Mapping of Fishes of Brahmaputra River Using GIS Technology: A New Introduction to Fishery Business

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Abstract— GIS helps to answer questions and solve problems by looking at data in a way that is quickly understood and easily shared. GIS benefits organizations of all sizes and in almost every industry. The benefits of GIS are generally: Increased Efficiency, Better Decision Making, Improved Communication, and Better Recordkeeping & Managing Geographically. We have taken our study area as Brahmaputra River: the largest river of Assam to make some GIS analysis. It includes mapping of collected data (Primary & Secondary) about fish seed production and fish generation, various comparative analysis etc. This basin covers the areas of Tibet, China, India and Bangladesh. The Ganges River originates in China, and along its 2,500 km long course, the river flows through northern India and passes through the state of West Bengal in India and then enters Bangladesh (A. Bhaduri and E. Barbier). Normalized Differential Vegetative Index (NDVI) is sensitive to the presence of green vegetation and has been successfully used in numerous regional and global applications for studying the state of vegetation (Seller P J, 1985).

Index Terms— GIS, Mapping, NDVI, Vegetation.

INTRODUCTION

THIS is an era of globalization. Now every task is possible at low rate as well as consuming less energy. It makes our life so easy that from bill payment to analysis of a worldwide project or its decision making we can do sitting in one place by a single click.

One of the most prominent businesses existing in India is Fish farming & export. In addition to transportation what makes this business possible; another modern analyzing tool in this respect is GIS and RS. GIS describes any information system that integrates stores, edits, analyzes, shares, and displays geographic information for proper decision making. GIS applications are tools that allow users to create interactive queries (user-created searches), analyze spatial information, edit data in maps, and present the results of all these operations.

We have taken our study area as Brahmaputra River of Assam to make some of the GIS analysis. This basin covers the areas of Tibet, China, India and Bangladesh. The Brahmaputra changes its course and pattern along with its current flow very frequently especially in its upper stretches and this has a strong bearing on its hydrobiology. There are about 217 fish species have been recorded from the upper Brahmaputra of which about 150 may be considered as ornamental varieties (Web 1)

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OBJECTIVES/AIM OF THE STUDY:

- The main aim of this study is to know how GIS helps us in decision making. In this study the district wise fish count along the Brahmaputra River is analysed using GIS and RS.
- To analyse the fishery attribute of the river using GIS Technology.
- To know about the PFZ (Potential Fishing Zone): A new concept.

LITERATURE REVIEW:

Fisheries management and planning has many spatial components (e.g. movements and migrations of resources, definition of fishing grounds, transportation networks, markets), and many serious issues like habitat loss and environmental degradation have spatial dimensions.In this regard, GIS is a technology that can help to clarify the issues and lead to solutions by treating many spatial components simultaneously. However, many people are still unaware or afraid of the technology and its potential for fisheries management. (Web 2)

Flood impact on fishery (Fig 1, 2)

The before and after Brahmaputra River flooding satellite image pair. Their image shows the river as a blue color instead of the actual brown, sediment-laden color. Recent satellite surveys indicate that the Brahmaputra basin, as a whole, has a forest cover of about 14.5%, grasslands occupy about 44%, agricultural lands about 14%, cropland/natural vegetation

mosaic 12.8%, barren/sparsely vegetated land 2.5%, water bodies 1.8%, snow and ice 11%, urban land 0.02% and permanent wetlands 0.05%. The total forest cover of the Brahmaputra basin in India is 1, 14,894 sq. km. i.e. 54% of the total area. The distribution of forest covers in Assam (20.6 %). Recent satellite surveys indicate a considerable decline in forest cover due to deforestation, land-use conversion and land degradation. Shifting (jhum) cultivation, which is widely practiced in the northeastern region and is a major cause of deforestation and has a disastrous impact on the region's ecology through soil erosion, loss of soil fertility, falling crop yields, lowering of groundwater recharge, increase in surface run-off, sinking of the groundwater table and acceleration in the rates of sedimentation in rivers and reservoirs downstream ultimately leading to a significant rise in riverbed levels and intensification of flood hazards.

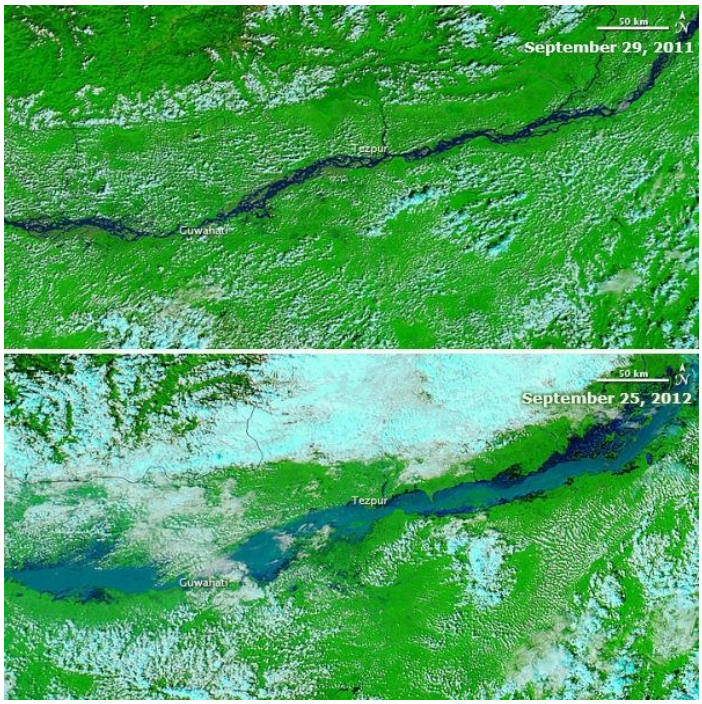


Fig 1. Satellite view of flooding around Brahmaputra River captured on September 25, 2012 by MODIS/Aqua satellite (Web 3)

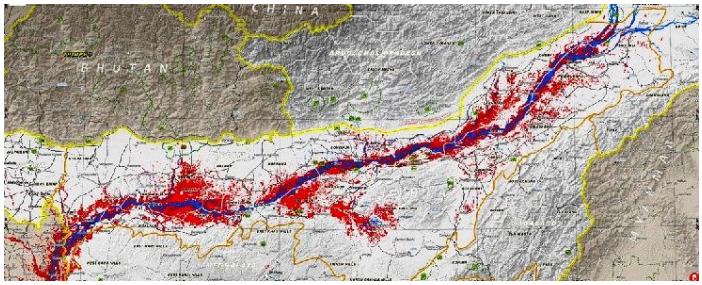


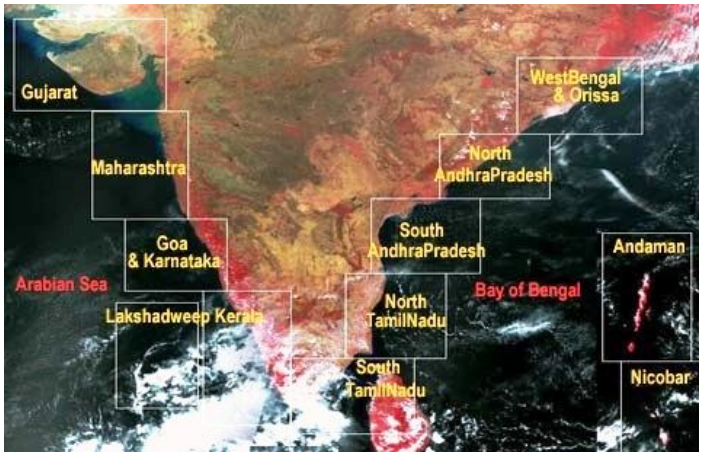
Fig 2. Map of flood water over the affected Assam:Aqua imagery 2-5th august, 2007 (Web 4)

Potential Fishing Zone: (Fig 3)

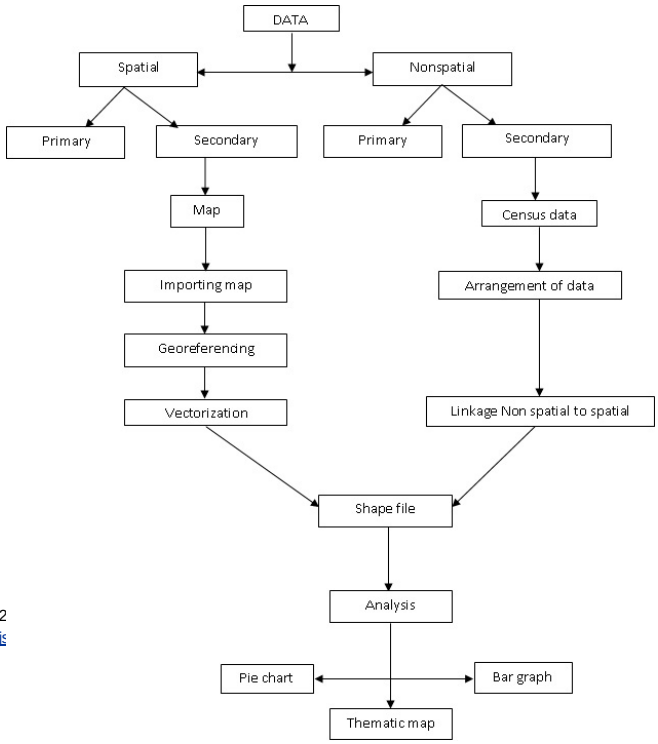
In recent years, study of ocean from satellite in terms of temperature, sea level and ocean colour has given an insight into the changing climate of the world. Phytoplankton pigment which is present in all living plant and which is responsible for photosynthesis is chlorophyll.

NDVI gives positive values to the vegetation based on the spectral characteristic of chlorophyll present in them. NDVI is commonly used for land applications, but in the present study it has been used for water bodies as the NDVI is negative to water surfaces (Prangsma G J, Roozekrans J N, 1989). Presence of chlorophyll gives positive value for NDVI, which indicates the presence of phytoplankton, which intern indicates the presence of zooplankton and fish. This becomes an indicator to identify potential fishing zones.

Fig 3. Image showing PFZ zones of India: (Web 5)
PFZ Forecast Date: 04-DEC-2009
Valid up to: 06-DEC-2012



Remote sensing data is used extensively for large area vegetation monitoring. Various mathematical combinations of these bands have been used for the computation of NDVI,



which is an indicator of the presence and condition of green vegetation.

NDVI = NIR – RED / NIR + RED

METHODOLOGY:

Methodology is the body part of any study. Different methods are implemented as a set of well defined steps or phases which aids with a clear measurable set of existing entities. The methodology adopted in this study incorporates GIS analysis. It is a schematic presentation of procedures and rules used by the analyst who working in a discipline or engaged in an enquiry.

Data is the soul of any information system. The efficiency and performance of any information system highly depends on nature, quality and availability of data. For GIS analysis we need two types of data at the same time viz. spatial & non-spatial. These data may of primary data type or secondary data type. (Table 1, 2)

FINDING AND DISCUSSION:

N.E. Region of India in particular has rich fish resource. Several migratory fishes have also been listed. All the fish species of Assam are more or less inhabitant of the river Brahmaputra or its tributaries i.e. fish attributes of Assam are directly or indirectly related with the Brahmaputra river environment. We can analyze district wise fish production by taking in account the fishes of the river Brahmaputra and its tributaries.

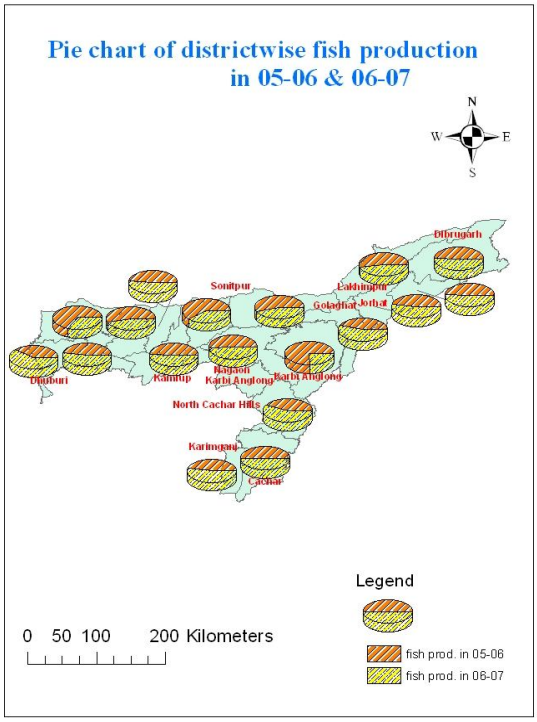


Fig 4 shows that Production of fish (in tone) increases remarkably in Dhubri district in the year 06-07. Karimganj and Jorhat also show increasing fish production trend. But the remaining most of the districts has decreasing trend and few has almost same rate. Overall performance of the state in fish production comes drastically downward due to low district wise fish production.

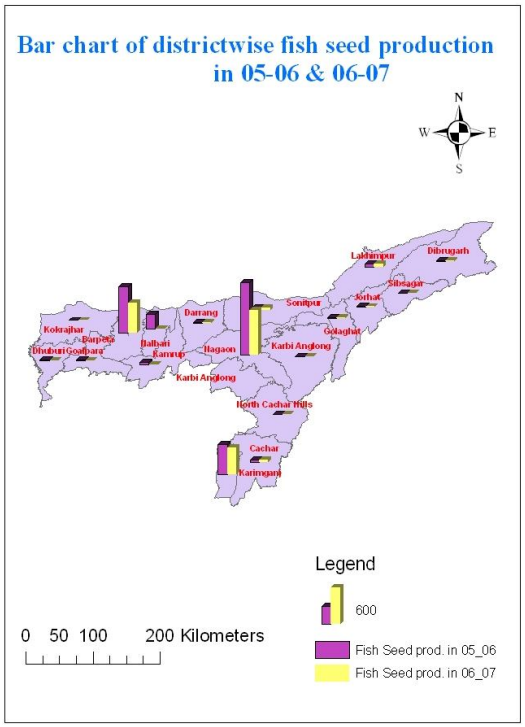


Fig 5 depicts Fish seed (in million) production is very poor throughout the state. But among all the districts Nagaon, Barpeta, Karimganj and Nalbari bears some value accordingly. All remaining has negligible value. In the session 2005-06 the above districts show some good result. But in the next session the seed production number decreases. This in turn leads to less number of fish productions in 2006-07. The decreasing trend of fish seed and fish production is due to increasing pollution rate and unstable climatic condition. So for the preservation of these natural recourses scientific way of culture must be taken in Assam as production rate is low here and as graph is also in decreasing trend.

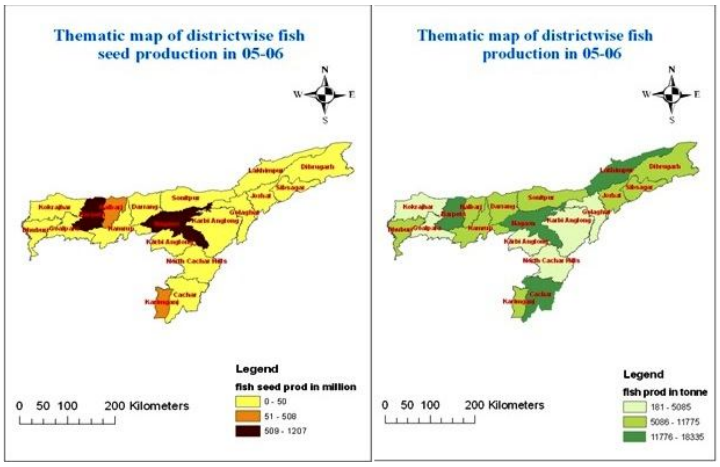
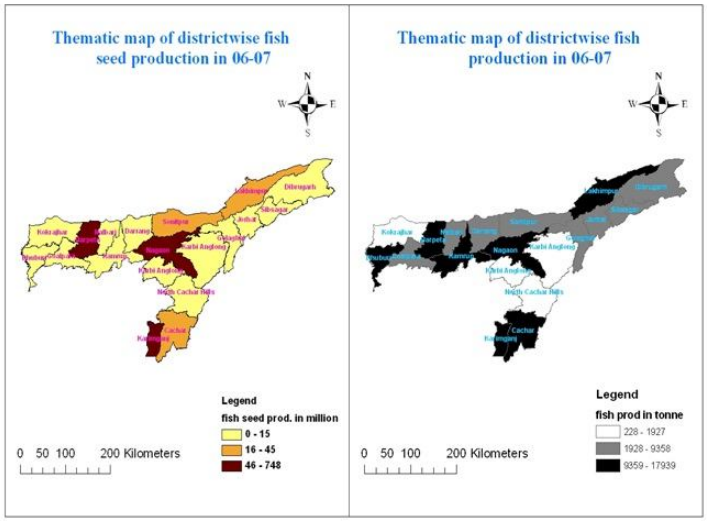


Fig 6 (Thematic map of Fish seed & fish production in 2005-06) shows Fish seed production is highest in Nagaon and Barpeta in 2005-06, and in the same year fish production is highest in Nagaon, Barpeta and also in Cachar and Lakhimpur within a range of 11776 tonne to 18335 tonne.second position in fish seed production are Karimganj and Nalbari, again in fish production second position is occupied by several states viz. Karimganj, Nalbari, Dhuburi, Kamrup, Darrang, Sonitpur, Jorhat, Sibsagar and Dibrugarh. From this it is clear that though seed production is very very low in the districts like



Dhuburi, Kamrup, Darrang, Sonitpur, Jorhat, Sibsagar, Dibrugarh etc but fish production is not bad, i.e. less number of eggs is spoiled. The remaining districts have low seed as well as fish production.

Again, in Fig 7 (Thematic map of Fish seed & fish production in 2006-07) the legend itself clarifies the decreasing trend of seed and fish number. In 2006-07 seed production is highest again in Nagaon, Barpeta and in Karimganj. Then comes the position of Sonitpur, Cachar and Lakhimpur. In the same session fish production is comparatively highest in many of the districts like Dhuburi, Kamrup etc along with Nagaon, Barpeta and Karimganj. But the highest range of fish seed production decreases from 509-1207 million to 46-748 million. Again in the same way fish production also decreases from 11776 -18335 tones to 9359-17939 tone. Such lowering of population size and genetic resource indicates threat to the time to come.

In large low-gradient rivers, benthic fish may actually be more likely to survive floods due to a higher tolerance for suspended sediment (Whitfield and Paterson, 1995). In all systems, direct impacts on fish are inseparable from habitat changes and fluctuations in other parts of the food chain. In high-gradient systems, recovery periods and long-term effects of flooding on fish populations are closely tied to geomorphic changes in aquatic habitat. In cases where key habitat is lost and must be repaired by future geomorphic Processes, population levels may be depressed for decades.

Tables and Figures

Table 1 Type of Data

Sr.no.	Type of data	Source of data
1	Districtwise map of Assam	*maps of India*
2	Districtwise production of fish seed	*census of India 2006-07*
3	Districtwise production of fish	*census of India 2006-07*

Table2: District-wise production of fish seed and fish in Assam

District	Production of Fish Seed (In Million Nos.)		Production fish (In Tonne)	
	2005-2006	2006-2007	2005-2006	2006-2007
Dhubri	3.60	0.20	9326	13360
Kokrajhar	Nil	Nil	3718	1927
Bongaigaon	7.53	7.85	4229	4270
Goalpara	17.49	4.83	4229	4555
Barpeta	764.50	495.37	13677	11830
Nalbari	244.19	2.14	8890	9358
Kamrup	32.24	0.40	11775	12174
Darrang	6.76	7.68	7460	5042
Sonitpur	39.81	41.05	7311	6130
Lakhimpur	50.27	44.56	13329	11787
Dhemaji	0.02	2.27	3523	3402
Morigaon	169.59	181.28	7525	7981
Nagaon	1207.26	748.36	17502	17048
Golaghat	12.24	15.31	5085	5971
Jorhat	6.04	3.57	7920	8551
Sibsagar	2.92	0.73	6865	6945
Dibrugarh	5.10	3.82	8698	8840
Tinsukia	9.72	7.65	7585	4536
Karbi Anglong	Nil	Nil	3210	1037
N.C. Hills	0.15	0.19	181	228
Karimganj	508.10	453.35	9916	11012
Hailakandi	76.70	Nil	7089	7556
Cachar	40.20	42.00	18335	17939
Assam	3207.99	2062.61	1873778	181479

CONCLUSION:

Brahmaputra being an international river of immense size, huge resource base and high hazard potential, only effective cooperation and coordination among the basin countries,

together with persistent efforts at the national and regional levels using higher technologies like GIS and RS can create an effective response mechanism to the problem like floods and also help in decision making purpose for the progress and prosperity for the region. Thus we can use such tools anywhere to analyze the situations from another corner using various databases like satellite imagery at low investment and within effective time period.

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