

## ***Environmental Hazard of Tea garden belt in Jalpaiguri District, West Bengal***

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### **Introduction:**

Integrated development is one of the important dimensions of economic aspects in our country. Mapping communities is therefore an integral component of planning, while mapping communities, it is important to include not only the physical / surface geography but also the social geography. The district of Jalpaiguri in West Bengal flanks the foothill of the Himalayas. The area forms a part of what is well known in literature as the 'Terai' or 'Dooars' and has lately been subjected to large-scale human interference and its consequential hazards, mainly, river shifting, deforestation, water quality and also social problem. Water resources are at the heart of sustainable development in Jalpaiguri district. Water of sufficient quantity and quality is an essential resource for agriculture, industry and tourism, but also for everyday life in cities and villages. But water resources are deplete and degrade due to the use of huge amount chemicals in tea garden belts for better production which contaminates ground water through percolation and rivers and other water bodies through surface run-off. The lost of quality is causing health hazards and death of human which disturbs the whole ecology system of this region. The identification of environmental hazard of tea garden belts is directly or indirectly caused by the water quality, geomorology, geological, hydrological condition and other land use and also socio-economic pattern with the help of GIS.

### **Study Area:**

The present investigation area untakes to unravel the various geological, geomorphological features encountered while studying Quaternary fluvial deposits and land forms in the Mahananda, Tista, Jaldhaka, Torsa basins in parts of Jalpaiguri district in West Bengal, bounded by 26° 16 to 27°02 North latitude and 88°04 to 89°53 East longitude covering an area of 6227 Sq.Km. This district is bounded to its North by the Himalayan ranges including the Darjeeling, Sikkim & Bhutan Himalaya from West to East. Jalpaiguri district is flanked by Darjeeling and Bhutan in the North, Assam in the East, Bangladesh and Coochbehar is the South and Bangladesh and Darjeeling in the West.

Topography of this district and its environs is characterized by uneven elevation of this region varies form 62m to 350m. The altitude falls from 350m to above mean sea level at the foot of the Himalayas to 150m above mean sea level over a distance of 25km and then falls to about 60m above mean sea level over a distance 110 km further south. The climate of the area is characterized by a sub-tropical & humid, the maximum, minimum temperature 37° C and 6°C respectively. The average annual rainfall of this district is 3736mm. The storm rainfall is of hydro-meteorological significance causing inundation and flood of the area.

### **Geomorphological set up of the area:**

Jalpaiguri district is bounded in the North by the hill ranges of the Himalayan and the South by the piedmont plains, which gradually grade into the alluvial plains further south. This district exhibits a diversity sediment and soil colour. This feature has been fan deposit in this tectonically affected composing the piedmont plain in the area are of apparently fluvial origin. As evidence by the huge size of the boulders they display later fluvial activity is seen in the terraces and later deposits besides a plethora of distributary channels. Rill and gully erosion over a long period of time has produced an undulatory surface in these ancient deposits. The North they consist mainly of pebble to quartzite overlain by finer water lain deposit. Later fluvial deposits ranging mainly from cobble to clay size material over lain the area. In alluvial plains leaves, back swamps, ox-bow lakes etc. represent the usual landscape features comprising mainly the more recent flood plains but ancient flood plains surfaces may, perhaps be coeval with the uplifted Barind landform.

#### **Geological and structural set up of area:**

The geological milieu in the district represents the sub-Himalayas or the foothill zone consist almost entirely of the Siwaliks and typical formation of Quaternary and recent sediments. The upper part of the district mainly consist of Siwalik and older Quaternary formation, which are dominated by thick boulder and conglomerate horizons. The lower portion occurs as a fluvial terrace deposit. The recent sediments mainly represent thicks pile of fluvial, unconsolidated sediments. The various faulting occur in this region. The time of faulting ranges from Pliocene to Recent with some of the structures assumed to be seismically active. The tectonic activity has played the pivotal role in creating the elevations and depression has had both a direct and indirect effect on the erosion and depositional aspect and drainage networks in the region, which persist even today.

#### **Soil of the area:**

The soil of this district is alluvial in nature and has a light texture and defined as sandy loam to loamy sand which highly permeable porosity. The Geological point of view soils are mainly the products of weathering of fluvial clastics. Pedagogically the deposits can be grouped into five unit based on soil formation, colour of topsoil and composition of soil, quaternary terrace deposits. The first one has no soil cover which is the present day flood plain, the second unit consists of enormous well developed coarse to fine sand size grading southward away from the foot hills, to silt and clay. The third and fourth unit ranges from boulder to sand size fraction, which is developed highly porous and permeable soil. The last unit mainly made up of boulder of various sizes, with little or no matrix.

#### **Land use:**

The dramatic transformation of land use pattern of Jalpaiguri district has taken place during the second half of the last century. Huge migration vis-à-vis influx of population compelled the people to settle in the former water bodies, marshy lands, hilly forest, decayed water bodies and interior area of the district. So the land use pattern has also been changing from natural land to man made or artificial structure. The land use pattern of the area is forest (25%), teagarden (15%), cultivated and non-cultivated land (43%), and others (17%) (Water bodies, residential, hill etc.). The tea garden and hill area covered in the northern part of the district. Forest covers area scatter in whole district. Land use pattern changed dramatically from last decade that is the one of the major cause of environmental hazard of this district.

**Hydrological characteristic:**

Hydrological condition at a particular point is guided by topography, geology, and rainfall (Annual rainfall 3736 mm) of the region. Under uniformly excellent water aquifer condition groundwater simulates topography. Most of the aquifer is semi-confined and unconfined in this belt. (Prevalence of sand to boulder size material) Groundwater contour map depicts the region spanning from east to west where as to the North to South depth to water level increase gradually. The groundwater table coincides with the surface water, so many rivers originate from the groundwater in this region. In monsoon period groundwater level upper than surface water, which causes more danger for contamination.

Hydrological characteristics also have changed from last decade. Ground water level and water quality of the region varies from pre to post monsoon period due to recharge of rainfall.

**Environmental hazards:**

The Jalpaiguri district is a part of sub-Himalayan West Bengal which is generally known as 'Terai' or 'Duars'. The study area which is situated in the foothills region of Himalayas, facing different type hazards which are natural and also man made like floods, landslides etc. Main four causes which affect vulnerably are-

- i) Due to River Shifting
- ii) Due to Deforestation
- iii) Soil Erosion
- iv) Ground and surface water Quality

**River Shifting:**

The region is the interfluvium of numerous rivers and rivulets. Because of the foothills situation, rivers are coming from hills suddenly reach the plain. Due to this sudden flattening of slope rivers are not capable to carry the debris which flow through from hills and deposit the detritus in different region as per their specific gravity, like boulders, pebbles, shingles, coarse sand, fine sand, silt and finer silt particles, that formation is called alluvial fan. For this reason height of the riverbed increase, river siltation increase, which cause shifting and changing of river course. With the help of LISS-III satellite image March, 2001 have observed, shifting of river Teesta and Jaldhaka from West to East 2.9km and 2.1km respectively. River Torsha including Sil and Char Torsha shifts frequently. The only exception is shifting of Diana River from East to West.

So, changing of river course and shifting of river is not new features for this region. But with increasing habitation and changing land use pattern, it become vulnerable headache for now-a-days. Adding insult to injury, deforestation heavily occurred due to natural and man made hazards like illegal cutting of trees, unscientific dolomite mining in Bhutan and surrounded hills etc. Now we are trying to discuss how river shifting becomes very serious problem for this region with suitable example.

**a) Shifting of Teesta :-**

Teesta was originally a river of Ganga basin as per history. In 1787, due to heavy flood and devastating earthquake Teesta shifted its course to Bhramaputra basin (Source: Hunter's Statistical Account of Bengal)

In recent times, after the flood of 1950's it is observed that a huge quantity of water of river Teesta is flowing through Buri Teesta and falling into the Yamuna in Bangladesh. This course tends to develop further with the course of time. To prevent this Jalpaiguri

town protective embankment had to extend up to Jharsing Swar near Haldibari in Coochbehar district.

During the flood of 1968, river opens a new course through Upalchand Forest near Kathalbari in Mal block. It devastated huge quantity of forest area and took its course again to its main course. A big chunk of Upalchand Forest was washed out in this case.

b) Shifting of Torsha:-

River Torsha bifurcates itself near about a 1.5 km .down of the road bridge near Suhasini Tea Garden Hasimara , into two branches namely-i)Sil Torsha- the eastern branch ii) Char Torsha , the western one. During 1950's due to sudden flood the Sil Torsha course developed severely and washed out the road bridge on NH-31 over Sil Torsha and widened its width in double.

During 1954 , on the other hand the Torsha river developed the Char Torsha course and wash out the bridge over Char Torsha on NH-31 and widen the course about 1 km. Width.

c) Shifting of Jaldhaka:-

Since the flood of 1954, river Jaldhaka was shifting towards East near Tandu Tea Garden in Nagrakata block. The river devastated 10 km (approx) of forest and almost 50% of the Tandu Tea Garden. To prevent the tendency of avulsion of Jaldhaka to river Bamni, an embankment had to be constructed.

In the late 90's another shifting took place. Jaldhaka, by breaching the left bank embankment avulsed into river Doikhowa and ruined a huge area of Northwestern part of Dhupguri block.

d) Shifting of River Diana:-

During 1956, river Diana avulsed through a rivulet Jhumur and Rangati just south of Kalabari Tea Garden, devastating about a100 sq. km (approx) area. Due to this original course of river Jhumur was abandoned and it is now a tributary of river Rangati. By constructing embankment at Kalabari, the course of Diana was thrown back to its own. But this river has a tendency to avulse to river Rangati.

### Deforestation:

The Terai or Duars are covered with forests. The swampy wet land helps to grow natural forest. But increasing population and requirements of foods force to change the land use pattern of this region. Forests are also being damaged to establishing tea gardens. Mainly two types of hazards cause deforestation. That is-

- 1) Natural hazards
- 2) Man made hazards

**Natural Hazards:** Due to the shifting of river deforestation occurred here. Shifting of river Jaldhaka devastated nearly 50% of Tundu forest and Tundu Tea Garden. Shifting of river Diana deforested the Western part of this river i.e., Diana forest.

During 1960's shifting of river Torsha to Buri Torsha caused huge damages to Chilapota forest. In the foothills region shifting and changing course of river Torsha damages a huge portion of Reti forest near Jaigaon.

**Man-made Hazards:** On the other hand, man made hazards also causes deforestation in this region. In the name of development, and requirements of cultivable lands- huge forest area is damaged for this purpose. In this regard we took the example of Baikunthapur forest, which is now just a shadow of the past. Deforestation of huge area causes ecological imbalances in this region and changing weather condition is the result of this.

**Soil Erosion:**

Due to natural and man-made hazards erosion of top soil is a major problem of this region. Erosion of soil mainly occurred due to human interference. In the name of so called development, for constructing roads in hilly region, detonators are often used for blasting stones or part of hills, which causes loosening and cracking of stones and ultimately causes severe landslide and sleeps.

Unscientific spreading of human habitation is also a big factor for soil erosion. To meet the demand of greater population in the hills, terrace cultivation of paddy with the help of flow irrigation is adopted. This process washed out the cementing material, which bonds the stone. It is experienced that hill flow irrigation project areas are often followed by severe sleeps. Adding to this unscientific dolomite mining in Bhutan and neighboring Sub-Himalayan hills causes erosion of soil in heavy amount. It is true, that due to some natural process soil erosion occurs but interference of human activities increases its margin heavily. So, it is high time necessary steps should be taken before any calamity can take place.

**Ground and surface Water Quality:**

Ground and surface water quality monitoring is the process of regular study of parameters related to ground and surface water. It helps determining the quality trend and hence the threshold values for the restoration of water quality to its normal. Different factors those affect the water quality are physical, chemical and socio- economic parameters of the area. The water quality is differing in circumference of tea garden belts than other area of the district. Using GIS, the database on water quality, the relationship between water quality parameters with land use (tea garden, non tea garden and drainage networks) have been asserted and graphically presented (Fig -2).

About eleven water quality parameters, the physical parameters temperature and total dissolve solid and chemical parameters  $P^H$ , Total hardness, conductivity, Sulphate ( $SO_4$ ), Phosphate ( $PO_4$ ), Chlorite, Bio-carbonate, Sodium, Calcium and BOD are studied from their pre-monsoon and post-monsoon period. In monsoon period all water quality parameters are more than non-monsoon period. Total dissolve solid, Sulphate, Sodium,  $P^H$ , BOD and other parameter are more than the permissibility limit (WHO) in the tea garden area .

The contamination of surface water and groundwater pollution can result from the large-scale application of fertilizers, pesticides and agrochemicals in tea garden area. Unwanted elements and others excess elements easily leach out though high permeable and porosity soil, which are easily contaminated with ground water. The ground water model described the first, shallow aquifer that is directly exposed to tea garden region, which is the major cause of contamination. The major driving forces include the spatially distributed recharge from huge rainfall in hilly region depending on land use, infiltration or exfiltration from and to the river and the pumping of groundwater in shallow wells that constitute the majority of small domestic wells. Spatially varying characteristics of the aquifer and land use are directly taken from GIS.

Another problem of water quality in the north-eastern part (Birpapa, Dhuppuri, Kalchini Blocks) of district due to the unscientific excavation of dolomites mine at Bhutan border that effect fall on the drinking and irrigation system in this region cause the hardness of water is increased though soluble of excess of carbonate, bi-carbonate in the water system which is deceased the fertility of tea and agric-land.

Excessive levels of Sulphate, TDS, BOD,  $P^H$  and Bi-carbonate and other water quality parameters that can pose a long-term health hazard such as Diarrhoea, Malaria, and others water-bone diseases are the major problem of tea garden area. Waste tea garden management is one of the cause of health hazard because do not have any concrete platform of drinking tube wells.

All environmental hazards directly or indirectly effect of the health condition of tea garden belts compare to other part of district. The Diarrhoea, Malaria, and others water-bone disease are 'Acute Problem' of the tea garden belts in the monsoon period in every years (Table -1).

The GIS database used for relationship of health condition with land use and other spatial and non-spatial data of the district, which show positive relationship with poor health condition and tea garden belts than other part of district.

The primary causes of the poor health are –

- a) Poor drinking facility due to the contamination of ground and surface water and waste management of tea garden belts because do not have concert platform of tube well and deep tube well.
- b) Land use pattern, geomorphology, hydrology condition and drainage networks all are directly or indirectly related with marshy land which are more favourable condition for malaria disease.

The secondary cause of the poor health condition –

- a) Literacy
- b) Lack of awareness
- c) Poverty

#### Literacy:

Literacy is one of the prime factors of human interference hazard and creating awareness. Health and literacy both are complementary step for better future. But unfortunately literacy rate is very poor in the tea garden area compare to the district. In 2001 census literacy rate is 63.62% in whole district where as 37.48% in tea garden area. Illiterate people do not know how to combat with the hazard. To tell of the backwardness of the tea garden people the incidence of witch-hunting is still on these days of 21<sup>st</sup> century. Even in this year of 2002 several cases occurred, of which two cases one at Kalchini block and other at Kilkot tea garden in Matiali block get the headlines of the newspapers.

#### Lack of Awareness:

Being a backward district Jalpaiguri is confronted with a very major social problem which is a great concern for the programmed of eradication water-borne diseases like malaria, Diarrhoea. The entire problem is alarming in this region due to lack of awareness about their health. The rural families, majority of whom are living under the poverty line, they are aware about their sanitation. As per the 1991 census report, only 24.96% of the households in Jalpaiguri have access to toilets. In the tea garden areas, this figures is such at 10.43%

#### Poverty of the Tea Garden belt area:

More than 70% of the total populations in Tea garden area are working as daily-labourer. The percentage of Below Poverty Line (BPL) families have decreased from 62.01(1997) to 59.53 (2002) in all over the district. But the percentage of BPL families in Tea Garden area is 67.07%. Tea garden labourer gets minimum wage in relation to labourers of other spheres. The feudalistic character of tea garden management still treats them as their bonded labours. The amenities are to be provided as per rule to the labours which is absent in almost all tea gardens. The development and living-standard of the people of village of West Bengal is induced by Panchayeti Raj since 1978 but the tea garden people were deprived. Since 1997 the tea gardens were brought under Panchayet system. But Panchayet could not provide any development or make any expenditure for the betterment of the people, as the tea gardens are bind by Tea-Plantation Act. The contradiction of the two rules i.e. T.P.Act and the Panchayeti system if not resolved immediately, no development of the tea garden people and their spouses can be achieved, which ultimately may lead to a regional imbalance even within the district.

Year	No. of affected person by Malaria	Dead by Malaria	No. of affected person by Diarrhoea	No. of affected person by Water-borne diseases
1995	2375	157	263	128

1996	3225	408	212	325
1998	1734	92	306	125
2000	4302	113	159	258
2001	5449	258	286	195

Table: 1

When the hazard zonation map, hydrological map (Water quality, ground water level), land use map, socio-economic (literacy, Poverty) map and health condition map are input to a GIS and then an overlay is performed by giving weights and ranks to the various factors (Fig-3). The result of the overlay would give us areas where the precaution and awareness should be created, on what acute problem, to what level, its intensity and the type of solution that can be best used. Thus such a solution program can be compared with an other solution program, if any, conducted earlier. This would help us estimated the success and make any alteration in the solution of the 'Acute problem' of the area.

### Conclusion:

The Jalpaiguri district exhibits different pattern geomorphological, hydrological and physical set up of the Quaternary terrain comprising the interfluvial area of the Mahananda, Teesta, Torsha, Jaldhaka, Sankosh and other rivers provide evidences of parallel transverse faults. The neotectonic movement controls the drainage pattern, topography and groundwater. GIS has been utilized in the storage and retrieval of attribute spatial and non-spatial data such as land use, soil, water quality, socio-economic, and health condition of district. Natural resource is the heart of the district but which is faces the problem by the natural and large scale human induced activity and its consequential hazards such as deforestation, flooding though frequently river shifting, soil erosion and degrade of water resource system due to intensive used of chemical fertilizers and pesticides of tea garden belts for increasing production. The various chemical parameter of water quality shows abnormality in surface and sub- surface water in monsoon periods rather than others seasons which effect falls in the health conditions of tea garden belts. Low literacy, poverty and lack of awareness are indirectly caused of the poor condition of health of tea garden belts. Integrated thematic maps with spatial and non-spatial data help the planner and decision maker to take special attention which areas are appropriate to set up adult education centre or Public Health Centre to increase or improve the literacy rate or health condition and safe drinking facility. From the foregoing details of different thematic layer with spatial and non-spatial in different aspects is apparent that a comprehensive methodology will be necessary for environment development, which is the bed- rock of development for the whole country.

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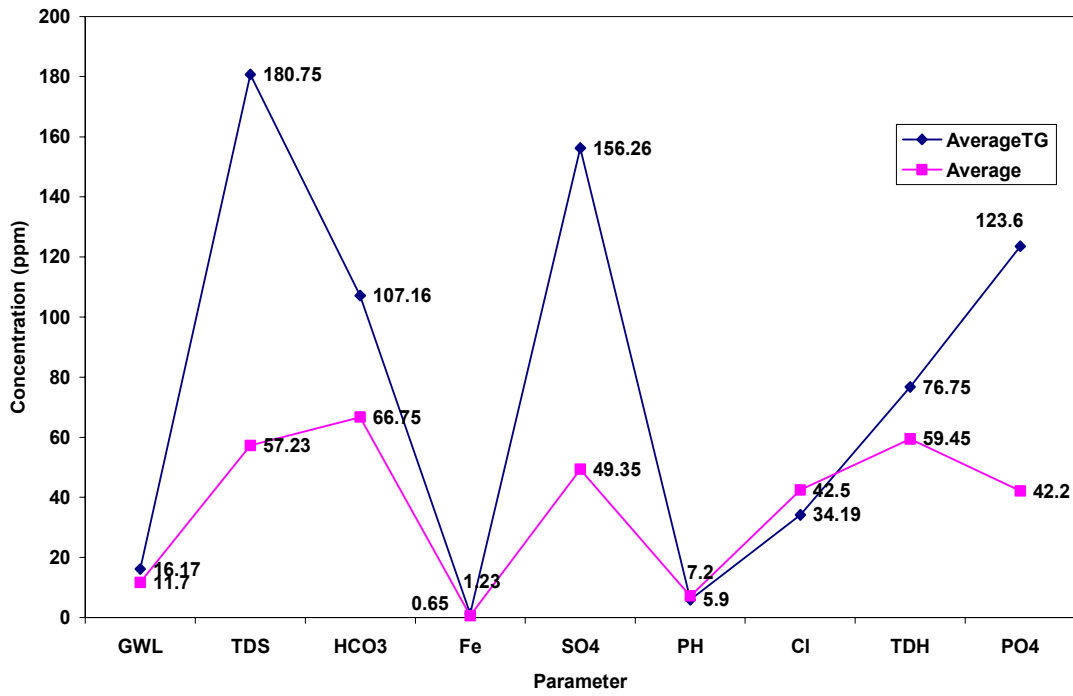


Fig-2, Compare study of Ground water Quality

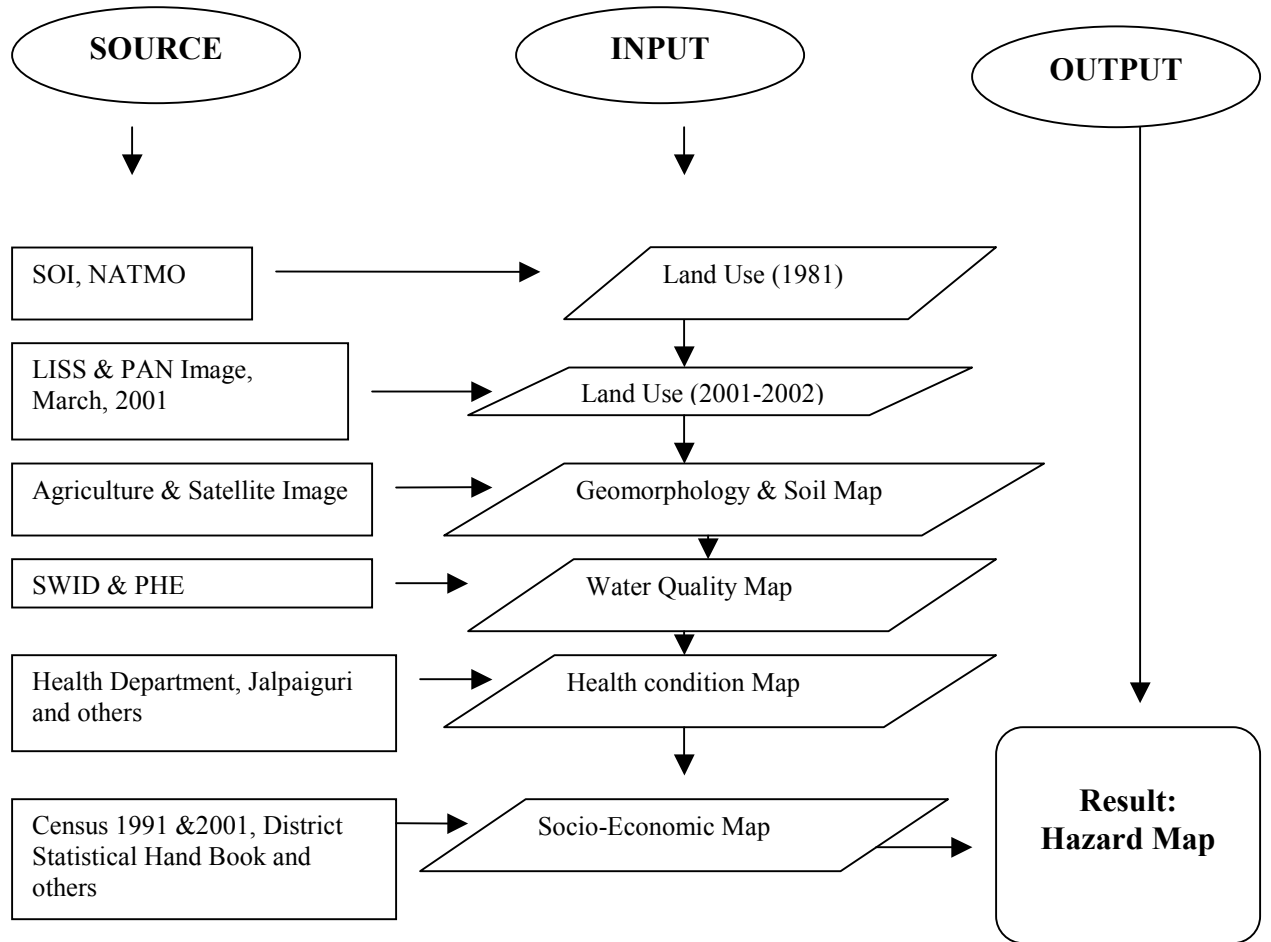


Fig -3 Step of GIS Analysis