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Long Term Monitoring of Landuse/Landcover Through Remote Sensing and Geographical Information System in Great Himalayan National Park, Himachal Pradesh

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CONTENTS

1.0 INTRODUCTION

The Himalaya is one of the most fragile Ecosystem on the earth. The dwindling forests have had a serious impact on wildlife resources because of loss of habitat. Management of wildlife depends on the basic understanding of biotic and abiotic elements of habitat such as animal, vegetation, water, soil, geomorphology and geology etc.

There is a need to develop an integrated approach to both management and conservation of wildlife. This is often the area of great interest to ecologists and conservationist who are invariably concerned about external pressure on wildlife and threats to its continued survival.

The basic aim of Forestry Research Education and Extension Project in the Great Himalayan National Park (GHNP) is to conserve biological diversity whilst fulfilling the needs of local through an Ecodevelopment approach. Mapping of major vegetation communities is one of the objective of task no. 5 using Remotely Sensed Data including broad density classes. The park has been classified through visual interpretation into 11 forest and 12 non forest classes (Naithani & Mathur, unpublished). Density classes are as per the FSI norms, closed forest : canopy cover >40% and open forest : canopy cover 10 - 40%. The detailed classification based on floral inventory which is in progress (Singh & Rawat, unpublished).

On the basis of visual interpretation with limited ground checks, the Satellite data FCC (False Colour Composite paper print) on 1: 50,000 scale of IRS IB of 1993 with standard band combination has been used for the study. The season chosen is Sept/Oct, which is appropriate for doing studies in higher Himalayan region. The ancillary data Survey Of India toposheets on 1:50,000 scale 53E/5, 53E/6, 53E/9, 53E/10, 53E/13 and 53E/14, Park map, Management plan and existing thematic maps were use to prepare the final vegetation map.

The whole park is divided into an Ecodevelopment Zone, Sainj sanctuary, Tirthan sanctuary and main Great Himalayan National Park. Along with a generation of above layers the change detection analysis for the Ecodevelopement Zone has been done on 1961 SOI toposheets and 1993 satellite data paper print on 1:50,000 scale. It reveals that the overall change is about 12.79% and the increased area is about 8.48%. The decreased area is about 4.31% (Naithani & Mathur unpublished). The following layers for all the areas have been prepared with area statistics density classes, and are shown in the Appendices.They include

* Vegetation map, Cover density map, Contour map, Drainage map, Slope map, Aspect map, Digital Terrain Model and a Geologycal map.

For continuous & accurate monitoring of vegetation Remote Sensing and Geographical Information Systems is being used as a tool periodically under the specified season.

2.0 MONITORING

Change in Landuse/Landcover in time and space is called Monitoring. These changes may be Natural e.g. Landslides, Regeneration, Fire and Induced i.e. Excessive grazing, Illegal felling, Encroachment etc. The season is also important, particularly when trying to measure change.

2.1 ROLE OF REMOTE SENSING IN MONITORING

Effective use of Remote Sensing can only be achieved if the user understands the relationship between the characteristics of vegetation canopy and its spectral signature as measured by the sensor. Major use of this techniques for vegetation mapping, have proved its usefulness for mapping and monitoring .

Ground based photography is one of the simplest forms of Remote Sensing, but one problem is its high resolution which is not representative of the resolution of aerial photograph or more particularly satellite data.
(Budd . 1991). Salient features of the role of Remote Sensing:

- Repetitiveness in data acquisition for large area such as GHNP which is not possible by conventional methods.
- Information acquisition in inaccessible areas, where reaching is not easy.
- Save time and money.
- Pin points the change areas.
- Data on different season and resolution.
- Information generation at different levels- I, II, III.
- Whereas digital data are permanent data.
- Information is unbiased.

2.2 SIGNIFICANCE

The significance of Remotely sensed data and Geographical Information System for long term monitoring is as follows:

- It is a historic data, the satellite data acquisition is started from 1975 onwards whereas aerial photography has been started from 1960.
- Satellite acts as an Eye in the Sky and covers a large area.
- Temporal data acquisition is available and enables the change to be seen.
- Proportion of forest types/non forest type, area of extent and density cover can be observed with area estimation.

- Enables the planner and decision maker to know the past and present scenarios.
- Helps in locating the action areas.
- Wide variety of spectral bands.
- Low cost of data.
- Digital data processing allows quantitative analysis of the reflectance value.
- Integration with GIS without expensive data capturing system, i.e. Photogrammetric equipment.

Remote Sensing technique with integration of GIS is better than any other used for all Ecological monitoring tasks (Budd 1987).

2.3 INDICATORS

Indicators for any change in the area can be observed through Remote Sensing and are as follows:

√ Presence of exotic sp.,
√ disturbance
√ Change in reflectance value
√ Early warning of disease.

3.0 METHODS OF LANDUSE/LANDCOVER MONITORING

The methodology used for mapping the Landuse/Landcover is described below:

The ground truths/sampling plots have been taken on the basis of forest/non forest classes, on the basis of an Interpretation key & Classification scheme used in major routes of the park with the help of toposheets. Vegetation structure profile and canopy cover estimation were plotted on a 2cm graph sheet.

The 25m x 10m quardrats were laid down in different forest types. Girth at breast height (GBH), structure and species composition were taken at each sampling plot along with altitude, aspect, slope, terrain, and vegetation type.. An example is given in Fig. No. 1

The overall mapping for park and change detection analysis (Ecodevelopement Zone) has been done. For illustrations of methodology, results, & aerial estimations please refer to the Appendix 1a to1b, 2a to 2d, 3a to 3c, 4a to 4j and 5a to 5j.

4.0 CONCLUSION

4.1 PLANNING MONITORING PROGRAMME

After two years of the project a vast amount of baseline information including detailed methodologies devised to measure indicators has been developed. Actual monitoring based on research work is now required.

For the involvement of the park staff a workshop on a Planning Monitoring Programme for the Great Himalayan National Park conservation area was held at SAI-ROPA, KULLU, HIMACHAL PRADESH on 21-22 May,1998.

All researchers from the Wildlife Institute of India working in GHNP presented their work. Afterwards the group presentations were made. The Botanical group has decided upon the precious & important parameters for different forest types, plant species, medicinal plants and grasslands. The monitoring of major vegetation types & grasslands will be carried out using the remote sensing technique in the months of Sep./ Oct.,in three to five years intervals. The total approach shown in Table No. 1

As far as the training of front line staff is concerned the training will be completed between 15th June to 23 June of 1998 at Shangarh in Sainj Valley. The abstract of training through remote sensing technique is given separately as Appendix 6.

Finally the details regarding monitoring through remote sensing, which are required under project mode are given in Appendix 7a to7c.

REFERENCES

Budd, J.T.C., 1987. Remote sensing applied to the work of the NCC in upland areas, in *Ecology and Management of Upland Habitats*: the Role of Remote Sensing, Remote Sensing Special publication No.2 . Department of Geography, University of Aberdeen, Aberdeen.

Budd, J.T.C., 1991. Remote Sensing Techniques for monitoring Land -cover Monitoring for Conservation and Ecology Edited by F.B. Goldsmith , Chapman and Hall : 33-59

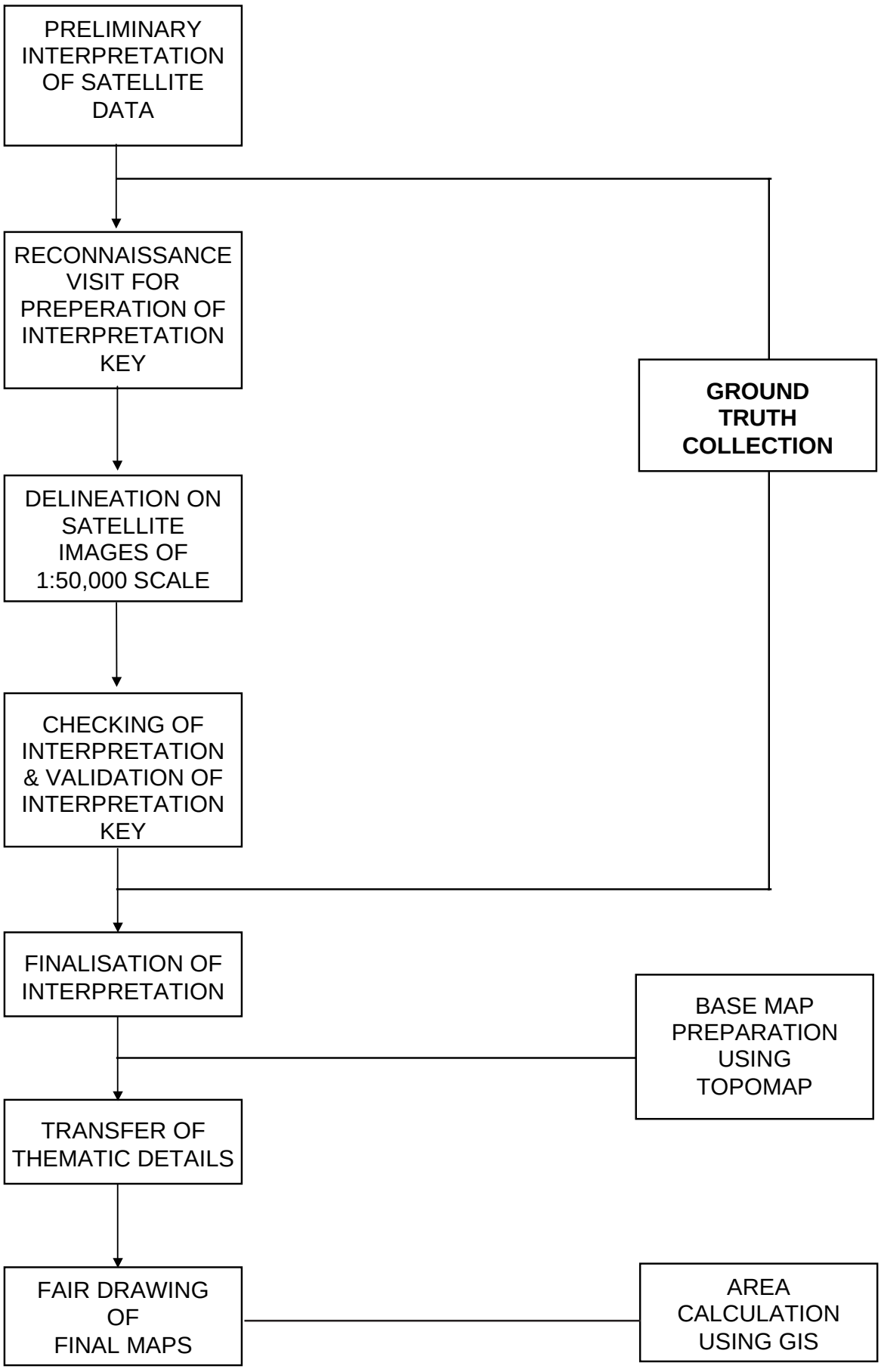
TABLE 1

Monitoring of Major Vegetation Types and Grasslands

Veg. Type	Why	What	How	Where	When Sept/Oct.
Lower Tree Line	To see the impact of human intervention	Lopped / unlopped Encroachment.	Site Photograph R.S. Tech. Visual Observation.	Shangarh	Once in 3 years
Upper Tree line	Sensitive or impo. Eco-Zone	Continuity/ Vertical shift	R.S. Tech.	Dhela	Once in 5 years
Alpine Meadows	Ecological Biodiversity	Cover/ Extent	Cover estimation (2 step method)	Impo. Thatches	Once in 3 years
Riparian Zone	Ecological/WL Values	Extent/Shift	R.S. Tech, Site Photo	Tirthan, Sainj valleys	Once in 5 years
Grasslands a: Ghasnees b: Forest Blanks/ Thatches	 Hay Production Encroachment / Degradation of forest	 Structure/ Expansion ---Do-----	 Cov. Estimation 2 step method R.S. Tech.	 Opposite Kharongcha, Lappha Major routes of Graziers	3-5 years 3-5 years

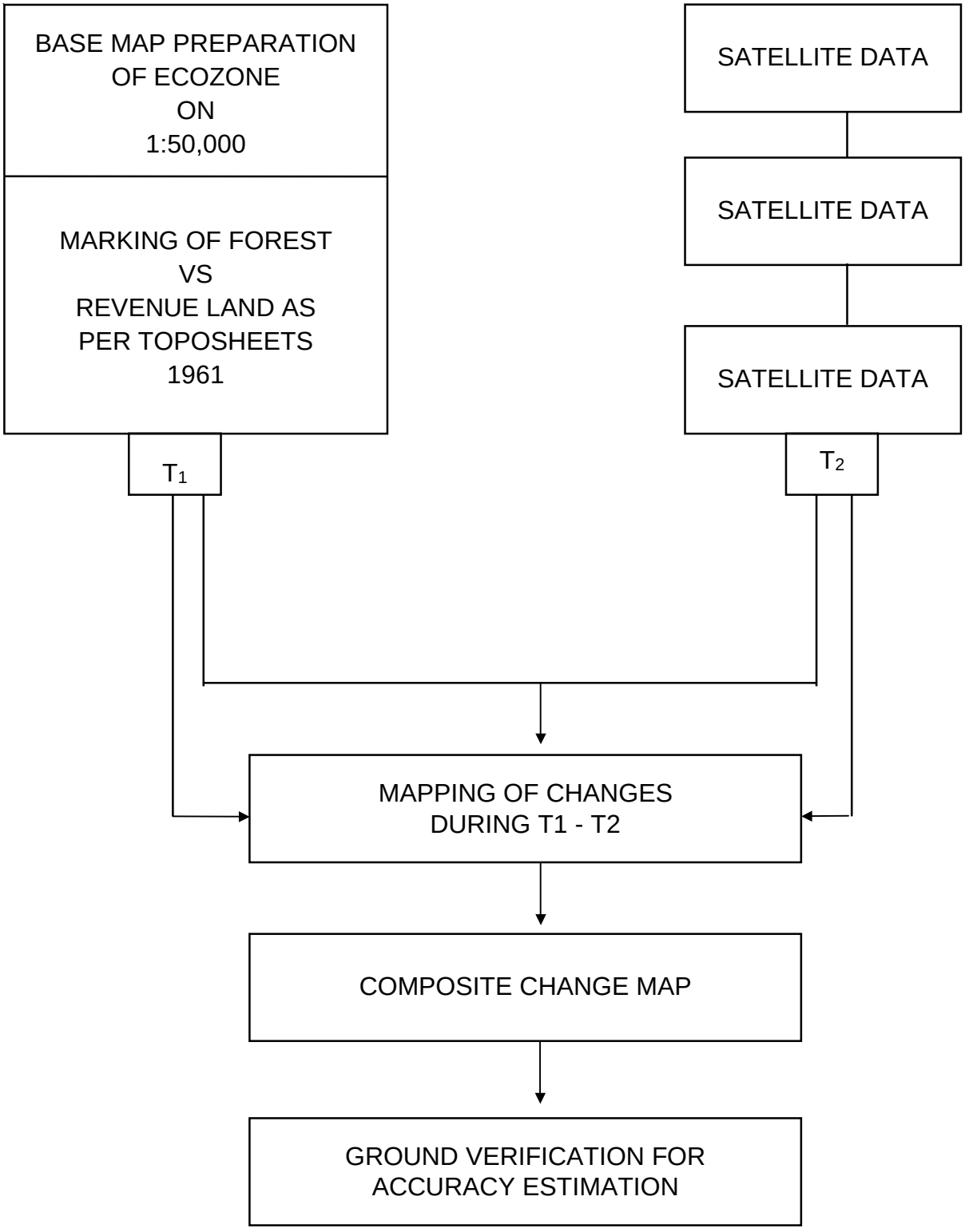
APPENDIX - 1a

Steps in Landuse/Cover Mapping Through Visual Interpretation of Satellite Images



APPENDIX -1b

Flow Chart of Change Detection in Landuse/Cover Mapping



APPENDIX - 2a

Interpretation key for forest type and land use mapping of GHNP using IRSLISS II data band combination 432, on *1:50,000 scale*

TONE	TEXTURE	PHYSIOGRAPHY	Elevation [Garson and Gaston (1993)]	TYPE	Veg. Association
Bright red	Medium to coarse	Moderate to steep slope of hill	600-1700m.	Sub tropical pine forest Mainly chir pine	**Conifer** Chir pine-*Pinus roxburgh*
Brownish red to dark brown	Medium to coarse	All the study area and all aspect with varying density till the beginning of sub alpine	1500-3300m.	Himalayan moist temp. forest	Mixed confer, *Pinus wallichiana Abies pindrow Picea smithiana Cedrus deodara* Shrubs- *Rosa* sp., *Berberis* sp., on Southern aspect. *Arundinaria* sp., and *Viburnum*sp.,on Western aspect
Red to Brownish red to bright red with whitish tinge	Medium to coarse	Gentle to medium slopes with thick soil cover in all study area and along nallas	1500-3300m.	Himalayan moist temp. forest	Conifer mix with broad leaved *Pinus wallichiana*, *Abies pindrow*, *Quercus leucotrichophora, Quercus floribunda, Acer* sp., *Aesculus indica*, *Prunus cornuta* Shrubs- *Rosa* sp., *Arundinaria* sp., *Berberis* sp., and Ferns

Various shades of Red to Brownish red	Medium to coarse	Gentle to Medium slopes and spurs on the ridges, soil cover sufficient	1500-3300m	Himalayan moist temp. forest	Broad leaved mix with Conifer Upper storey- *Quercus semecarpifolia, Betula utilis*, *Abies pindrow*, *Taxus bacata*, *Prunus cornuta*, *Acer* sp., Under storey- *Viburnum* sp., *Lonicera sp., Rosa* sp., *Arindinaria* sp., etc.
Bright red to deep red	Medium to coarse	Along gentle to medium slopes, Moist containing areas, Along nalas and village surroundings	1500-3300m.	Himalayan moist temp. forest	Broad leaved Upper storey- *Quercus floribunda*., *Aesculus indica*., *Quercu leuchotrichophora*., *Betula alnoides*., *Q. semecarpifolia*., *Prunus*.sp., Understorey- *Rhododendron campanulatum*., Bamboo braks, *Viburnum* sp., *Berberis* sp., *Indigofera sp., Rosa sp., Sorbaria* sp., and grasses
Light Red to Brownish red	Medium to coarse	Along river bed only in low elevated areas of park	Up to 2500m.	Himalayan moist temp. forest	*Aluns nitidula* sp.,
Light pink with varying shades of greyish and brownish tinge	Medium to coarse	Higher to medium slopes and around villages also	1500-3300m.	Himalayan moist temp. forest	Secondary scrub *Berberis chirita*., *Spirea* sp., *Indigofera* sp., *Rosa* sp., *Pinus wallichiana* sp *Abies sp., Acer* sp., and grassess

Pinkish yellow green tinge	Fine to Medium	Top of the ridge portions, spurs and moist sloppy areas	Above 3000m to 3600m.	Sub-alpine and alpine zone	Dry alpine scrub *Rhododendron campanulatum*, *Juniper* sp., *Rohodendron lepidotum, Rohododendron anthopogon*, with grassess, like *Poa himalayana, Danthonia cachemyriana*
Light red yellowish and green tinge	Fine to Medium	Generally all types of slope	1500-3600m.	Temp., sub-alpine and alpine grass lands. (Have been Classified through GIS in a separate layer)	Grass lands *Poa annua, Poa alpina, Agrostis, Danthonia cachemyriana*
Various shades of Red to Brownish Red	Medium to coarse	Medium to Higher Slopes	1500-3300m.	Temp. Zone Plantation	Plantation Mainly Conifer :*.Pinus wallichiana*, *Abies* sp., Broad leaved :*Acer* sp., and grassess
Varying shades of yellowish green with red ting	Smooth to fine	Steep to moderate slope	1500-3600m. and above	Temp. , Sub-alpine and alpine zone	Exposed rock with slope grass. Cliff Alpine exposed rocks
Bluish to cyan colour	Smooth to fine	Steep to moderate and gentle slope	1500-3600m. and above	All the study area	Land slides
Bright to white and Light grey colour	Smooth to fine	Between river channels		Along the rivers	Sand bar

Dark blue to dark brown	Smooth to fine	All the water bodies of study area,Mostly on higher elevated peneplain	Between 2000to 3000m.	specially on higher reaches	Water bodies
White to dirty white	Smooth to fine	Mostly on gentle to medium slope, specially North and North West aspect	Mostly above 3000m.	above snow line and also depend on slope and aspect	Snow
Grey to dirty grey and white	Medium to coarse	Mostly on medium to higher slope on upper reaches	Above 3600m.	Below/above snow line and confined within valley/undulated portions	Morrain
white	Fine	Mostly on upper reaches	Above 3600m.	Above morrains	Glacier
Dirty brown to grey	Medium to coarse	Mostly at middle and margins of morrain	Above 3600m.	After and within Morrain	Morrainic Ilands
Various tone of red with dark to light grey and pink	Medium to coarse	Medium to gentle slopes on south as well as South East Aspect	1300m-2500m	Mostly on moist temperate zone	Habitation/ Orchards/ Agriculture

APPENDIX - 3a

Classification Scheme for Visual Interpretation of Satllite Data

TYPE FOREST	SPECIES COMPOSITION	SYMBOL
Conifer	Pinus roxburghii	1
Mixed Conifer	Pinus. wallichiana, Abies pindrow Picea smithiana., Cedrus deodar	2
Conifer and Broad Leaved	P. wallichiana, Abies pindrow Quercus sp., Aesculus indica., Prunus sp.,	3
Broad Leaved and Conifer	Quercus sp., Betula sp., Abies sp., Taxus sp., Prunus sp.,	4
Broad Leaved	Quercus sp., Aesculus sp., Betula sp.,	5

APPENDIX - 3b

Classification Scheme for Visual Interpretation of Satellite Data

TYPE FOREST	SPECIES COMPOSITION	SYMBOL
Secondary scrub	Berberis chitra, Spirea sp., Indigofera sp., Rosa sp.,	6
Dry alpine scrub	Rhododendron sp., Junifer sp., Poa himalayana	7
Riverine	Alnus nitida dominated	8
Plantation	Cedrus deodara dominated	9
Grasslands of temp, sub alpine & alpine zone	Poa annua, Poa alpina etc	10
Grassland (slope grasses)	Berberis, Indigofera, Desmodium Salix with slope grasses	11

APPENDIX - 3c

Classification Scheme for Visual Interpretation of Satellite Data

TYPE NON FOREST	SYMBOL
Cliffs	12
Rock outcrops	13
Landslides	14
Sand bar	15
River	16
Lakes	17
Morain	18
Moranic Islands	19
Glacier	20
Snow	21
Habitation/Orchards/Agriculture	22

APPENDIX - 4a

APPENDIX - 5a

Aerial Estimation of Great Himalayan National Park Conservation Area

S.No	Type	Area in sq.km
1	Conifer (*Pinus roxburghii*)	2.08
2	Mixed conifer	127.98
3	Conifer and Broad Leaved Mixed	33.16
4	Broad Leaved	66.62
5	Broad Leaved and Conifer Mixed	83.36
6	Riperian	.14
7	Slope Grasses	25.92
8	Grasslands/ Blanks (Temp. sub Alpine & Alpine)	221.80
9	Secondary Scrub	22.28
10	Alpine Scrub	117.62
11	Plantation	.16
12	Habitation/Agrculture/Orchards	25.55
13	Exp.Rocks with Slope Grasses	27.60
14	Alpine Exp. Rocks with Slope Grasses	149.73
15.	River	4.35
16.	Lakes	.87
17.	Escarpments	33.82
18.	Landslide	.41
19.	Snow	184.01
20.	Morian	24.24
21.	Morainic Islands	.48
22.	Glaciers	18.82
	Total	**1171**

APPENDIX - 4b

APPENDIX - 5b

Aerial Estimation of Great Himalayan National Park Conservation Area - Ecozone

S.No	Type	Area in sq.km
1	Conifer (*Pinus roxburghii*)	2.18
2	Mixed conifer	73.86
3	Conifer and Broad Leaved Mixed	10.63
4	Broad Leaved	30.10
5	Broad Leaved and Conifer Mixed	45.20
6	Riperian	.14
7	Slope Grasses	16.50
8	Grasslands/ Blanks (Temp. sub Alpine & Alpine)	7.23
9	Secondary Scrub	15.88
10	Alpine Scrub	6.08
11	Plantation	.01
12	Habitation/Agrculture/Orchards	25.90
13	Exp.Rocks with Slope Grasses	8.28
14	Alpine Exp. Rocks with Slope Grasses	.07
15.	River	1.05
17.	Escarpments	1.29
18.	Landslide	.08
	Total	**255**

APPENDIX - 4c

APPENDIX - 5c

Aerial Estimation of Great Himalayan National Park Conservation Area
Great Himalayan National Park Protected Area

S.No	Type	Area in sq.km
1	Mixed conifer	34.69
2	Conifer and Broad Leaved Mixed	15.97
3	Broad Leaved	25.63
4	Broad Leaved and Conifer Mixed	27.55
5	Slope Grasses	1.24
6	Grasslands/ Blanks (Temp. sub Alpine & Alpine)	170.94
7	Secondary Scrub	4.83
8	Alpine Scrub	85.77
9	Habitation/Agrculture/Orchards	.04
10	Exp.Rocks with Slope Grasses	16.21
11	Alpine Exp. Rocks with Slope Grasses	128.56
12	River	3.65
13	Lakes	.85
14	Escarpments	29.89
15	Landslide	.03
16	Snow	176.22
17	Morian	23.85
18	Morainic Islands	.47
19	Glaciers	18.52
	Total	**765**

APPENDIX - 4d

APPENDIX - 5d

Aerial Estimation of Great Himalayan National Park Conservation Area Tirthan Wildlife Sanctuary

S.No	Type	Area in sq.km
1	Mixed conifer	18.37
2	Conifer and Broad Leaved Mixed	5.51
3	Broad Leaved	4.66
4	Broad Leaved and Conifer Mixed	5.69
5	Grasslands/ Blanks (Temp. sub Alpine & Alpine)	8.71
6	Secondary Scrub	.02
7	Alpine Scrub	9.15
8	Habitation/Agrculture/Orchards	.09
9	Exp.Rocks with Slope Grasses	1.29
10	Alpine Exp. Rocks with Slope Grasses	5.46
11	Escarpments	1.19
12	Snow	.80
	Total	**61**

APPENDIX - 4e

APPENDIX - 5e

Aerial Estimation of Great Himalayan National Park Conservation Area
Sainj Wildlife Sanctuary

S.No	Type	Area in sq.km
1	Mixed conifer	3.51
2	Conifer and Broad Leaved Mixed	1.11
3	Broad Leaved	7.61
4	Broad Leaved and Conifer Mixed	5.65
5	Grasslands/ Blanks (Temp. sub Alpine & Alpine)	32.57
6	Secondary Scrub	22.21
7	Alpine Scrub	15.67
8	Habitation/Agrculture/Orchards	.37
9	Exp.Rocks with Slope Grasses	2.07
10	Alpine Exp. Rocks with Slope Grasses	13.62
11	River	.16
12	Escarpments	1.00
13	Landslide	.30
14	Snow	4.10
	Total	**90**

APPENDIX - 4f

APPENDIX - 5f

Aerial Estimation of Great Himalayan National Park Conservation Area Excluding Ecozone

S.No	Type	Area in sq.km
1	Mixed conifer	56.25
2	Conifer and Broad Leaved Mixed	22.44
3	Broad Leaved	37.80
4	Broad Leaved and Conifer Mixed	38.71
5	Slope Grasses	1.36
6	Temperate Grasslands	4.60
7	Secondary Scrub	7.08
8	Sub Alpine Grassland	17.80
9	Alpine Scrub	109.99
10	Alpine Grasslands	190.66
11	Habitation/Agrculture/Orchards	.48
12	Exp.Rocks with Slope Grasses	18.87
13	Alpine Exp. Rocks with Slope Grasses	148.198
14	River	3.64
15	Lakes	.86
16	Escarpments	32.24
17	Landslide	.34
18	Snow	181.53
19	Morian	23.97
20	Morainic Islands	.47
21	Glaciers	18.60
	Total	**916**

APPENDIX - 4g

APPENDIX - 5g

Aerial Estimation of Great Himalayan National Park Conservation Area
Climatic Zones of Ecozone

S.No	Type	Area in sq.km
1	Conifer (*Pinus roxburghii*)	2.18
2	Mixed conifer	73.86
3	Conifer and Broad Leaved Mixed	10.63
4	Broad Leaved	30.10
5	Broad Leaved and Conifer Mixed	45.20
6	Riperian	.14
7	Slope Grasses	16.50
8	Grasslands/ Blanks (Temp. sub Alpine & Alpine)	7.23
9	Secondary Scrub	15.88
10	Alpine Scrub	6.08
11	Plantation	.01
12	Habitation/Agrculture/Orchards	25.90
13	Exp.Rocks with Slope Grasses	8.28
14	Alpine Exp. Rocks with Slope Grasses	.07
15.	River	1.05
17.	Escarpments	1.29
18.	Landslide	.08
	Total	**255**

APPENDIX - 4h

APPENDIX - 4i

APPENDIX - 4j

APPENDIX - 5h

Aerial Estimation of Great Himalayan National Park Conservation Area
Great Himalayan National Park Protected Area (Cover Density)

S.No	Type	Area in sq.km
1	Close Forest	103.93
2	Open Forest	4.83
3	Slope Grasses	1.24
4	Grasslands/ Blanks (Temp. sub Alpine & Alpine)	170.94
5	Alpine Scrub	85.77
6	Habitation/Agrculture/Orchards	.04
7	Exp.Rocks with Slope Grasses	16.21
8	Alpine Exp. Rocks with Slope Grasses	128.56
9	River	3.65
10	Lakes	.85
11	Escarpments	29.89
12	Landslide	.03
13	Snow	176.22
14	Morian	23.85
15	Morainic Islands	.47
16	Glaciers	18.52
	Total	**765**

APPENDIX - 5i

Aerial Estimation of Great Himalayan National Park Conservation Area Ecozone (Cover Density)

S.No	Type	Area in sq.km
1	Close Forest	172.63
2	Open Forest	15.88
3	Slope Grasses	16.50
4	Grasslands/ Blanks (Temp. sub Alpine & Alpine)	7.23
5	Alpine Scrub	6.08
6	Plantation	.01
7	Habitation/Agrculture/Orchards	25.90
8	Exp.Rocks with Slope Grasses	8.28
9	Alpine Exp. Rocks with Slope Grasses	.07
10	River	1.05
11	Escarpments	1.29
12	Landslide	.08
	Total	**255**

APPENDIX - 5j

Aerial Estimation of Great Himalayan National Park Conservation Area Climatic Zones

S.No	Zone	Area in sq.km
1	Above Snow Line	146.05
2	Cold Arid Zone	228.06
3	Alpine Zone	317.19
4	Sub Alpine Zone	143.25
5	Temperate Zone	92.63
6	Sub Tropical zone	244.20

APPENDIX - 6

Abstract

TEACHING MATERIAL FOR TRAINING WORKSHOP IN GHNP

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Training of front line staff has been considered one of the most important activities aimed at improving the management the protected areas. The coming workshop on training the front line staff and foresters working in GHNP is likely to focus on improving more that one of the many skills required for proper management and better enforcement of the park and wildlife sanctuaries.

Skills of map reading and interpretation has an important role in the better management of protected areas. It has been seen that more often that the concern staff is only acquainted with the popular paths, river, flora and fauna but lacks knowledge overall geographical position/ location and diversity in various ecological system in protected areas.

It is proposed to provide the following skills to the front line staff of GHNP with special emphasis on :

- √ Interrelationship between Human, Forest, Water, Soil and Geography of the area, their role and importance.
- √ Map reading on 1:50,000 scale.
- √ MATERIALS: SOI toposheets of the park on 1: 50,000
- √ Slides of Snowbound area, Pastures, Forest, River terraces
- √ (Agriculture-land), Landslides, Village/Social gathering.
- √ Drawing pen, Board or large paper sheets.

APPENDIX - 7a

MONITORING APPROACH THROUGH REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM

IMPLEMENTATION

1: GIS facility within forest deptt.

2: Facility in SRSC

3: Facility in RRSC

4: Consultancy Mode/Project Mode

NOTE :

- **SRSC : State Remote Sensing centre**
- **RRSC : Regional Remote Sensing Centre**

APPENDIX - 7b

MAN DAYS REQUIRED FOR VEGETATION AND GRASSLANDS MAPPING THROUGH REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM

Monitoring : Project Mode/ Consultancy

A: **Vegetation Mapping**
Baseline data: Already available

DAYS	NATURE OF WORK
7 Days	Pre Interpretation.
15 Days	Field work/ Ground Checking/Point Sampling.
25 Days	Map Preparation.
10 Days	Field work for error estimation.
7 Days	Final output.

B: **Change Detection Analysis**

20 Days	Analysis on GIS Domain Digitization,Editing,Topology
7 Days	Change detection analysis

Total Man Days	**90 (Three Months)**

APPENDIX - 7c

Tentative Expenditure in Consultancy/ Project Mode For One Theme

One geocoded scene	Rs. 11,000
Three persons for field work for 25 days	Rs. 6,000/ - @ Rs. 80/day
Consultancy charges	Rs. 30,000
Contingency	Rs. 5,000
Travel	Rs. 10,000
Use of GIS facility in SRSC/RRSC for a week in regular 8 hours / day.	44,800/ - @ Rs. 800/hour for private users.
Reports/ Production coast	44,800
Miscellaneous	20,000
Total	1,41800

Note: About rate of consultancy charges NRSA Norms can be followed.

: Above price quoted are subjected to change depending on supplying/ resource agencies rates.