Forest Vegetation Analysis and Land Cover Assessment in Tan Sub Watershed of Hasdeo River Basin, Chhattisgarh, India

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What is a Forest?

The forest is a complex ecosystem consisting mainly of trees that buffer the earth and support a myriad of life forms.

FAO Forest Definition

- **The FAO defined forest as land with tree crown cover (or equivalent stocking level) of more than 10 percent and area of more than 0.5 hectare.**
- **The trees should be able to reach a minimum height of 5 m at maturity in situ.**

Forests are further subdivided into plantations and natural forests.

Natural forests are forests composed mainly of indigenous trees not deliberately planted.

Plantations are forest stands established by planting or seeding, or both, in the process of afforestation or reforestation.

Role of Forest

The trees help create a special environment which, in turn, affects the kinds of animals and plants that can exist in the forest.

They clean the air, cool it on hot days, conserve heat at night, and act as excellent sound absorbers.

Forests are the most valuable natural resources available to the mankind on planet earth. Trees are an important component of the environment.

On the one hand, they are the essential source of livelihood for the poor and marginalized sections of the society; it also they provide furniture and other items of desire for the rich.

Contd…..

Role of Forest

Plants provide a protective canopy that lessens the impact of raindrops on the soil -reducing soil erosion.

The layer of leaves that fall around the tree prevents runoff and allows the water to percolate into the soil. Roots help to hold the soil in place.

Dead plants decompose to form humus, organic matter that holds the water and provides nutrients to the soil.

Plants provide habitat to different types of organisms. Birds build their nests on the branches of trees, animals and birds live in the hollows, insects and other organisms live in various parts of the plant.

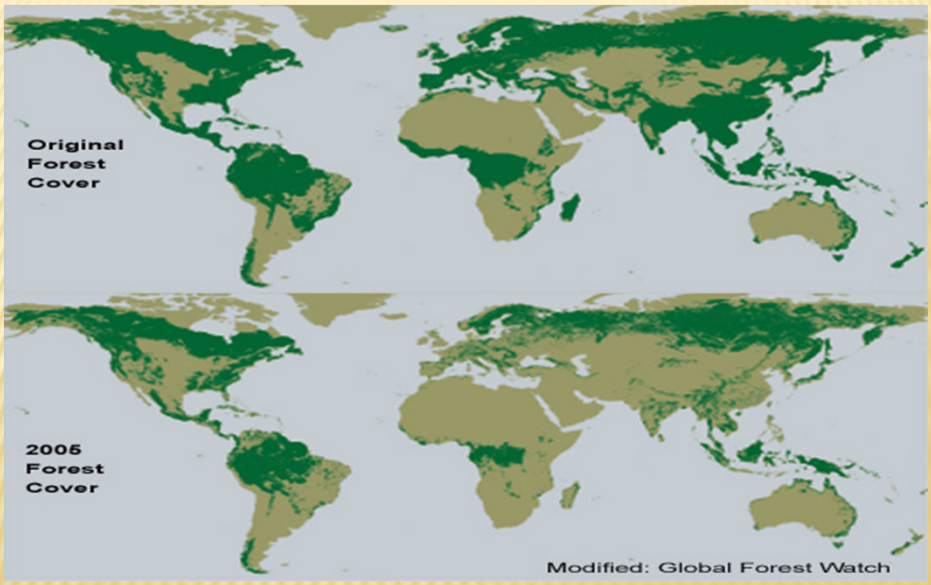
They produce large quantities of oxygen and take in carbon dioxide. Transpiration from the forests affects the relative humidity and precipitation in a place.

Agro-Climatic Conditions

Forests can develop wherever the average temperature is greater then 10 C in the warmest month and rainfall exceeds 200 mm annually.

In any area having conditions above this range there exists a variety of tree species grouped into a number of forest types that are determined by the specific conditions of the environment there, including the climate, soil, geology, and biotic activity.

FOREST DISTRIBUTION IN WORLD



TOTAL FOREST COVER OF THE WORLD
=4 BILLION HECTARES
=30.3% (FAO report, 2005)

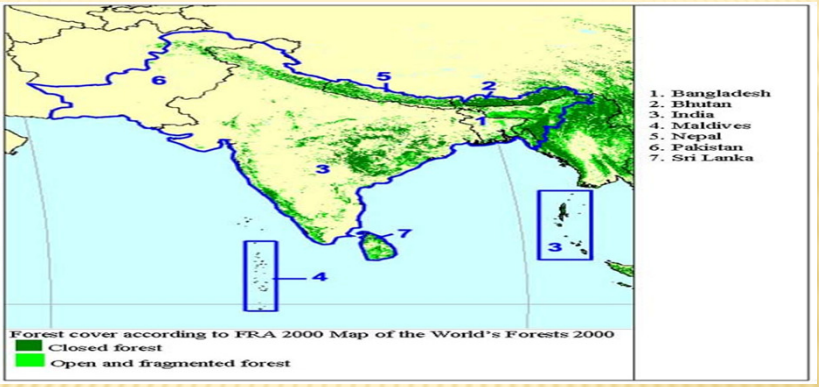
IMPORTANT FACTS ABOUT THE WORLD FOREST:

- World has about 4 billion ha or about 40 million sq km or 30.3% of total land area forest
- Forest area per capita is 0.62 ha
- 64 countries have less than 10% of their total land area under forest
- 45 countries have more than 50% of their total land area under forest
- Each year about 13 million ha of the world forest are lost due to deforestation
- Forests are home to 300 million peoples around the world
- In developing countries about 1.2 billion peoples rely on agro forestry farming system that help to sustain life
- Global employment in the farm forestry sector : 17 Million peoples.
- Forest provide habitat to about 2/3 of all spices on the earth.
- Deforestation accounts for up to 20% of the global green house gas emission that causes global warming.

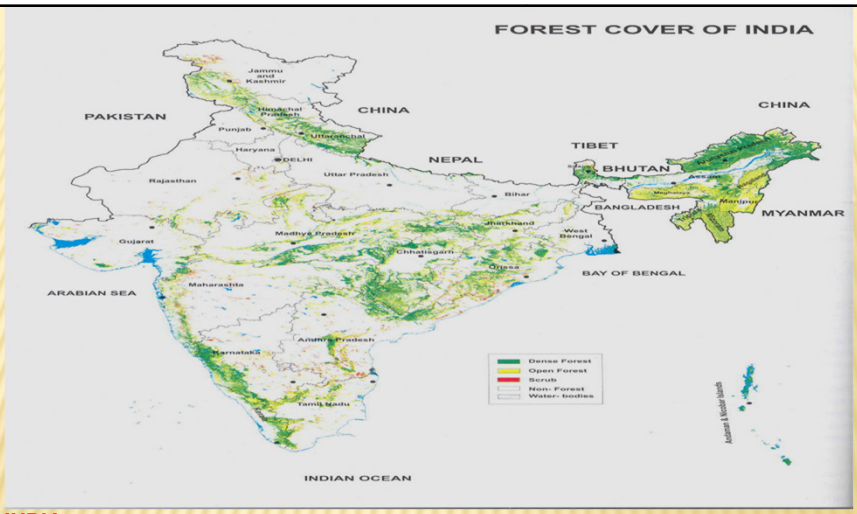
Most primary forest cover in World:

1	BRAZIL	415,890
2	RUSSIAN FEDERATION	255,470
3	CANADA	165,424
4	UNITED STATE OF AMERICA	104,182
5	PERU	61,065
6	COLOMBIA	53,062
7	INDONESIA	48,702
8	MEXICO	32,850
9	BOLIVIA	29,360
10	PAPUA NEW GUINEA	25,211

South Asia: forest resources



Country/area	Land area	Natural forest	plantation	area 2000	Total forest		Area change 1990-2000(total forest)	
	000 ha	*000 ha*	*000 ha*	*000 ha*	*%*	*ha/ capita*	*000 ha/ year*	*%*
Bangladesh	13 017	709	625	1 334	10.2	n.s.	17	1.3
Bhutan	4 701	2 995	21	3 016	64.2	1.5	n.s.	n.s.
India	297 319	31 535	32 578	64 113	21.6	0.1	38	0.1
Maldives	30	1	-	1	3.3	n.s.	n.s.	n.s.
Nepal	14 300	3 767	133	3 900	27.3	0.2	-78	-1.8
Pakistan	77 087	1 381	980	2 361	3.1	n.s.	-39	-1.5
Sri lanka	6 463	1 625	316	1 940	30.0	0.1	-35	-1.6
Total	**412 917**	**42 013**	**34 652**	**76 665**	**18.6**	**0.1**	**-98**	**-0.1**
Total	**3 084 746**	**431 946**	**115 847**	**547 793**	**17.8**	**0.2**	**-364**	**-0.1**
TOTAL WORLD	**1,3 0,63, 900**	**3 6,82, 722**	**1,86, 733**	**3 8,69, 455**	**30.6**	**0.6**	**-9 391**	**-0.2**



IN INDIA:

Forest Cover (in hectares)	:	67,701,000
Forest Cover (as % of total land area)	:	22.8%
Other wooded land (in hectares)	:	4,110,000
Other land with tree cover (in hectares)	:	815,000
Total land area (in hectares)	:	328,726,300

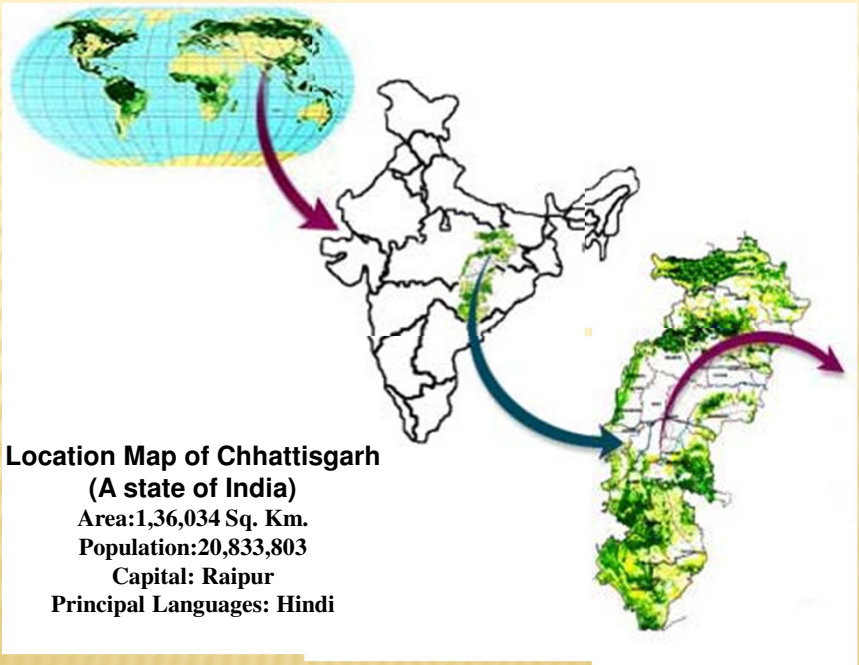
(IRS-P6 LISS III 2008)

Different types of forests in India

India has a large and diverse forest resource. The country's very large population means, that intense demands are placed on its forests.

India's forest types vary from tropical rainforest in north-eastern to desert and thorn forests in Gujarat and Rajasthan; mangrove forests in West Bengal, Orissa and other coastal areas and dry alpine forests in the western Himalaya.

The most common forest types are tropical moist deciduous forest, tropical dry deciduous forests found in Madhya Pradesh and Chhattisgarh and wet tropical evergreen forests.



Location Map of Chhattisgarh
(A state of India)
Area:1,36,034 Sq. Km.
Population:20,833,803
Capital: Raipur
Principal Languages: Hindi

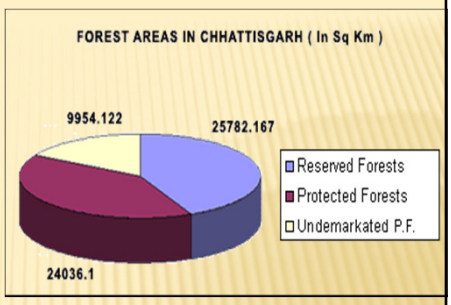
CHHATTISGARH FOREST AT A GLANCE

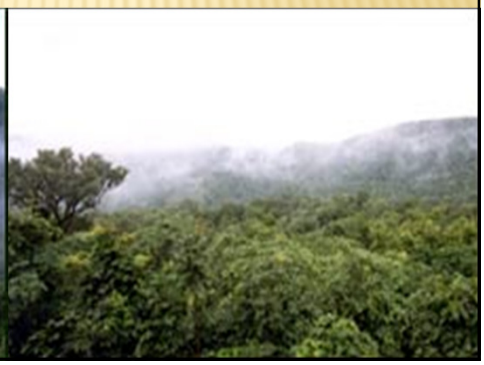
- Forest area : 59,772 sq.km. (44% of geographical area)
- Forest cover :
  - 55998 sq. km.
  - 8.26% of forests cover of India.
  - 3rd largest forest cover in India.
- Main tree species : Sal, Teak, Bija, Haldu, Saja, Aonla, Mahua, Arjun, Bamboo etc.
- Main wildlife species : Tiger, Panther, Wild buffalo, Gaur, Chital, Barking deer, Sambhar, Boar, Wild dogs, Hill Myna, Migratory Elephants etc.

CHHATTISGARH FOREST AREA

Reserved Forests	25782.167 Sq.Km.
Protected Forests	24036.100 Sq.Km.
Un-demarkated Protected Forest	9954.122 Sq.Km.

Total Forests : 59772.389Sq.Km.





The main forest tree species and herbs/shrubs found in Chhattisgarh forest are Sal (*Shorea robusta*), Teak (*Tectona grandis*), Bija (*Pterocarpus marsupium Roxb.*), Saja (*Terminalia tomentosa*), Haldu (*Adina cordifolia*), Mahua (*Madhuca indica*), Tendu (*Diospyros melanoxylon*), Harra (*Terminalia Chebula*), Khair (*Acacia catechu*), Babool (*Acacia nilotica*), Sirish (*Albizia procera*), Shisham (*Dalbergia letifolia*), Palash (*Beutia monosperma*) and Bamboo (*Dendrocalamus strictus*), Amla (*Phyllanthus emblica*), Bhui neem (*Andrographis peniculata*), Kali musli (*Curculigo orchioides*), Malkagni (*Celastrus paniculatus*), Safed musli *(Chlorophytum borvillinium)*, Asparagus *(Asparagus racemosus)*, Tikhur *(Curcuma angustifolia)*, Aloe vera *(Aloe barbadensis Linn)*, Ashwagandha *(Withania somnifera)*, Bach *(Acorus calamus)*, Sarpgandha *(Rauvolfia sarpentina)*, Tulsi *(Ocimum sanctum)*, Citronella grass (Cymopogon winterianus), Lemon grass (*Cymopogon flexuosus)* and Kalihari *(Gloriosa superba*) etc.

Introduction of Hasdeo River Basin

•In Chhattisgarh, Mahanadi river has three major tributaries like Sheonath river, Hasdeo river and Mand river.

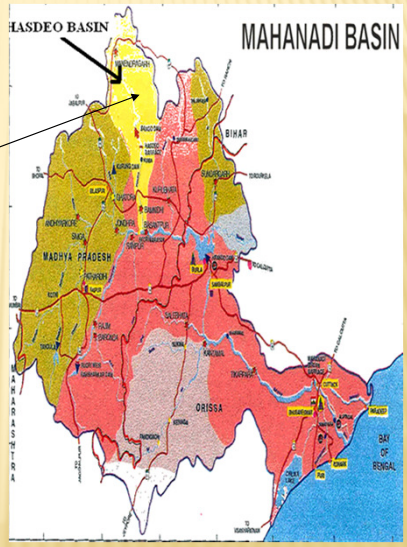
•Hasdeo river basin is one of the major basins in the northern and central Chhattisgarh region. It is located between the $21^0$45'N to $23^0$37'N latitude and $82^0$00'E to $83^0$04'E longitude.

•It flows from north to south direction and meets in Mahanadi after covering the length of 330 kms. It has 10,405.99 sq kms catchment area.

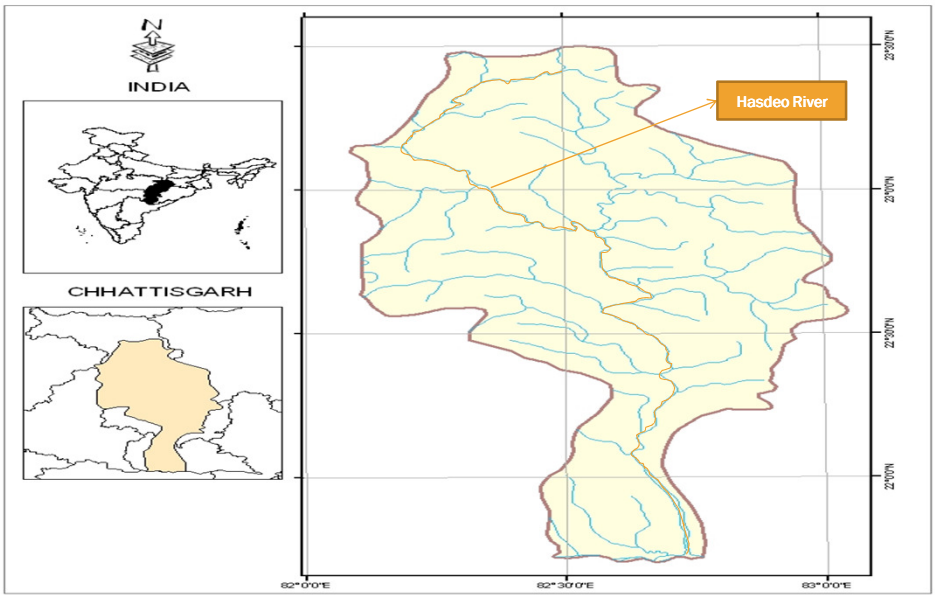
•The Hasdeo river basin has eight main sub watersheds namely, Upper Hasdeo, Bamni, **Tan**, Gej, Ahiran, Chornai, Lower Hasdeo and Lower Basin Mahanadi **(Source: Central Ground Water Board, India) .**

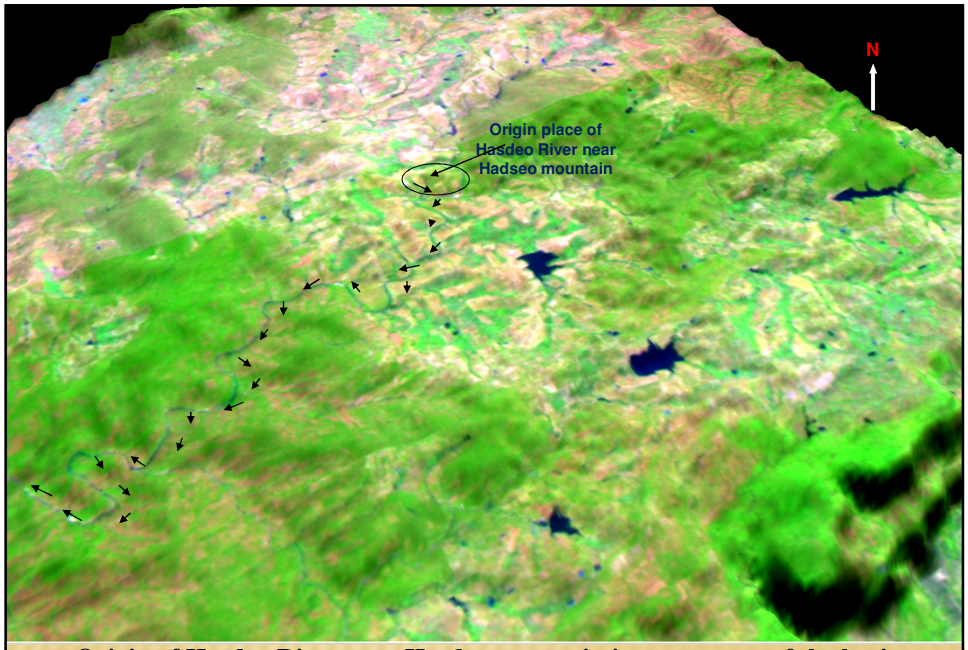
•The Upper Hasdeo, Gej, Tan and Chornai sub watersheds were identified as those that could benefit most of the upper part of the basin and occupying 47% of the total area, together they account for 68% of the sediment and 73% of the water supplied by the eight sub watersheds of the Hasdeo River.

LOCATION MAP OF HASDEO RIVER BASIN



Hasdeo river basin





Origin of Hasdeo River near Hasdeo mountain in upper part of the basin : Imagery of IRS-P6 LISS 3 date 29.10.2008

Introduction of Tan Sub Watershed

•Tan sub watershed is situated in western part of the Hasdeo basin in between $22^0$34' N to $22^0$47' N latitude and $82^0$00'E to $82^0$37' E longitude.

•This sub watershed covers 870.44 sq km area.

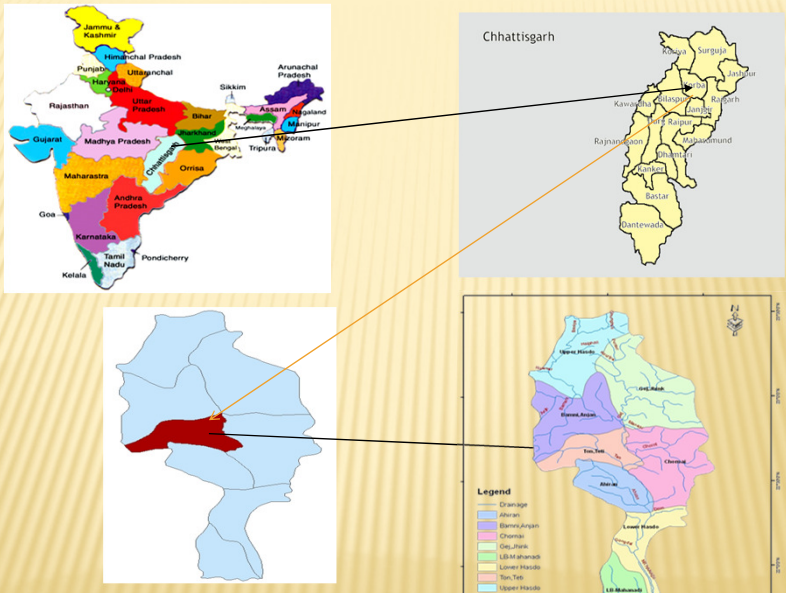
•The total population of the area is 2.67 lacs (Census of India, 2001). The area consists of hilly and mountainous terrain with minimum elevation of 423 m to maximum elevation of 702 m in the sub watershed.

•The climate is generally sub–tropical characterized by summer and rainy months. The whole area is depending upon the monsoon.

• The temperature varies from 24.7^0 C to 44^0 C in summer and 11.4^0 C to 26.4^0 C in winter and the relative humidity recorded 25.5 to 93% in the area.

•The geological structure of the sub watershed is gondwana super rock which covers most part of the sub watershed. The soil of the area is almost fine – loamy and rest area has clays soil.

•Rich forest biodiversity in the area.



Location map of Tan Sub watershed in Hasdeo river basin

MATERIAL AND METHOD USED FOR FOREST LAND USE/ LAND COVER STUDY IN TAN SUB WATERSHED

•Images obtained from IRS P6 LISS III dated 26.10.2008 path 102 rows 55/56 is used.

Following hardware and software were used for image processing and GIS analysis:

•Hardware:

During present study the image processing was carried out in a system with Pentium Processor, 4GB RAM and 24 bits Graphics Windows acceleration Board with resolution of 1024 x 768.

•Software:

➢ArcGIS 9.3 (ESRI)

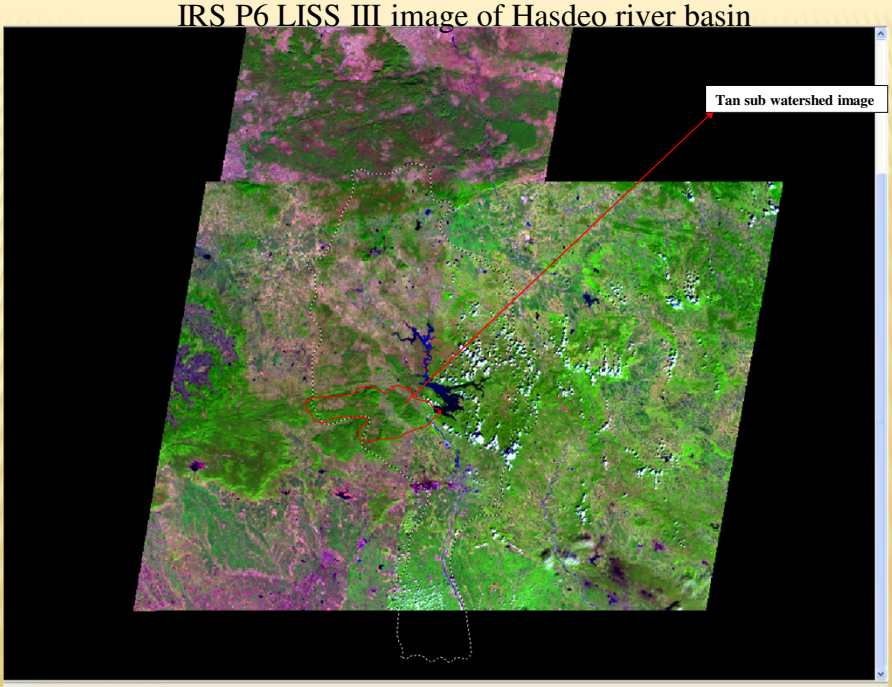
➢ERDAS IMAGINE 9.5 (Leica) software for image processing

•MS Office XP: MS-Excel, Ms-Word for word processing

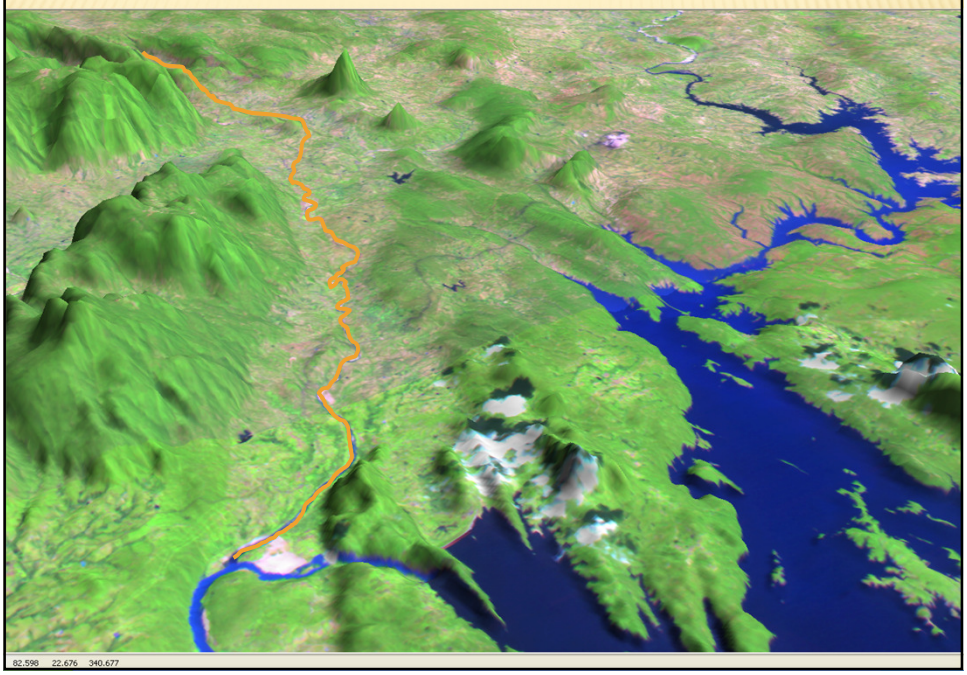
PRELIMINARY INTERPRETATION:

The study is primarily based on topographical sheets on scale 1:50,000/1:25,000 published by the Survey of India (SOI).

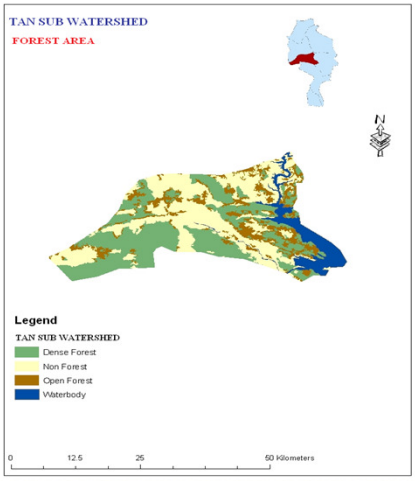
IRS P6 LISS III image of Hasdeo river basin



Tan sub watershed catchment and its LULC pattern



Forest vegetation land cover distribution in Tan sub watershed (IRS-P6 LISS III Dated 26.10.2008)



Forest Land Cover Type	Area (in sq. Kms.)	% area
Dense forest (DF)	308.808	35.48
Non Forest (NF)	218.357	25.09
Open Forest (OF)	186.406	21.42
Scrubland (SBL)	00.00	0.00
Water bodies (WBD)	156.869	18.02
Total	870.44	100

Non Forest land cover distribution in sub watershed

Non Forest Land Cover Type	Area (in sq. Kms.)	% area
Agriculture land without Crop	164.738	75.44
Agriculture land with Crop	53.619	24.56
Total	218.357	100

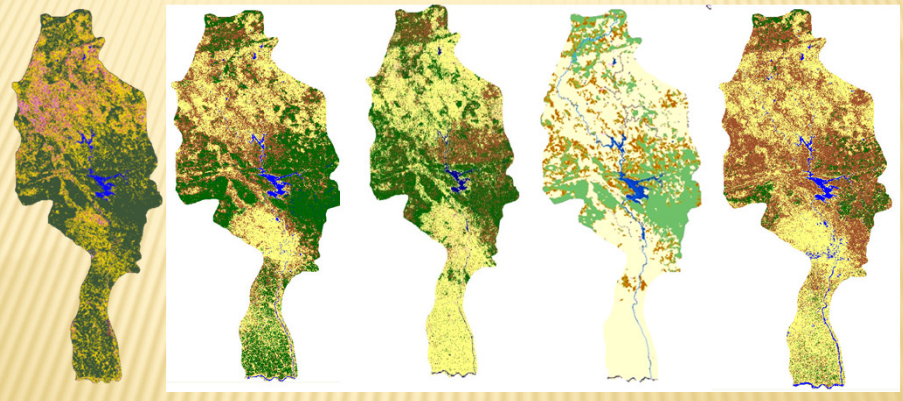
Some snap shots of Tan sub watershed area

FOREST LAND USE/LANDCOVER (LULC) IN HASDEO RIVER BASIN

Spatio-temporal variation in Forest land cover classes:

Forest Land Use / Land Cover Class	1999 (Landsat +ETM)		2006 (Landsat ETM SLC off)		2007 (Landsat ETM SLC off)		2008 (IRS P6 LISS3)		2009 (Landsat5 TM)	
	Area (Sq.km.)	%	Area (Sq.km.)	%	Area (Sq.km.)	%	Area (Sq.km.)	%	Area (Sq.km.)	%
Dense Forest	3105.57	**29.85**	2718.78	26.14	2688.19	25.83	2405.58	23.13	2323.65	**22.33**
Non Forest	2970.32	**28.55**	3256.21	31.24	3344.37	32.13	3653.63	35.14	3865.72	**37.14**
Open Forest	1322.61	**12.71**	1578.09	15.16	1595.36	15.33	1632.63	15.70	1690.00	**16.26**
Scrubland	12.81	**0.12**	22.58	0.21	23.00	0.22	24.50	0.23	25.05	**0.24**
Water bodies	2994.68	**28.78**	2830.33	27.25	2755.05	26.47	2689.65	25.87	2501.57	**24.05**
Total	10405.99	100	10405.99	100	10405.99	100	10405.99	100	10405.99	100

TEMPORAL CHANGE DETECTION OF THE HASDEO RIVER BASIN IN FOREST POINT OF VIEW



- DENSE FOREST - NON FOREST - OPEN FOREST - SCRUBLAND - WATERBODIES

1999 2006 2007 2008 2009

Forest Land Cover Change Detection in Hasdeo river basin between year 1999 to year 2009

	1999-2006		2006-2007		2007-2008		2008-2009		2006-2009		1999-2009	
	Change		Change		Change		Change		Change		Change	
Forest land Cover Class	Sq kms	(%)	Sq kms	(%)	Sq kms	(%)	Sq kms	(%)	Sq kms	(%)	Sq kms	(%)
Dense Forest	-386.79	**-3.71**	-30.59	**-0.31**	-282.61	**-2.7**	-81.93	**-0.8**	-395.13	**-3.81**	-781.92	**-7.52**
Non Forest	+285.89	**+2.69**	+88.16	**+0.89**	+309.26	**+3.01**	+212.09	**+2.0**	+609.51	**+5.9**	+895.4	**+8.59**
Open Forest	+255.48	**+2.45**	+17.27	**+0.17**	+37.27	**+0.37**	+57.37	**+1.09**	+111.91	**+1.1**	+367.39	**+3.55**
Scrubland	+9.77	**+0.09**	+0.42	**+0.01**	+1.5	**+0.01**	+0.55	**+0.01**	+2.47	**+0.03**	+12.24	**+0.12**
Water bodies	-164.35	**-1.53**	-75.26	**-0.78**	-65.42	**-0.6**	- 188.08	**-1.84**	-328.76	**-3.22**	-493.11	**-4.73**

NB: (+) indicates increasement, (-) indicates decreasement

CONCLUSION/SUGGESTION

- Remote Sensing Technique is a gift for forest to find its status more accurately and think for the conservation and protection of the available or to increase the forest resources.
- GIS based method to estimate future forest land cover in any watershed and helps to make a management plan for the better livelihood protection.
- Forest is a good source of water and due to deforestation most of the rivers, waterholes are dried or dry in summer in all over the world.

THINK.....

Is forest deforestation is the best idea for modern development in the world?????????????

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THANK YOU

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