ISSN No-2231-5063 Vol.1,Issue.XII/June 2012pp.1-4

Research Paper

GIS IN UNDERSTANDING HUMAN ELEPHANT CONFLICT AND IT'S MANAGEMENT

Amit Sharma, Hiten K. Baishya, Anupam Sarmah, Soumen Dey, Gopala Areendran and A.C. Williams
NBL Conservation Programme, WWF India, Parvati Nagar, Tezpur Assam, India 784 001

ABSTRACT

The North Bank Landscape is an ongoing program for the conservation of large mammals specially Elephants and Rhinoceros undertaken by WWF as a part of its AREAS (Asian Rhinoceros and Elephant Action Strategy). This landscape based conservation program is implemented by WWF India in North East India nineteen districts in the states of Assam and Arunachal Pradesh in North East India since the year 2000. This area is considered as a strategic conservation zone, comprising of Asian elephants, Indian rhinoceros, Indian tiger, Pigmy Hog, Hispid Hare and a host of endangered species. The landscape's biodiversity values have been internationally recognized, and find a place in WWF's Gobal 200 Ecoregion (Eastern Himalayas). A study by the North Bank Landscape (NBL) Conservation Programme has revealed that the forests of the Pakke – Nameri complex in the North Bank Landscape are amongst the world's richest (Gillison, 2004).

Keywords – Conservation, GIS, Conflict, Management, Assam, India

In this paper, an attempt has been made to illustrate the use of GIS in the conservation program as a backbone to the different process of multi-data management, generation of visual outputs, analysis & research, decision making, formulation of strategies and influencing policies. The issue of human elephant conflict is a major one in the landscape, and in recent years the conflict has increased in terms of crops destroyed, people killed and elephants killed in retaliation. In the whole landscape 108 humans and 59 elephants got killed between 1996 and 2001. It has been this ongoing crisis which prompted the NBL Conservation Programme team to engage in conflict mitigation activities. This required playing a coordinating role mainly, between local communities, Forest Department, police and other relevant agencies. The process of mapping elephant movement resulting in conflicts in the most trouble torn district of the landscape is presented vividly here. The output generated has been of great help to plan for management of conflict and for the conservation of elephants in the region and this is acknowledged by different sections of the community as well as the forest department.

INTRODUCTION

The North Bank Landscape (NBL) is situated between the North Bank of the Brahmaputra River and the Himalayan mountains harbors one of Asia's largest populations of Asian elephants (Elephas maximus) with an estimated number of 1,800 (2002/03). With an estimated number of 150, the area is of critical importance to the continued survival of tiger (Panthera tigris) as well. The biological significance of the Landscape is further illustrated by the facts that it holds two Endemic Bird Areas (Assam Plains and Eastern Himalayas) and 20 Important Bird Areas. A study has revealed that the forests of this area are amongst the world's richest (Gillison, 2004).

Species often face increasing competition with people for space and resources in most parts of the globe. As a result many come into increasing contacts with humans leading to a conflicting situation, and this is particularly true in the case of large mammals like elephants. The issue of human elephant conflict (HEC) has become very significant as human populations have expanded and encroached upon elephant habitats, particularly in areas where people practice cultivation. HEC may take place in many forms -- crop raiding and property damage; disturbance of normal activities such as travel to work and school; injury or death of humans and elephants (Hoare 2000). HEC occurs almost throughout the elephant range in India and adjoining countries posing a threat to both humans and the elephants alike. This issue is a serious challenge for wildlife managers and conservationists all over. These highlights further the importance to understand the problem thoroughly in order to devise and implement HEC management and mitigation strategies with success.

The continuous and rapid degradation of the natural environment of in the North Bank Landscape due to growth of population resulting in increasing spatial needs and haphazard expansion of developmental activities has resulted in high levels of HEC in many parts of the region. This highlights the need for an accurate, fast and cost-effective means to study the various dynamics in operation in detail at the landscape level to come out with effective solutions. As such, in the present era of information technology, GIS and Remote Sensing has been found to be a very effective tool for proper and prompt management and monitoring of the degrading natural environment and plan measures for HEC management in the North bank Landscape (NBL).

Please cite this Article as : Amit Sharma, Hiten K. Baishya, Anupam Sarmah, Soumen Dey, Gopala Areendran and A.C. Williams, GIS IN UNDERSTANDING HUMAN ELEPHANT CONFLICT AND IT'S MANAGEMENT : Golden Research Thoughts (June ; 2012)

THE STUDY AREA

The North Bank Landscape extends between $89^0 51^/E$ to $96^0 17^/ 24^{//}E$ longitude and from $26^0 10^/ 12^{//}N$ to $28^0 17^/ 29^{//}N$ latitude covering parts of the states of Assam and Arunachal Pradesh in the north east part of India. It is the area between the northern bank of the river Brahmaputra (south), the foothills of the eastern Himalayas (north), Sonkosh River (west) and the Dibang River (east). The total size of the landscape is ca. 40,000 km2 of which about 16,000 km^2 is used by elephants effectively. The area is not only rich in forest resources and wildlife but also has a very long and rich cultural history. The landscape is estimated to have a human population of about 75,00,000 (2001) dominated by people from the Assamese, Bodo, Mishing, Adivashi, Adi, Nyshi, Mishmi, Monpa & Nepali community.

DATABASE AND METHODOLOGY

In NBL multi source data has been used and integrated to a single GIS platform after rectification and processing of the same. Geo-databases of different layers of information have been generated after developing the base maps from existing and reliable sources. Toposheet information of RF 1:250,000 and RF 1:50000 form the backbone of the spatial data bases. The false color composite (FCC) in the form of geo-coded data have been used to generate broad land use / land cover information for the area. Attribute database has been generated mainly from Ground Surveys and also from reliable Government sources. R2V and ArcGis have been used for digital data creation; ArcView GIS and ArcView Spatial Analysis have been used for setting up the NBL GIS for Analysis and mapping; ERDAS IMAGINE has been used for the Image Processing works.

Data primarily used are -

1. Single season multi-date LANDSAT TM data (1990-91).
2. Single season multi-date LANDSAT ETM data (2000-01).
3. Topographic maps covering the area.
4. Forest boundary maps covering the area.
5. Village level map for Sonitpur district.
6. Data generated through GPS surveys.
7. Primary data generated through a variety of field activities.

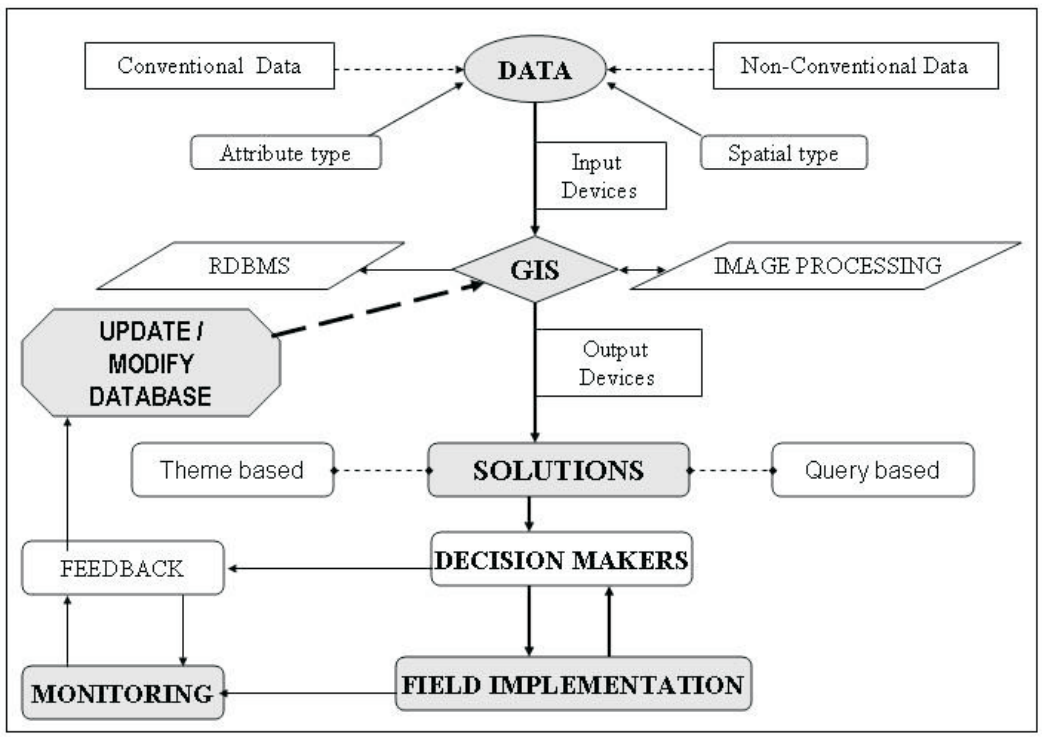

Fig.1 – Schematic model for developing a GIS for HEC management

DISCUSSION

The first aim was to build information on the distribution of the species elephas maximus in the landscape and the occurrence of human-elephant conflict (HEC). For this GPS surveys were done throughout the length and breadth of the area using standard formats. The initial surveys were done from 2001 to 2003 to explore the area especially in terms of occurrence of elephants and human elephant conflict and thereafter the data was integrated into the GIS for analysis, output generation and to ultimately develop a strategy for the management of HEC in the region.

The initial study provided a picture regarding the pattern of conflict in the area as well as the intensity of conflict in the different parts of the landscape. It was found that the species is quite widely distributed in the Himalayan foothill areas and conflict also was quite widespread in the adjoining plains of the Brahmaputra with a couple of high conflict zones. This also helped identify the conflict hotspots in the landscape. The analysis at the landscape level was done based on a 5/ interval grid

Please cite this Article as : Amit Sharma, Hiten K. Baishya, Anupam Sarmah, Soumen Dey, Gopala Areendran and A.C. Williams, GIS IN UNDERSTANDING HUMAN ELEPHANT CONFLICT AND IT'S MANAGEMENT : Golden Research Thoughts (June ; 2012)

system (Fig.2). Changes in the forest cover were also studied for the landscape and it was found that about 65% of the lowland and foothill forest favored by elephants was lost during the period from 1972 to 2000-01 in NBL. Initial analysis showed that Sonitpur district of Assam in the landscape came out to be the most affected area in terms of both HEC as well as loss in forest cover.

As per forest department data about 85 human deaths and 58 elephant deaths were recorded in the district alone in a space of four years from 2000 to 2003. This district was selected among others for studying the occurrence of HEC at the micro level and to develop a strategy thereof for management of the problem. For this conflict hotspot, the analysis was done based on a 1/ interval grid system and on the basis of the revenue villages developed as polygons.

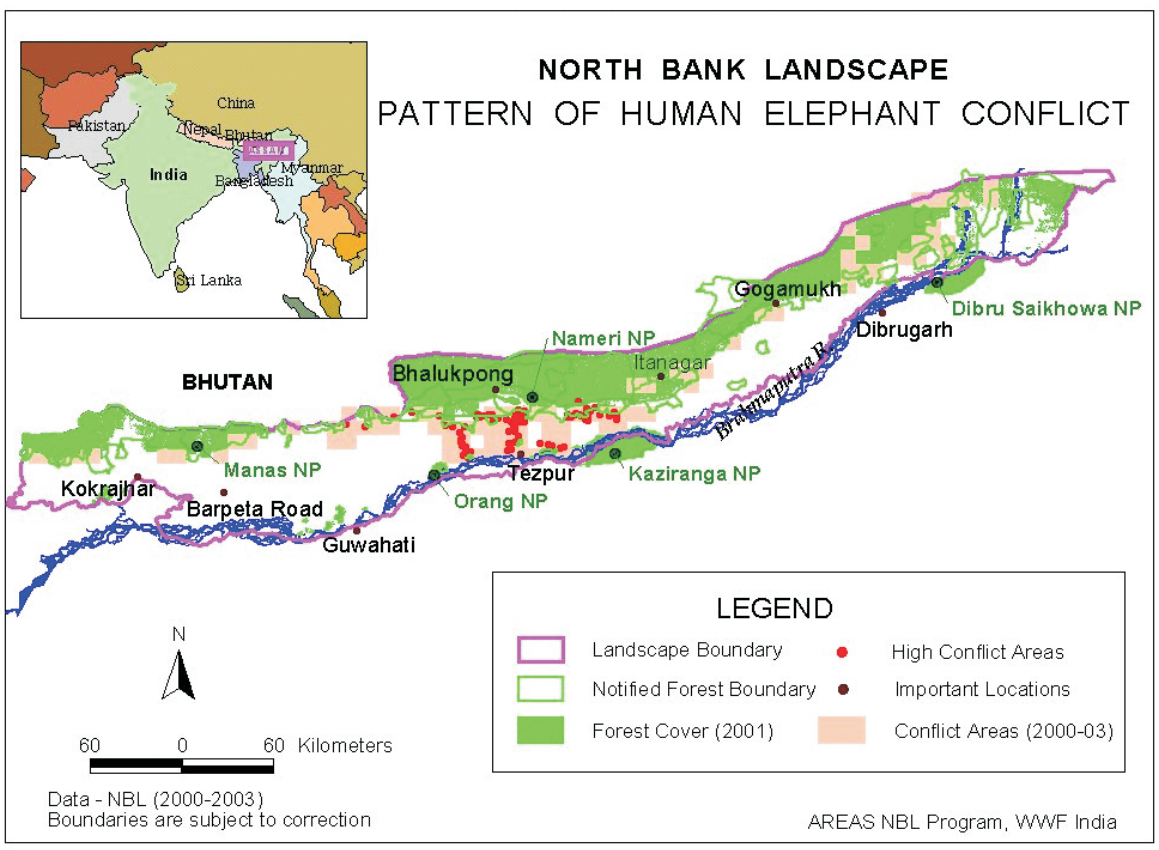

Fig.2 – Conflict scenario in NBL (2000 – 2003)

Monitoring of forest loss was one of the prime activities and it was found that the district had a forest cover of about 11% only in 2000-01 and has recorded a loss of about 6% during the period 1990-91 to 2000-01.

Pattern of conflict was studied in detail for the district during 2003-04 and mapped for better understanding of the problem. Elephants were seen to follow distinct trends to move out from the forest areas in the north to the south through settlement areas which leads to conflict situations. These movement trends of the elephants into the settlement areas are popularly known as the raiding tracks; these were surveyed and tracked using handheld GPS systems. Areas experiencing regular conflict in the district resulting in loss of crops and properties were surveyed and recorded. Locations with previous record of human and elephant causalities were recorded. It was found that during movement from north to the south the elephants cover a distance of about 30kms from the forest fringes up to the banks of the river Brahmaputra. The elephants usually traverse this length during the night and the maximum distance of about 30kms is usually not covered in a single event. A few areas were identified where elephants usually take shelter in the daytime during the period of movement. All these data / information were integrated into the GIS as layers of information for understanding, analysis and planning strategies. It was found that there are two very active and distinct stretches in the district used by the elephants for their movement from the north to the south (Fig.4). One stretch in the western part of the districts are used by the elephants to mainly come out from the forests of Sonai-Rupai, Balipara and Nameri to move to the south up to the river brahmaputra in the south and spend a lot of time in the small riverine islands locally known as chars. The second distinct movement is seen towards the eastern part of the district where elephants from the forests of Beehali move up to the river Brahmaputra (forming part of the 6th addition to Kaziranga NP in the south).

From the analysis it was found that even though conflict was prevalent all throughout the district there are distinct patches where the occurrence was more frequent and intense. Of the seventeen hundred odd villages in the district it was observed that about four hundred of these were highly and frequently affected. One highly affected patch was identified in the western part of the district south of the Sonai Rupai – Charduar – Balipara forest areas; and the second patch was identified in the eastern part of the district south of the Beehali forest areas.

Please cite this Article as : Amit Sharma, Hiten K. Baishya, Anupam Sarmah, Soumen Dey, Gopala Areendran and A.C. Williams, GIS IN UNDERSTANDING HUMAN ELEPHANT CONFLICT AND IT'S MANAGEMENT : Golden Research Thoughts (June ; 2012)

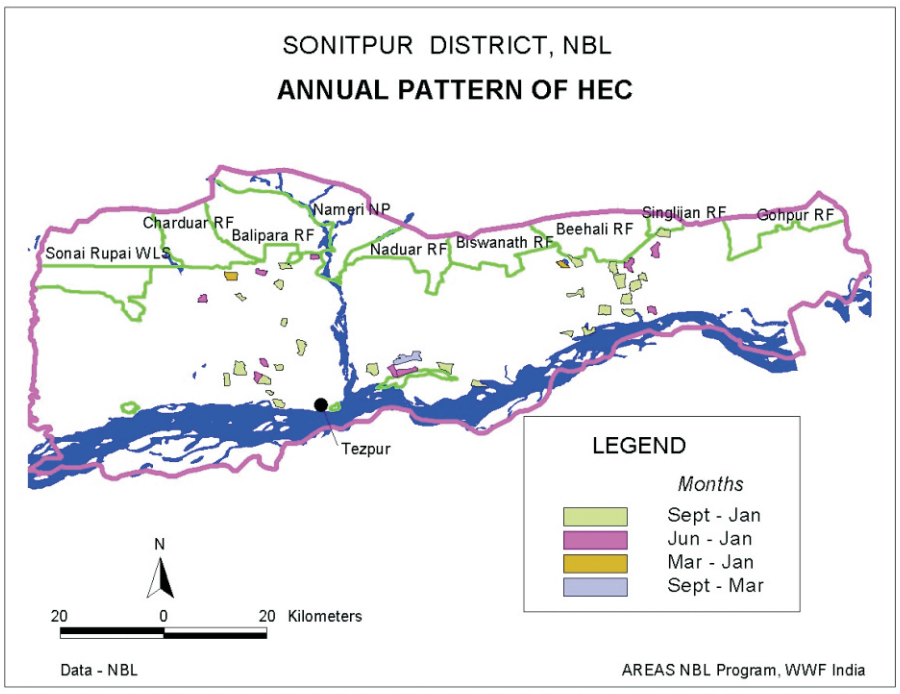

Fig.3 – Annual Pattern of Conflict in Sonitpur district (2003-04)

From field observations it was identified that raiding by elephants usually takes place from the evening hours to the early morning. It was also found that occurrence of raiding is seasonal and is more common during the months from October to January. In December and January 100 percent of the area experiences conflict followed by 97 percent of the area during October and November and August to September are the third most affected months with about 68 percent of the area experiencing conflict (Fig.3). Three distinct raiding pattern has been identified viz. – from the forest and tea garden areas in the north the elephant raids the adjoining crop areas (within a distance of about 3 to 5 kms); from the riverside in the south elephants raid the adjoining crop areas (within a distance of about 3 to 5 kms); and elephants also raid the adjoining crop areas from the spots where they take shelter during the daytime. Crops and property gets damaged apart from human and elephant casualties at times when elephants move from one area to the other during the night. As such for management of the problem in the district the above findings were taken into consideration for devising interventions to contain the HEC levels.

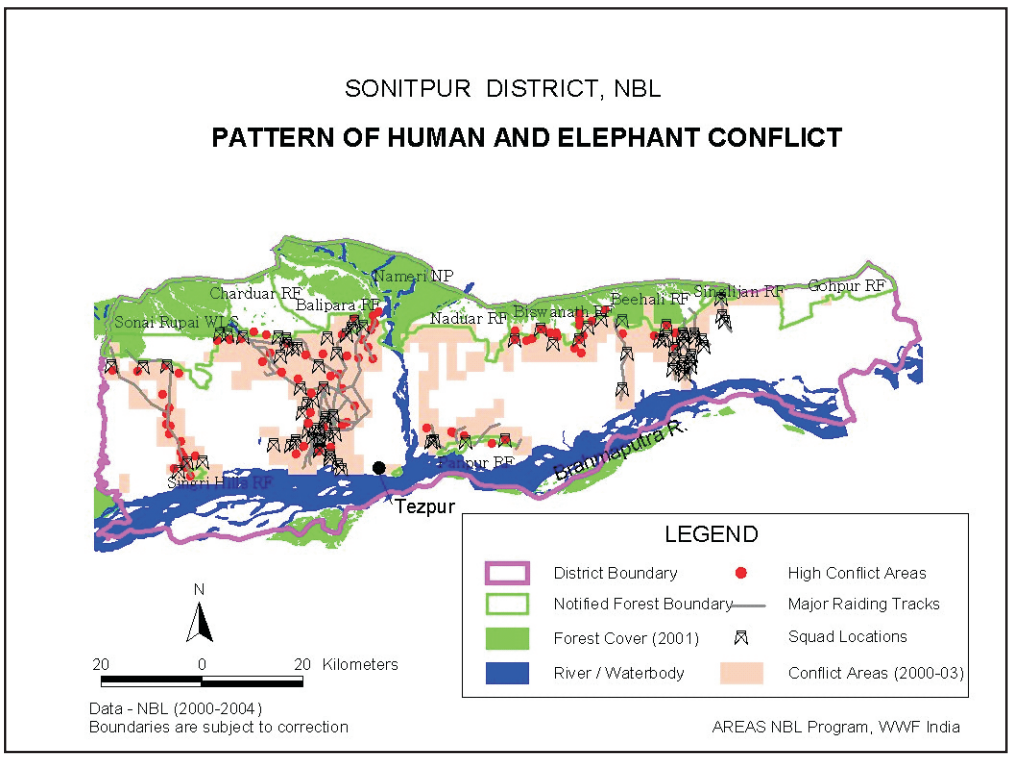

Fig.4 – Conflict pattern in Sonitpur District, NBL (2000-2003)

Please cite this Article as : Amit Sharma, Hiten K. Baishya, Anupam Sarmah, Soumen Dey, Gopala Areendran and A.C. Williams, GIS IN UNDERSTANDING HUMAN ELEPHANT CONFLICT AND IT'S MANAGEMENT : Golden Research Thoughts (June ; 2012)

Discussing the outputs and findings at different levels of the forest department and other stakeholders a strategy for human elephant conflict management was devised for ground implementation. The basic idea was to check the movement of the elephants into the crop fields and settlement area. All major entry and exit points of the raiding elephants were identified and mapped, all major raiding tracks were identified and mapped and all major spots of temporary shelter were identified and mapped. All the above information was super-imposed over the village layer and a buffering analysis was done to identify the most vulnerable villages / areas in the district. After identification of the vulnerable villages the HEC management and mitigation strategy was put into operation covering the identified vulnerable villages with the help and support from the village community and forest department of the state. Village youths trained in anti-depredation operation and armed with necessary equipments for chasing the raiding elephants were placed in identified strategic locations and are commonly identified as the Anti-Depredation squads (ADS). The Kunkie elephants trained for chasing / driving the raiding elephants were also positioned strategically to get the best results (Fig.4).

The mitigation strategy thus developed and implemented with the help of GIS has been put on trial since 2003-04 and is showing encouraging results till date. The GIS based decision support system is in place is updated during every conflict season for keeping a track of the events and for making need based changes to the strategy under implementation on almost a real time basis. The success and failures are assessed at the end of every raiding season to modify and further strengthen the HEC management strategy for the next season. GIS is also used in NBL to analyze the success of the management strategy implemented and find out localized needs of the villages to meet the challenge posed by the raiding elephant herds. As per the analysis done on the basis of community feedback for the raiding season of 2005, the results are very encouraging as in the district a decrease of more than 60% is recorded in terms of both crop and property damage. Even elephant causalities due to retaliation and conflict have shown a downward trend.

CONCLUSION

Even though the results are non-conclusive, yet these are very encouraging and the last three years were quite successful for the program in terms of HEC management in Sonitpur. GIS has a great contribution for the programme not only in terms of data analyzing and strategy building but it terms of the visual power through the outputs generated. The visuals have been a very powerful medium to aware the community and also to get necessary inputs and support from them. The forest department has also realized the benefit and effectiveness of the same and very much appreciates the capability of monitoring and planning through the use of GIS. This process of developing and implementing a HEC management strategy can be considered to be a successful one for the landscape and only a repetition of a similar process in another area will help rate the model effectively.

ACKNOWLEDGEMENT

This work is a part of the WWF AREAS program for the long term conservation of elephants and rhino and we are thankful to WWF US, WWF UK, WWF NL, and the USFWS for the support and encouragement. Thanks are also due to the Department of Forest, Assam for their constant support and collaboration. Thanks to all local organizations and communities that helped us in the field activities and special thanks to Sanjay, Jamir, Sushila, Bulen and Bharali for their untiring assistance in the field. Department of Geography, Gauhati University, Bajali College and National Informatics Centre, Guwahati deserves special mention for their help and collaboration. Last but not the least we would like to acknowledge the contribution of our dear friend and colleague Late Pankaj Sarmah who died of cerebral malaria during field activities in 2006 at a young age of 32 years only.

REFERENCES

1. Desai, A. (2004): Survey manual – Asian Elephants, WWF AREAS.
2. AREAS – North Bank Landscape Conservation Programme (2003): Elephant Conservation in North Bank Landscape, North-East India WWF-India (unpublished report).
3. AREAS – North Bank Landscape Conservation Programme (2004): North Bank Landscape, Basic Profiles of Important Forest Areas and Corridors Critical for Elephant Conservation. WWF India (unpublished report).
4.AREAS – North Bank Landscape Conservation Programme (2006): GIS and Remote Sensing and Its Role in Conservation Efforts in North Bank Landscape, North-East India. WWF-India (unpublished report).
5.illison, A.N. (2004): Biodiversity Assessment in North Bank Landscape, North East India, WWF India.
6. Hoare, R.E. (1999): Standardized Data Collection and Analysis Protocol for Human Elephant Conflict Situations in Africa, IUCN / SSC African Elephant Specialist Group, Kenya.
7. Hoare, R.E. (2001): A Decision Support System (DSS) for Managing Human Elephant Conflict Situations in Africa, IUCN / SSC African Elephant Specialist Group, Kenya.
8. IGCMC (2005): Landuse / Landcover Change Monitoring using GIS & Remote Sensing Techniques in North Bank Landscape (NBL), North East India, WWF India.
9. Kushwaha, S. P. S. (2002): Geoinformatics for Wildlife Habitat Characterization, Proceedings of Map India, 5th Annual International Conference, New Delhi.
10. Kushwaha, S. P. S. and Roy, P. S. (2002): Geospatial Technology for Wildlife Habitat Evaluation, Trop. Ecol. 2002
11. Kushwaha, S. P. S. and Hazarika, R. (2004) : Asian Elephant Habitat Analysis and Suitability Modeling using Remote Sensing and GIS in Kameng-Sonitpur Elephant Reserve, India, Current Science Vol. 87(10), India.
12. Lavakare, A. (2006): GIS and Risk Assessment, www.gisdevelopment.net
13. Lilesand, T.M. and Kiefer, R.W. (1989): Remote Sensing and Image Interpretation, John Willey & Sons.
14. Mongkolswat, C. and Thirangoon, P. (1998) : Application of Satellite Imagery and GIS to Wildlife Habitat Suitability Mapping, AARS-ACRS1998, (http://www.gisdevelopment.net/)
15. Ravan, S.A. (2006): GIS in Biodiversity Conservation, www.gisdevelopment.net
16. Sitati, N.W., Walpole, M.J., Smith, R.J. and Williams, N.L. (2003): Predicting Spatial Aspects of Human Elephant Conflict, Journal of Applied Ecology, 40, UK.
17. Sukumar, R. (1992): The Asian elephant. Ecology and management. Cambridge University Press. Cambridge, UK.
18. WWF AREAS and Polet, G. (2006): Programme Document – North Bank Landscape Conservation Programme. WWF India.

Please cite this Article as : Amit Sharma, Hiten K. Baishya, Anupam Sarmah, Soumen Dey, Gopala Areendran and A.C. Williams, GIS IN UNDERSTANDING HUMAN ELEPHANT CONFLICT AND IT'S MANAGEMENT : Golden Research Thoughts (June ; 2012)