitized for area delineation and mapping for diara land. Out of sixteen blocks of Bhagalpur district, only six blocks were identified as an old Diara land (203.26 km^2) and thirteen blocks were identified as a new diara land (869.78 km^2). Occupied areas viz. Narayanpur, Bihpur, Kharik, Naugachhiya, Ismailpur, Rangra Chowk and Gopalpur blocks were identified under complete diara land. No any one Diara land characteristics ware marked in Shahkund, Goradih and Sanhaula blocks.

Keywords: Bhagalpur, Diara land, Digital map, Satelite image

INTRODUCTION

The Diara land is found in between the natural levees of the river and formed due to periodical erosion and deposition of sediments (alluvium) under the influence of meandering and course changing behavior of the rivers. Such a land form is recognized as one of the most valuable natural resources (ICAR, 2005).

The Diara land soils are distributed in an area of more than 11 lakh hectares on both sides of river Ganga, Gandak, Kosi, Sone and subsidiary rivers. The topography of diara land is mostly undulating and intersected with numerous dead and alive streams forming complex type of physiography (ICAR, 2005). Occurrence of flood is an annual feature. The important diara lands are Shankarpur and Chawania. Erosion and depositions of new sediments take place almost every year during the floods. The soils of diara are excessively drained and constitute layered coarse sands to silt. The cultivated lands of diara may be grouped as (i) upland, (ii) medium land and (iii) low land. Upland diara is flooded normally for periods varying from a few days to a month between mid-august to mid-September. Medium lands are flooded for periods varying 1 to 3 months during rainy July to October. Low lands are flooded for more than 3 months during rainy season. The flood fluctuation and repetition depends on time, intensity and duration of rain in the catchments of the Ganga and its tributaries. On uplands crops can be taken for 10-11 months if assured irrigation is provided and in medium land cultivation can be done for 9 months (2 crops can be taken) but low land diara, where crops can be taken for only 7 months. Since crop is being taken in this area as this land remains wet in Rabi and gets too dry during summer.

Remote sensing has proved to be the most efficient, economical and reliable technique to prepare a comprehensive inventory of soil resources and land use pattern of an area (Venkatratnam, 1980; Patel *et al.,* 2001) and detection of special and temporal changes in these resources (Manchanda *et al.,* 2002; Mini *et al.,* 2007).The present study was carried out for assessment of diara land under Bhagalpur district, Bihar using spatial software (TNT Mips).

MATERIALS AND METHODS

Study area: The study area i.e. Bhagalpur district (2612.55 km^2) is distributed in Bhagalpur division of Bihar. It lies between 25 ^{0}12'N and 25^{0}32'N and 46^{0}42'E and 47^{0}32'E. The River Ganga separates north Bhagalpur from south Bhagalpur (Fig.1) .The area south of Ganga comprises the major portion of the district with generally plain surface, comprising nine blocks known as Sultanganj, Shahkund, Nathnagar, Jagdishpur, Gaura dih, Sabour, Sanhaula, Kahalgaon and Pirpainty.The portion north of the Ganga is comprised of the seven Blocks i.e. Bihpur,

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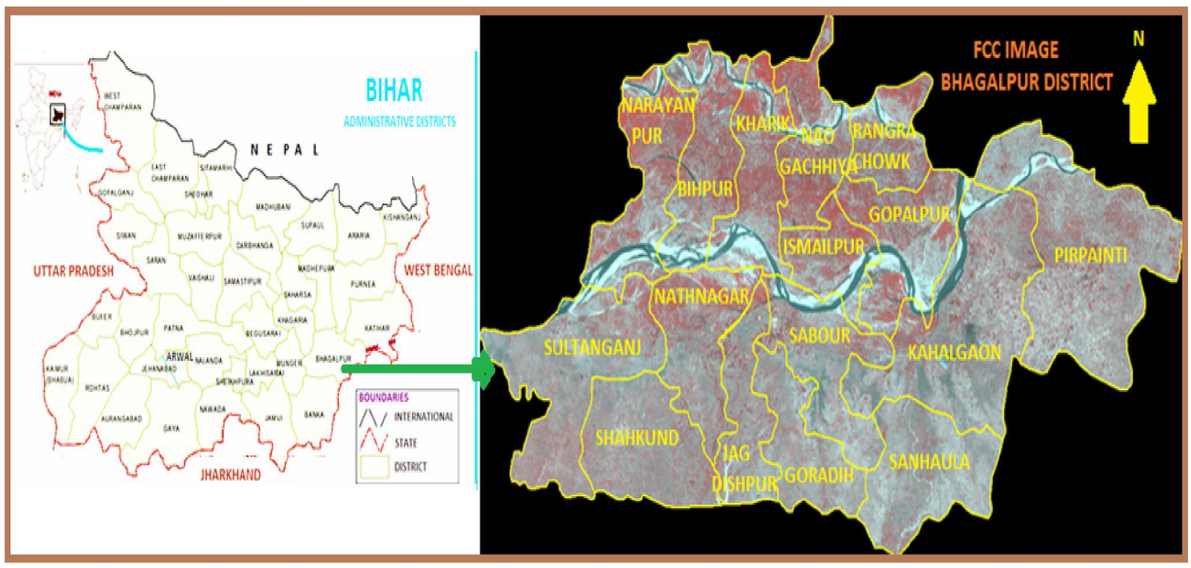

Fig.1. *Location of Bhagalpur district and its False Color Composite (FCC) image.*

Narayanpur, Kharik, Naugachhia, Rangra, Gopalpur and Ismailpur under Naugachhia Subdivision. The land under the Naugachhia subdivision is almost fertile and known for the principal centers of trade in grain specially Maize and Banana in the state of Bihar. The whole areas under Bhagalpur district is a part of vast alluvial plain intersected by a number of small rivers Chanan, Badua and Kosi rivers. The Chanan and Badua rivers have been originated from the southern part of the hills and plateau regions of Santhal Pargana of Jharkhand state. The Ganga across from west to east in middle portion of the district and provides a large drainage pattern association with Chanan and Barua rivers. The relief of the whole district is almost normal.

Image processing: Geo-coded False Color Composite (FCC) image of IRS LISS III, 2010 were used to delineation of the diara land with adequate ground truth on 1:50000 scale topo sheet (National Remote Sensing Centre, ISRO). The land form is characterized by polygons features in shape file of old and new diara land based on tone, texture, pattern and morphological expression of the relief features.GPS and topo sheets were used for ground truthing. Spatial software (TNT Mips) was used for image processing and mapping in computer system.

Soil analysis: The soil samples were collected according to the method described by Jackson (1973). For knowing the various physico-chemicals properties, the soil samples were analyzed with standard laboratory procedures. Soil – water suspension of 1:2.5 were used for soil reaction (pH) with a pH meter as described by

Table 1. Diara land areas under different blocks of Bhagalpur district.

Blocks	Geographical area (km^2)	Old diara land (km^2)	New diara land (km^2)	River bed (km^2)
Narayanpur	144.27	42.51	91.55	10.21
Kharik	131.57	41.92	77.46	12.19
Bihpur	152.08	37.07	103.84	11.17
Naugachhiya	106.70	51.31	53.31	2.08
Rangrachowk	119.94	20.42	97.21	2.31
Gopalpur	132.57	10.03	117.25	5.29
Pirpainti	350.06	0.00	41.03	3.11
Colgong	335.84	0.00	37.65	8.91
Ismailpur	82.69	0.00	73.61	9.01
Sabour	114.95	0.00	38.21	7.32
Nathnagar	126.08	0.00	73.19	1.31
Sultanganj	219.24	0.00	43.74	1.76
Shahkund	168.18	0.00	0.00	0.00
Goradih	144.25	0.00	0.00	0.00
Jagdishpur	109.93	0.00	21.73	1.22
Sonhaula	174.20	0.00	0.00	0.00
Total	2612.55	203.26	869.78	75.89

Fig.2. *Diara land derived from FCC image of Bhagalpur district.*

Jackson (1973). Calcium carbonate ($CaCO_3$) was determined by Piper (1942) rapid titration method. Organic nitrogen determination was done by Bremner, 1965. Available phosphorous was estimated by Olsen (1954). For color estimation, Munsell soil color charts were used.

RESULTS AND DISCUSSION

District boundary with blocks were digitized in polygons for separation of the study area using traced district map then plotted on FCC image for separation of the area of interest (AOI) from image. Map of diara land was prepared after interpretation of satellite imagery in conjunction with field checks.

Image interpretation units having characteristics were grouped into two mapping units (old and new Diara land) and digitized in polygons. Area releted to diara land was filled in attribute table for calculation and analysis. Out of sixteen blocks in Bhagalpur district only six blocks were identified as a old diara land (203.26 km^2) and thirteen blocks were identified as a new diara land (869.78 km^2) (Table 1). Increment in diara land area was from 7% to 33% of geographical area of Bhagalpur and maximum new area comes under Gopalpur block i.e 107.22 km^2.

Narayanpur, Bihpur, Kharik, Naugachhiya, Ismailpur, Rangra Chowk and Gopalpur blocks were identified under complete diaraland. No anyone diaraland characteristics ware marked in Shahkund, Goradih and Sanhaula blocks (Fig. 2).

Soils and agriculture in Diara land: Soils are considered as the integral part of the landscape and their characteristics are largely governed by the landforms, on which they have developed (Sharma *et al.*, 1999). Soil series in the surveyed areas are Kamlakund, Milki, and Motichak (Soil survey report, 2012). Soils of Kamlakund series are light throughout the profile and are of recent origin. They remain inundated during rains. Every year sand or silt is deposited according to the height and velocity of flood water at the place. Water dries up quickly after rains. pH is alkaline and percentage of free calcium carbonate varies between 5 and 16. Percentage of organic nitrogen varies between traces to 0.09 and that of available phosphorous between 2 to 10 parts per million. Color varies between pale Olive to Olive grey.

Soils of Milki series are of recent origin. Surface soil consists of medium soils underlain by medium and light. These are slight to moderate alkaline and percentage of free calcium carbonate in less than 5%. The soils are mostly under direct influence of the rivers and subjected to flood annually. The colour varies between brownish grey to Olive grey. Organic nitrogen content varies between 0.05 to 0.1 % and available phosphorous between 2 to 14 parts per million.

Motichak series is characterized by light textured surface soil underlain by medium textured sub-soil or vice-versa.the soils are of recent origin and occur in the vicinity of rivers. pH is alkaline and percentage of free calcium carbonate is less than 5. Colour varies between pale yellow to olive grey. This corroborates the findings of soil survey report (2012).

Agriculture: Maize, the most important crops of the area covers the highest proportion of the gross sown area. The cultivation of maize crops depends upon the situation of flood. It is sown very early (in the month of last April to May) depends upon rains. In Rabi season, wheat and maize are generally grown in irrigated area where as pulses like gram, pea, mustard, lentil, kalai *etc.* are taken in non-irrigated areas. Among vegetables parwal, tomato, potato and brinjal are also grown in the surveyed areas.

Banana cultivation is famous of these characterized soils.

Conclusion

The study demonstrated the potentiality of satellite remote sensing technique for preparation of more consistent and accurate baseline information on diara land. Out of sixteen blocks of Bhagalpur district, only six blocks were identified as a old diara land (203.26 km^2) and thirteen blocks as a new diara land (869.78 km^2). Occupied areas Narayanpur, Bihpur, Kharik, Naugachhiya, Ismailpur, Rangra Chowk and Gopalpur blocks were identified under complete Diara land. No more Diara land characteristics were marked in Shahkund, Goradih and Sanhaula blocks. The study revealed that the Diara lands of Bhagalpur district have potential for agricultural uses. However, such area can be utilized in a better way for development of agro forestry orchards and recreation zones (heritage).

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