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ROLE OF SIMPLE GEOSPATIAL TECHNIQUES IN ASSESSING THE ANTHROPOGENIC IMPACT OF ENVIRONMENT ON LOWER THAMBRAPARANI BASIN

KARTHIKA KRISHNAN

Research Scholar, Department of Geography, Madurai Kamaraj University, Madurai, Tamil Nadu, India

ABSTRACT

Over the past few years, as a result of the rapid pace of economic development, environment is undergoing an irreversible change of degradation. River basins all over the world are under immense pressure due to various anthropogenic activities, as these activities threaten the very existence of river basin and its surrounding ecosystems. In this context, a study has been made on the impact assessment of environment on Kuzhithuraiar river sub-basin (Lower Thambraparani basin) using simple geospatial techniques. Indiscriminate mining of sand from the river bed and flood plain, encroachment of land on water bodies, stone quarrying and over dominance of monocrops such as that of plantations are causing severe damage to Kuzhithuraiar river sub basin region. This paper attempts to analyse the effectiveness of bringing GIS, GPS and ERDAS tools to find out the degree of damage undergone by the basin over the past 22 years.

The result has been brought out through maps prepared from toposheet and google earth imageries. The results that have been generated through geospatial techniques show that the sub basin is highly under the degree of degradation. There is an increase of 339.6 percent in over all area under quarrying. While in case of sand mining, more than 11.4 sq.km of area is under vulnerable site in 2012 as against 1.16 sq. km in 1990. Rubber plantation has also extended it area of dominance by acquiring 66.95 sq. km within the area under total sub basin. Finally, it has been assessed that geospatial tools proves to be the best scientific assessment for monitoring EIA of a river basin thereby formulating effective management strategies to reduce the impact of environmental degradation and looking forward for a sustainable development.

KEYWORDS: Anthropogenic, EIA, GIS, GPS, River Basin, Environmental Degradation

INTRODUCTION

Impact refers to the change in an environmental parameter taking place over a specified period and within a defined area on account of a particular activity in relation to the situation which would have resulted if their activity not proposed (Gupta, 2005). An Environmental Impact Assessment (EIA) is a process of identifying, predicting, assessing and mitigating the impacts of any developmental projects or proposals that may have on the biophysical environment (International Association for Impact Assessment, 1999), together consisting of natural, social and economic aspects.

Over the past few years, especially that of 21st century is undergoing a rapid pace of economic development. As a result, the environment possesses a serious threat of disintegration at an alarming rate. Now days, river basins all over the world are under immense pressure(Sreebhaand Padmalal, 2007) due to various kinds of anthropogenic activities, as these activities threaten the very existence of the basin and its surrounding ecosystem. In this context, a study has been

made on the impact assessment of environment on Kuzhithuraiar river sub-basin (Lower Thambraparani basin) with the help of simple geospatial techniques.

EMERGING SIGNIFICANCE OF GEOSPATIAL TECHNIQUES IN 21ST CENTURY

In the era of information technology with rapid advancement in computing, decision making has become more informed and scientific (Tejpalet. al, 2012). In this situation geospatial technology has strongly developed with diverse application. It has been identified as one of the three most emerging field along with nanotechnology and biotechnology because of providing unbiased, repetitive and synoptic nature of data as well as tool for integration of information for analysis, which is very useful in management and monitoring natural resources.

Geospatial technology is a multidisciplinary field that includes discipline such as Geographic Information System (GIS), Global Positioning System (GPS), Remote sensing, photo grammetry and mapping. According to the U.S. Department of Labour 2005, now a days, Geospatial techniques are considered as an information technology field of practice that acquires, manages, interprets, integrates, displays and analyses data focusing on geographical, temporal and spatial context (Klinkenberg, 2007). This paper discuss the application of GIS and GPS tools in managing and monitoring impact assessment of environment on a river sub basin. Hence, a geospatial technique based visualization and analysis of EIA has been attempted on Kuzhithurai sub basin.

PROBLEM DEFINITION

Throughout India, the studies on the impact assessment of anthropogenic activities on drainage basins and sub basins often suffer severe setbacks due to lack of various long-term data. Hence, there is a gaining significance to build an EIA for all the river basins and sub basins to analyze the level of vulnerability that is undergoing by the sebasins.

The present sub basin, Kuzhithuraiar basin, is facing a high threat of degradation as a result of indiscriminate mining of sand from river bed and floodplain, stone quarrying, encroachment of land on water bodies and over dominance of rubber plantation. The degradation is at a high level that it makes necessary to built EIA within limited period of time, so as to formulate an effective strategic management plan to reduce the level of environmental degradation of the sub basin.

STUDY AREA

The present field of investigation is at Kuzhithuraiar sub basin covering an area of about 382.93 sq. km (Figure 1). Kuzhithuraiar sub basin is located between 8°11'N to 8°26' N latitude and 77°05' E to 77°23' E longitude. Almost the entire basin lies within the administrative division of Kanyakumari district with a small catchment area under the state Kerala. It is the only river basin in Tamil Nadu that drains towards west to Arabian Sea.

Geologically, the sub basin is underlain by the peninsular gneissic terrain and crystalline rocks of Arc hean age and Warkalai sand stones of middle Miocene. The river basin falls within three distinct physiographic provinces of hilly terrain in the north and north-east, fertile sea coast on south, south east and south west and, undulating valleys and plains between the hilly terrain and the coast.

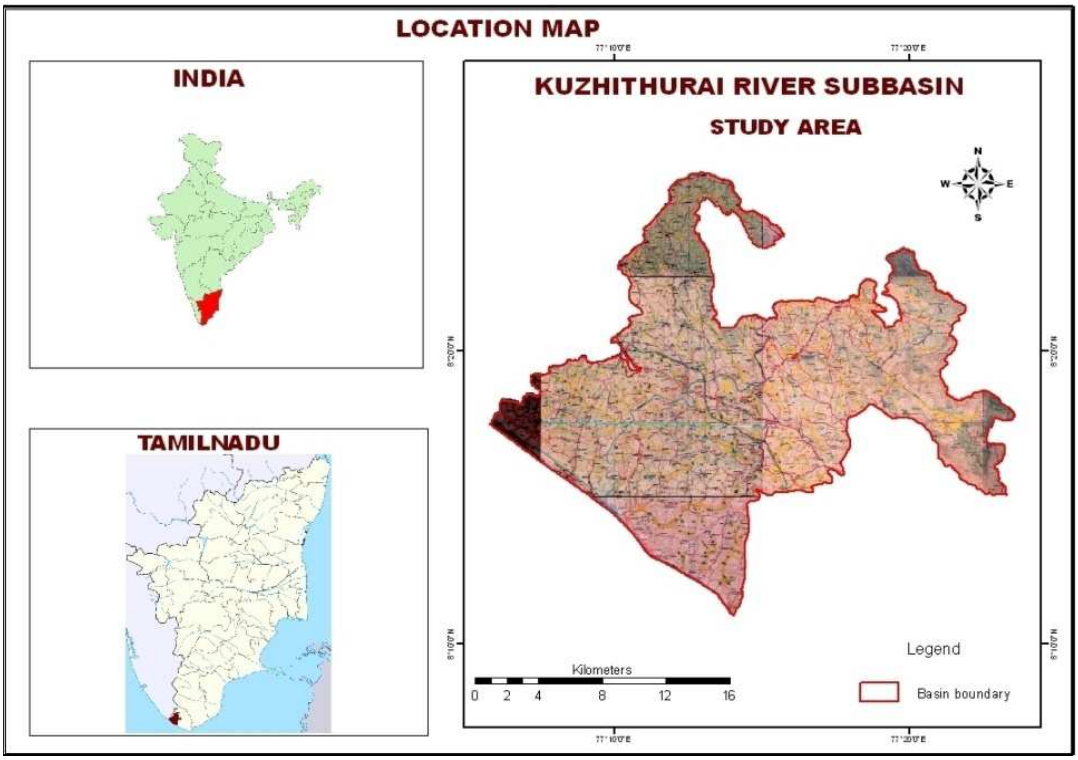

Figure 1

AIM AND OBJECTIVES

The main aim of the present study is to investigate how the geospatial tools would be effective in analyzing and monitoring the environmental impact of a river sub basin. The major objectives are:

- To analyze the temporal variations in the sub basin as a result of human interference in the name of development.
- To assess the potential environmental impacts due to unscientific and haphazard manner of developmental initiatives on the sub basin.
- To view the severity of environmental degradation caused by indiscriminate sand mining, stone quarrying and encroachment of plantations on water bodies in the study area.
- To provide a set of guidelines and some strategic measures of conservation and monitoring to tackle the problem of environmental degradation faced by the sub basin.

METHODOLOGY

An assessment of the impact of sand mining, quarrying and plantation agriculture on various environmental components of a river sub basin is often difficult as many of the adverse effects are surfaced only after a long period. Therefore, a method that involves original investigation to document the existing environmental conditions and selected case analysis are approximately used to attain key objective of the study.

The entire sub basin has been captured from survey of India to posheet of 1:25000 scale surveyed in the year 1990, and delineated with the help of Arc GIS software. Google Earth imaginary of the study area for the year 2012

has been captured and geo referenced with to posheet in ERDAS image processing software. Then a GPS survey has been conducted to locate the thrust areas of indiscriminate sand mining and quarrying. Once the vulnerable sites have been located, the coordinates have been transferred from GPS to Google earth imagery and areas have been plotted and calculated in Arc GIS 9.3. Finally the maps are generated in Arc GIS, and then interpreted, analyzed and suggestions have been made to overcome the crisis.

RESULTS AND DISCUSSIONS

The interpretation and analysis result after comparing the toposheet of 1990 and Google earth imagery of 2012 (Figure 2) shows that the degradation of Kuzhithuraiar sub basin is at an alarming rate. Through GPS survey (Table 1), it has been found that sand mining has been taking place illegally up to a depth of 30 feet over many kilometers as against the administrative and environmental norms of 3 feet. Stone quarrying operations both legal and illegal have been noticed in many places and the norms regarding the depth and area of quarries are often flouted. Similarly, the plantation have encroached many of the water bodies in the sub basin. Around 54 water bodies that meet drinking water requirements have been encroached by rubber plantation.

The major findings of present study through geospatial techniques shows that there is unprecedented rise in the degree of vulnerability due to quarrying as there is 339.6 per cent increase in area under stone quarrying within the past 22 years (Figure 4). In 1990, the area under quarrying was only about 1.04 sq. km., while in 2012 it is about 4.57sq.km. In the case of sand mining, the results throw an alarming situation as 11.414 kilometers along the river channel is under indiscriminate sand mining in 2012 as against 1.16 kilometers in 1990 (Figure 3).

While considering the case of plantation, there is a rise of 21.16 per cent under rubber plantation in 2012 when compared to the area under plantation in 1990 which is around 55.254 sq. km. Presently the total area under rubber plantation in the sub basin is approximately around 66.95 sq.km. Another observation made in the study of plantation reveals that most of the encroachment of plantation takes place in lower part of basin (Figure 5) when compared to the upper basin region.

Table 1

Impact Assessment	Area in Sq. Km		Percentage Change over 22 Years
	1990	2012	
Sand Mining	1.1648	11.414	879.9
Stone quarrying	1.04	4.5728	339.6
Rubber Plantation	55.254	66.95	21.16

Environmental Consequences of Developmental Activities on Sub-Basin

Impact of River Sand Mining

Indiscriminate sand mining activities especially in the lower end of river basin caused saline water intrusion and resulted in salinization of potable ground water that lead to ground water depletion. It has affected the stability of river bank in many parts of the basin and resulted in increased bank erosion, channel widening and bank failure. Another consequence of the increase in mining activity is that it not only lowers the level of water in tanks, ponds and other fresh water sources, but also affects the stability of nearby areas due to pit capturing. Further it has lead to reduction in canopy and hence a change in micro climate.

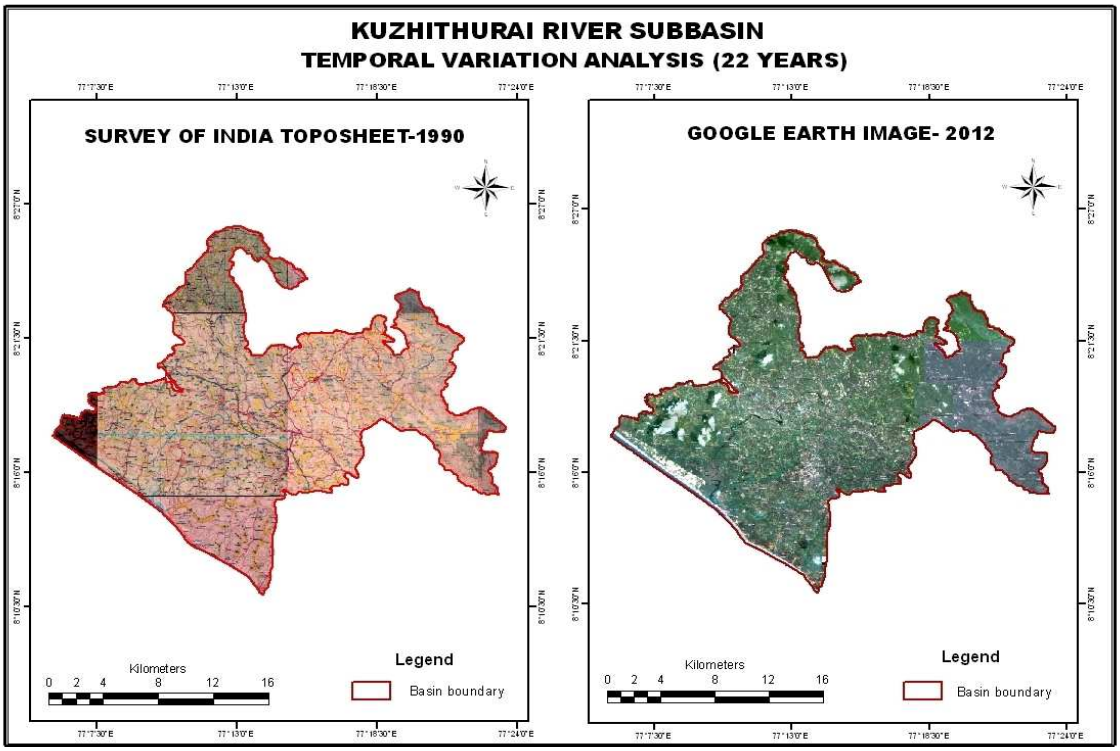

Figure 2

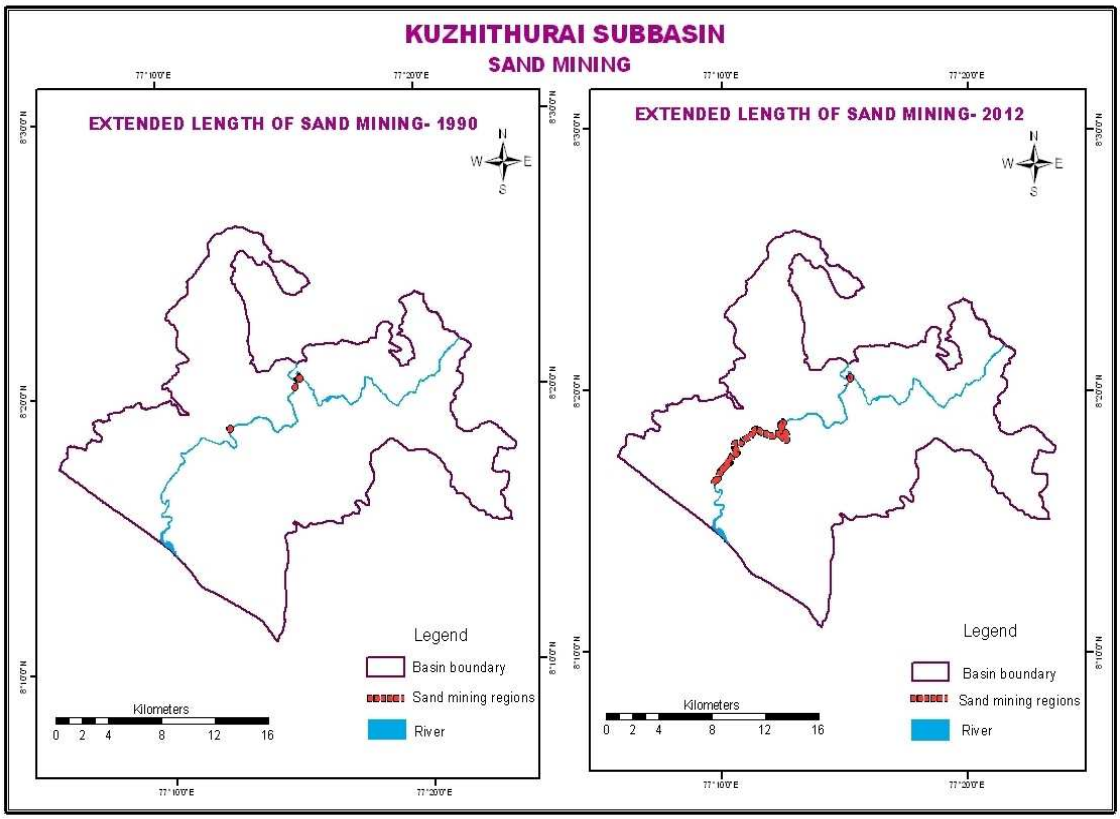

Figure 3

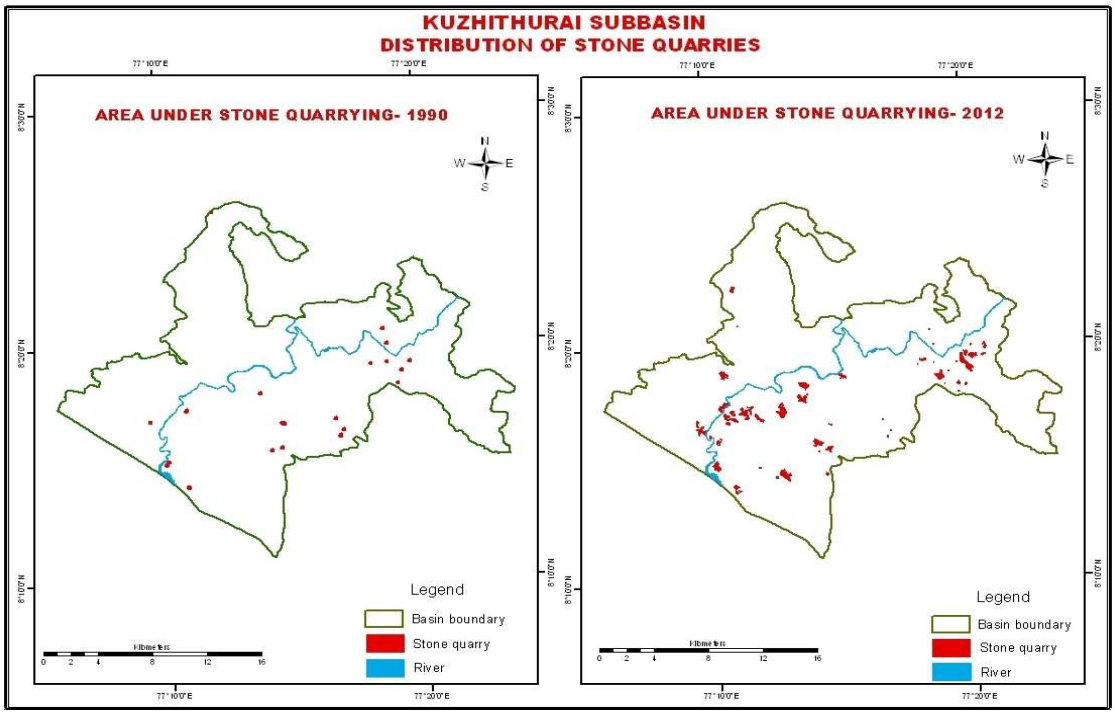

Figure 4

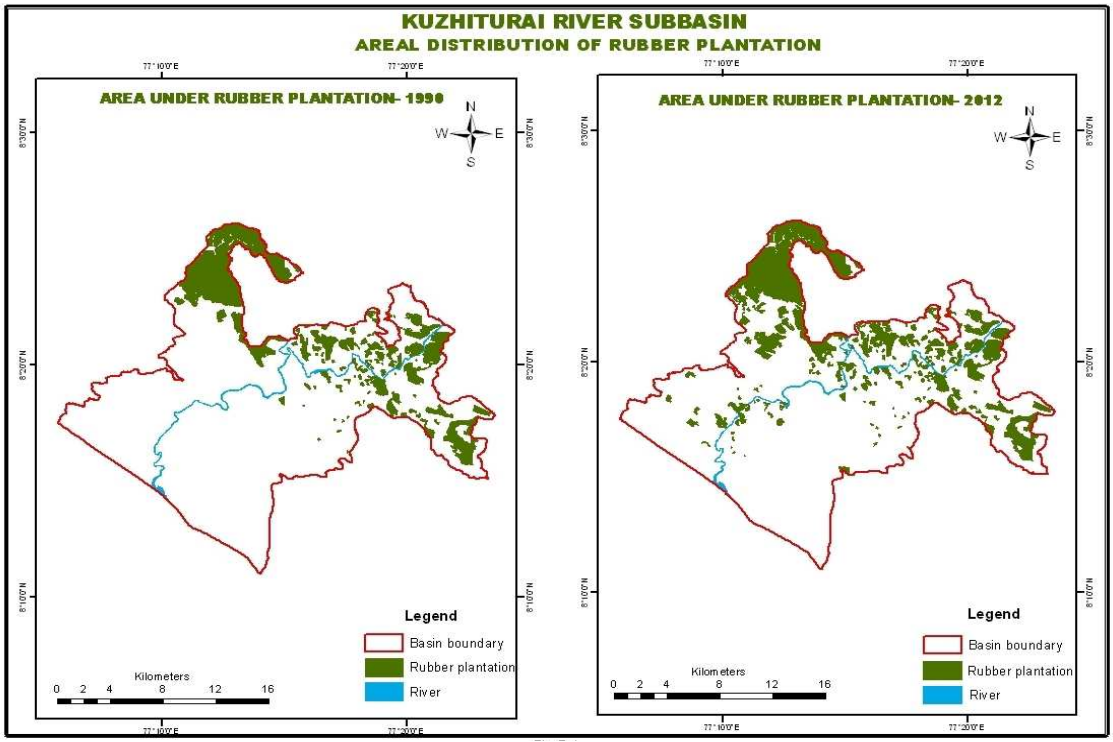

Figure 5

Impact of Stone Quarrying

Blasting and removal of rocks and its replacement in waste dumps or mined out pit significantly changed the topography of region. Some of the over dumping of the waste quarried rocks has released certain salts that generated acid mine drainage. Even the development of cracks affected the stability of landscape.

Impact of Plantation

The entire flora and vegetation of lower Kalakkad sanctuary falling in the basin got seriously affected as the region has now turned from its natural biodiversity to artificial plantation jungle. Plantations enormously affected the soil fertility of the region. As the sediment intake of plantation crops is high, the soil degradation is at a high level.

SUGGESTIONS AND RECOMMENDATIONS

Considering the degree of degradation caused by mining and quarrying from the present river basin region, no mining scenario may be opted in deeper zones. However, since the level of development should also get proceed in present century, some suggestions and recommendation are given to reduce the potential impacts of environmental degradation on Kuzhithuraiar sub basin. Before commencing of any development projects, it should be made mandatory to draft an Environmental Management Plan (EMP) in an area. The system of preparing an EMP report for the clearance from the government prior to implementation of mining and quarrying projects (State policy on River sand and stone mining: Final draft; Malaysia, 2001) can be a positive step for minimizing the negative impacts. Identification of an alternative to sand and metal rocks as a construction material would reduce the degree of exploiting these natural resources. Sand mining should be banned from such areas where the sand bed level is below the required level fixed by government. In order to reduce the impact of plantation on any region, biodiversity should be preserved at least in certain pockets. A compulsory environmental audit with the help with the help of GPS and radars could be another possible solution to measure the level of degradation in those areas that got clearance from government for development projects. Monitoring strategies at local level with geospatial tools could be a possible remedy for over sand mining and quarrying.

CONCLUSIONS

EIA is of global concern. EIA process makes sure that the environmental issues are raised and the problems are addressed at the right time. To be effective once implementation has commenced, EIA should lead to a mechanism whereby adequate monitoring is undertaken to realize the environmental management. Present study emphasis on bring the temporal change in the environment on Kuzhithuraiar river sub basin on account of various human interference through Geospatial techniques. EIA carried out with the help of geospatial techniques shows that sand mining, stone quarrying and plantation have affected not only Kuzhithuraiar river ecosystem but also degraded its over bank and surrounding landscape to a large extend. The emergence of geospatial technologies has thus substantially eased the problem of identifying vulnerable sites of degradation in an Environmental Impact Assessment. It can be concluded that the application of geospatial tools for river basin area studies provide several capabilities that can greatly help geoscientists, environmentalists and policy makers to monitor the impact assessment of any anthropogenic projects and developmental activities on environment.

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