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Assessment of Flood Induced Area using Geo-Spatial Technique

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Abstract: In this present study flood induced area of Banki and Banki-Dampara block, Cuttack, Odisha, India have been extracted by using geo-spatial technique. We extracted flooded area by using image interpretation method on Landsat ETM+ satellite imagery. To extract flood water in the study area we taken satellite data of 11th Sep 2011. The total flooded area was 178.31 km^2 in Banki and Dampara block of Cuttack District, Odisha, India.

Keywords: *Geo-spatial technique, Landsat satellite imagery and flood*

1. Introduction

Mahanadi, one of the major river flowing in the Odisha State and its tributaries has the potential to cause very severe. The Mahanadi river basin in eastern India is highly populated and major paddy growing region in the state of Orissa. Floods are a frequent phenomenon occurring in this part of the state during monsoon period (June-October), which causes severe damage to crops as well as lives (Patro, 2009). The coastal deltas of the river basins of Mahanadi, Brahani, Baitarani and Subarnarekha experience recurring flood, water logging and saline inundation. In consequence, extensive crop areas are damaged in the coastal districts of Puri, Cuttak, and Balasore. According to the crop damage analysis made by the National Commission on Flood for the period 1955-70, on the average, the affected crop area accounted for about 40 percent of the State's total area, annually affected by flood (Planning Commission, 1981). Cuttack district is highly prone to natural disasters like flood and cyclone due to its geographical location. An unprecedented super cyclone affected this district during 1999 and flood in major rivers in the year 1972, 1973,1975,1978,1980, 1982, 1984, 1991, 1999, 2000, 2001, 2003, 2006, 2008, 2011 causing heavy loss to lives and property (EOC, 2013).

Remote sensing satellite data is highly useful for flood mapping and management in India (Mohapatra and Singh, 2003; Jain et al., 2005; Chandran et al., 2006). Satellite data is an indispensable tool for vulnerability assessment of human settlements and disaster management (Gupta and Singh, 2005; Sanyal and Lu, 2005). This present study describes the procedure for mapping flood inundated areas using Landsat satellite data during Cuttack, Odisha flood. This would be very useful information for disaster response and mitigation.

2. Literature Review

Geo-information science and earth observation are the combination of tools and methods those are useful for the collection, storage, processing and distribution of geo-spatial data. The integrated use of Geographic Information system (GIS) and Remote Sensing (RS) has been performing a very important role in monitoring, controlling, relieving and assessing natural disasters, especially flood disasters (Monrroy, 2005).

Application of remote sensing techniques for flood related studies has established great attention especially during the last decade all over the world. GIS have extensive possibility for improving disaster management as they offer more efficiency and speed in the input, management, manipulation, analysis and output of data/information (Montoya, 2002). Thus, GIS is almost compulsory tool in hazard and risk assessment. Besides, the use of satellite (Remote Sensing data) data has become a normal input to hazard and risk assessment projects.

It is very difficult to get the cloud free satellite imagery during the time of floods, in this case, microwave data can be used successfully as it has penetration capacity through the clouds. Synthetic Aperture Radar (SAR) from ERS or RADARSAT satellite provides this type of advantage of space imagine in adverse weather condition (Bakimchandra, 2006). Even there is another important significance to use multispetral and panchromatic data with up to 1 meter spatial resolution.

Recently Cartosat 1 (panchromatic band) has quite popular in India as 2.5 meter high resolution satellite imagery. For community based flood risk assessment, high temporal resolution (AVHRR/NOAA/ RADARSAT) Sensing data provide daily flood situation throughout the country during the flood season, These types of data are useful for flood extent maps at peak of low time of flooding (Shamaoma, 2005).

The application of satellite captured earth observation imagery for monitoring and numerous crisis situations. Right after its launching in December 1999, MODIS satellite with its moderate-resolution

optical sensor of 250–500 m becomes useful tools for scientific studies and research (Sun and Yu, 2010).

In the past few years, various researches have used the hydrodynamic modelling approach to simulate flood inundation in the floodplains (Werner, 2004; Bates et al, 2005). Various numerical models have been developed for floodplain delineation/flood inundation and flow simulation which may be used as tools to delineate the floodplain zones bordering the rivers and calculate the associate risk considering hypothetical floods of various return periods. These numerical models are categorized into (a) one-dimensional (1D) models, (b) two dimensional (2D) models, and (c) one-dimensional river flow models coupled with two-dimensional floodplain flow (1D-2D) models (Patro et al., 2009).

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Dartmouth Flood Observatory (DFO, 2006) uses near real-time satellite remote sensing data to detect, map and measure all world-wide flood events. DFO releases World Atlas of Flood Hazard that illustrates river floods observed by MODIS, Landsat7, Radarsat, NOAA-AVHRR (Advanced Very High Resolution Radiometer) and other satellites since 1985. DFO produces inundation limits in vector GIS (Geographic Information System) format for the world (http://www.dartmouth.edu/~floods/ Modis.html).

3. Study Area

Banki and Dampara is located in the Indian state of Orissa at the Cuttack district. Banki - Dampara is a Tehsil in Cuttack District of Odisha State, India. Banki- Dampara Tehsil Head Quarters is Dampara town. It is located 34 KM towards west from District headquarters Cuttack. 31 KM from State capital Bhubaneswar towards East. Banki- Dampara Tehsil is bounded by by Banki Tehsil towards west, Tigiria Tehsil towards west, Athagad Tehsil towards North, Khordha Tehsil towards South. Bhubaneswar City, Khordha City, Jatani City, Cuttack City are the nearby Cities to Banki- Dampara. It is in the 24 m elevation (altitude). It is Hot in summer. Banki- Dampara summer highest day temperature is in between 30° C to 42°C Average temperatures of January is 21 ° C , February is 24 ° C , March is 29 ° C , April is 31 ° C , May is 32 ° C.

4. Data and Software Used

Topographic maps 73H/7, 73H/11and 73H/15 published in the year 2009, 2010 and 1976 respectively and having the scale of 1:50,000, were acquired from survey of India, Bhubaneswar, Odisha and used to extract different types of info-layers: administrative boundaries, rivers and water bodies. Landsat satellite data were acquired and used to map flood inundated areas. The Landsat data of the study area were provided by NASA at the location: (http://earthexplorer.usgs.gov/) Erdas Imagine 2014 and ArcGIS 10 were used for processing and analysis.

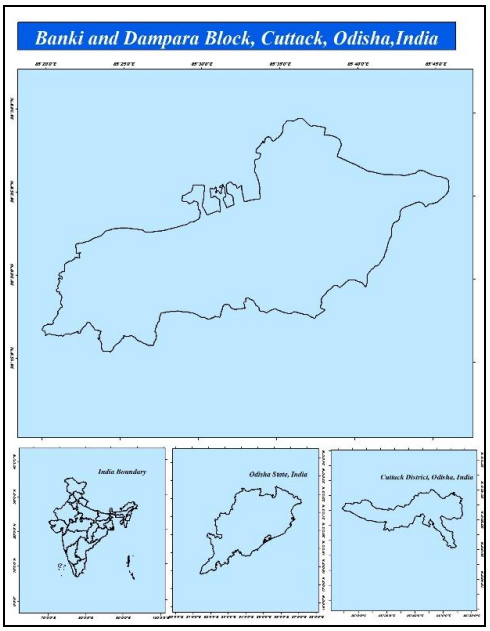

Figure1 *Location of the study area*

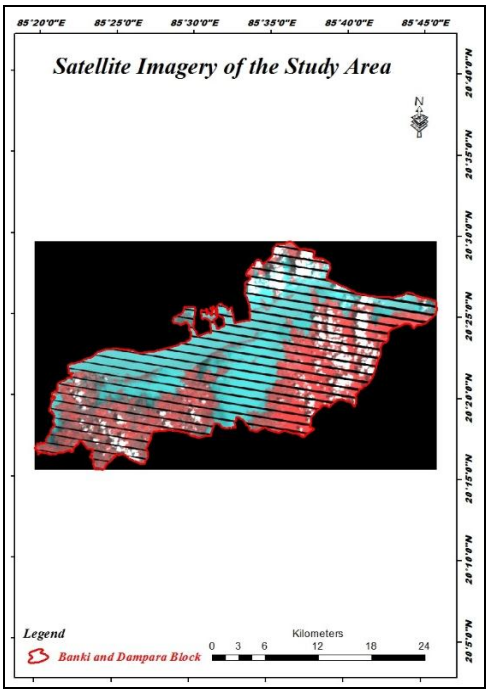

Figure 2 *Satellite image of the study area*

5. Methodology

The topographic maps were used to extract the water bodies and river. Landsat 7 images were acquired from NASA's website were having UTM projection and WGS 84 datum. Study area was extracted by using ERDAS IMAGINE software. Further, the flood inundated areas were identified by visual image

interpretation technique and flood induced maps were prepared in ArcGIS software. We excluded the water bodies from the flooded area. Flow chart of the methodology adopted in this study is shown in fig. 3.

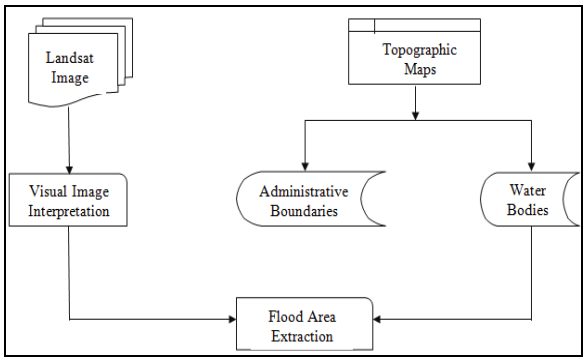

Figure 3 *Flow chart of methodology*

6. Results and Discussion

During floods, timely and detailed situation reports are required by the disaster management authorities to locate and identify the affected areas and to implement the corresponding damage mitigation; this is the most delicate management category since it involves rescue operations and the safety of people and property (Jeyaseelan, 2004). In this regard flood extent maps were prepared. It was found that, flood occurred in Cuttack district, Odisha and many blocks and villages of the district were submerged in flood water including Banki and Banki – Dampara block (Figure 4). It is clear from the figure 4 that, most of the area of Banki and Banki Dampara block were affected by flood water in the year of Sep, 2008. The flood water affected people, agricultural land and settlements etc. The total flooded area was 178.31 km^2 of Banki and Dampara block of Cuttack District, Odisha, India. Figure 5 is showing Mahanadi River, Water bodies and flood induced area of Banki and Banki – Dampara Block. We extracted water bodies and River from the flood water.

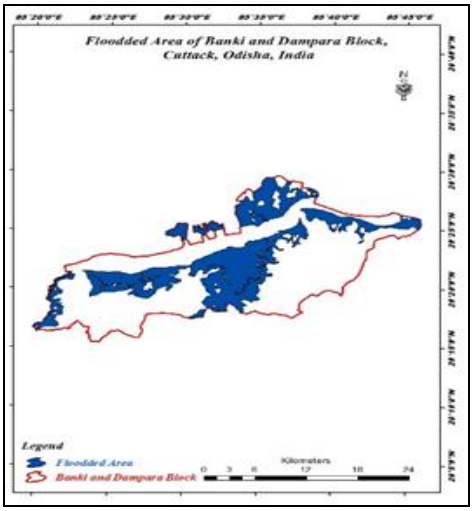

Figure 4 *Flood induced map of Banki and Dampara Block, Cuttack, Odisha, India*

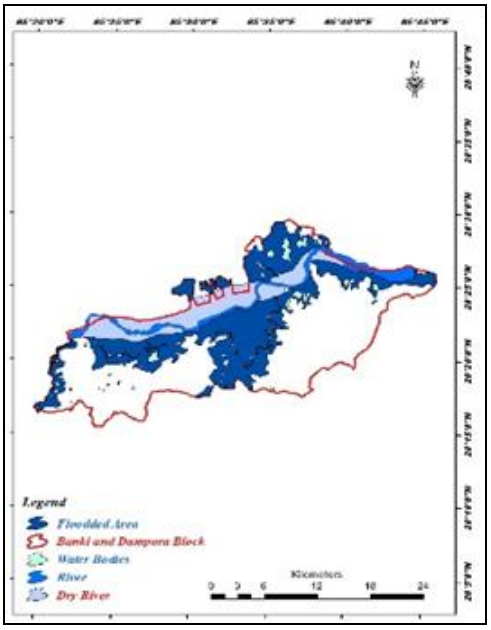

Figure 5 *Map is showing river, water bodies and flodded area of Banki and Dampara Block, Cuttack, Odisha, India*

7. Conclusion

In this present study we extracted the flood induced area of Banki and Banki – Dampara Block, Cuttack district, Odisha. To extract the flood induced area we used Landsat ETM + satellite imagery. We found that most of the portion of Banki and Banki – Dampara Block were submerged in flood water. The main cause of flood in the study was overflow of Mahanadi River. Based on the results of the study we concluded that, flood monitoring using satellite data proved to be an effective method to get quick and precise overview of flooded areas (Haq, 2012). In the study, flood affected areas were identified using Remote Sensing (RS) & Geographical Information System (GIS). It was found that, the process just required a few hours. The methodology used in this study has the capability to extract flood induced area.

References

[1] T. Jeyaseelan, "Droughts & floods assessment and monitoring using Remote Sensing and GIS", Satellite Remote Sensing and GIS Applications in Agricultural Meteorology, 291–313, 2004.

[2] DL Sun and YY Yu, "Deriving water fraction and flood map with the EOS/MODIS data using regression tree approach", IAPRS 38 (7b) 552-556, 2010.

[3] H. Shamaoma, "Extraction of Flood Risk-Related Base-Data from Multi-Source Remote Sensing Imagery", International Institute for Geo-information Science and Earth Observation and Utrecht University, Enschede, The Netherlands, 2005.

[4] J. Sanyal, and X.X. Lu, "Remote sensing and GIS based flood vulnerability assessment of human

settlements: a case study of Gangetic West Bengal, India." *Hydrol. Process*, 19(18): 3699-3716, 2005.

[5] M. Haq, M. Akhtar, S. Muhammad, S. Paras, and J. Rahmatullah, "Techniques of Remote Sensing and GIS for flood monitoring and damage assessment: A case study of Sindh province, Pakistan", The Egyptian Journal of Remote Sensing and Space and Sciences 15, 135-141, 2012.

[6] O. Bakimchandra, "Reconstruction of the 2003 Daya River Flood, using Multi - resolution and Multi-temporal Satellite Imagery", International Institute for Geo -information Science and Earth Observation and Utrecht University, Enschede, The Netherlands, 2006.

[7] P. K. Gupta, and A.P. Singh, "Disaster management for Nandira watershed district Angul (Orissa) India, using temporal Remote Sensing data and GIS", Environ. Monit. Assess, 104 (1-3): 425-436, 2005.

[8] P. K. Mohapatra and R. D. Singh, "Flood management in India", Nat. Hazards, 28 (1): 131-143, 2003.

[9] R. V. Chandran, D. Ramakrishnan and V. M. Chowdary, "Flood mapping and analysis using air-borne synthetic aperture radar: A case study of July 2004 flood in Baghmati river basin, Bihar," Curr. Sci., 90(2): 249-25, 2006.

[10] S. K. Jain, R .D. Singh, and M.K. Jain, "Delineation of flood-prone areas using remote sensing techniques", Water Resour. Manag, 19 (4): 333-347, 2005.

[11] S. Patro, C. Chatterjee, S. Mohanty, R. Singh, and N. S. Raghuwanshi, "Flood Inundation Modeling using mike flood and remote sensing data", J. Indian soc Remote sensing 37:107-118, 2009.

[12] District Disaster Management Plan, Emergency Operation Centre (EOC), Cuttack Odisha, 2012-2013.

[13] Rapid Baseline Assessment - Cuttack District, Ministry of Urban Development (MOUD), Government of India, 2013.

[14] Report on Development of Chronically Flood Affected Areas, Planning Commission, Government of India, New Delhi, 1981.

[15] National Centre for Atmospheric Research (NCAR), "Study on Super Cyclone in Odisha", 1999.

[16] L. A. Montoya, "Urban Disaster Management: A Case Study of Earthquake Risk Assessment", International Institute for Geo-information Science and Earth Observation and Utrecht University, Enschede, The Netherlands, 2002.

[17] P. Monrroy, "Flood Vulnerability Assessment: Structural, Social and Economic Aspects Case Study: Naga City", Philippines International Institute for Geo - information Science and Earth Observation, Enschede, The Netherlands pp. 104, 2005.

[18] Dartmouth Flood Observatory (DFO), http://www.dartmouth.edu/~floods/, 2006

[19] http://earthexplorer.usgs.gov/