PREFACE

In the curricular structure introduced by this University for students of Post-graduate degree programme, the opportunity to pursue Post-graduate course in subjects introduced by this University is equally available to all learners. Instead of being guided by any presumption about ability level, it would perhaps stand to reason if receptivity of a learner is judged in the course of the learning process. That would be entirely in keeping with the objectives of open education which does not believe in artificial differentiation.

Keeping this in view, study materials of the Post-graduate level in different subjects are being prepared on the basis of a well laid-out syllabus. The course structure combines the best elements in the approved syllabi of Central and State Universities in respective subjects. It has been so designed as to be upgradable with the addition of new information as well as results of fresh thinking and analysis.

The accepted methodology of distance education has been followed in the preparation of these study materials. Co-operation in every form of experienced scholars is indispensable for a work of this kind. We, therefore, owe an enormous debt of gratitude to everyone whose tireless efforts went into the writing, editing and devising of a proper lay-out of the materials. Practically speaking, their role amounts to an involvement in invisible teaching. For, whoever makes use of these study materials would virtually derive the benefit of learning under their collective care without each being seen by the other.

The more a learner would seriously pursue these study materials, the easier it will be for him or her to reach out to larger horizons of a subject. Care has also been taken to make the language lucid and presentation attractive so that they may be rated as quality self-learning materials. If anything remains still obscure or difficult to follow, arrangements are there to come to terms with them through the counselling sessions regularly available at the network of study centres set up by the University.

Needless to add, a great deal of these efforts is still experimental—in fact, pioneering in certain areas. Naturally, there is every possibility of some lapse or deficiency here and there. However, these do admit of rectification and further improvement in due course. On the whole, therefore, these study materials are expected to evoke wider appreciation, the more they receive serious attention of all concerned.

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Second Reprint : June, 2016

Printed in accordance with the regulations and financial assistance of the Distance Education Bureau of the University Grants Commission.

POST-GRADUATE GEOGRAPHY
[M. Sc]

Paper	:	Groups
PGGR : 05	:	A & B

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NETAJI SUBHAS OPEN UNIVERSITY

PGGR-05
Preparation of Thematic Maps
&
Map Interpretation and Field Techniques

Group A

Group B

UNIT 1 ❑ CONCEPT OF THEMATIC MAPPING

Structure

1.0 Concept of Thematic Mapping

A map may be defined as a two dimensional scale model of a part of the surface of the Earth. It is actually transformation of the three dimensional globe on two dimensional plane.

Broadly speaking, there are two types of maps: topographical maps and thematic maps.

A *thematic map* (also called a statistical or special purpose map) displays the spatial pattern of a theme or series of attributes. In contrast to *topographical maps* or reference maps which show many geographic features *(e.g.* settlement features, natural vegetation, communication network, administrative boundaries, etc.), *thematic maps* emphasize spatial variation of one or a small number of geographic distributions. These distributions may be physical phenomena such as climate or human characteristics such as population density and health issues. These types of maps are sometimes referred to as graphic essays that portray spatial variations and interrelationships of geographical distributions. Location, of course, is also important to provide a reference base of where selected phenomena are occurring. Thus, a *thematic map* is a map showing qualitative and / or quantitative information on specific features, concepts or subjects in relation to the necessary topographical details.

1.1 Uses of Thematic Maps

Thematic maps serve three primary purposes. First, they provide specific information about particular locations. Second, they provide general information about spatial patterns. Third, they can be used to compare patterns on two or more maps.

1.2 Displaying Data

In constructing any type of thematic map (or any map for that matter) it is understood that location is a key feature. After selecting the physical area to examine, the next step is collecting data sets.

Data dealing with one subject is called *univariate,* which examines occurrences of a single type of event. The distribution of population, tuberculasis rates, and rainfall are all examples of univariate data.

Bivariate mapping shows the distribution of two sets of data to explore possibilities of con-elations. For example, we can examine population density in relation to textile manufacturing. Other examples could be tuberculasis rates and population density, **or** rainfall and elevation.

More than two sets of data leads to multivariate mapping. Taking three or more data sets and displaying the result on a map helps to determine possible con-elations between different phenomena. **For** instance, our bivariate example maps two data sets, rainfall and elevation. If we add another variable such as population density, **our** map becomes multivariate rather than bivariate.

Map makers must be careful in designing thematic maps that display too much information or suggest phenomenon have a con-elation when in fact they do not.

1.3 Methods of Thematic Mapping

Geographers use many methods to create thematic maps, but the following techniques are generally in use.

1.3.1 Chorochromatic Maps

In this technology different colour tints are used to distinguish one feature from another. This type of maps are also known as colour patch maps. They are widely used to depict features like different categories of land utilization units, soil type, rock formation, etc. These maps basically represent qualitative information. Although

there is no universal colour code, but some conventional colour scheme is maintained. For example blue colour represents waterbody, green is used to depict vegetative cover, yellow indicated arable land, etc.

1.3.2 Choropleth Maps

In case of choropleth maps, different colour tints or shadings are used to show area density or intensity patterns belonging to certain administrative unit or boundary. Thus they represent unit wise quantitative information. Density of population per sq. kilometre, percentage of land under cultivation, yield per acre of arable land, etc. are some of the common maps prepared by using choropleth technique.

1.3.3 Isopleth Maps

Isopleth means a line on a map joining places with same value for certain element. This is the collective term for the various types of lines representing specific values that are drawn on a map. They are considered as quantitative areal maps where lines of equal values indicate the quantity. Familiar examples of isopleths are isobars, isohyets, isotherms, etc.

1.3.4 Dot Maps, Proportionate Symbols, Pie Graphs, Bar Graphs

To portray statistical information in graphical forms, geographers use charts and diagrams inside or outside the body of the map. Population distribution, crop acreage, etc. may be visualized in a better way if they are represented in terms of dot maps. Two dimensional or even three dimensional population phenomena may be represented with the help of proportionate circles or spheres. Proportionate circles may further be used to construct pie diagrams showing information like different categories of land utilization or livelihood pattern. Various types of bar graphs may represent single or multiple information. All these types of graphs and charts are considered as integral part of maps depicting thematic information.

UNIT 2 ❑ LAND USE MAP (CHOROCHROMATIC METHOD)

Structure

2.1 Introduction

Various techniques may be adapted for preparation of land use maps, the most common technique being *chorochromatic* method. Actually land use classification means the classification of land according to the use to which it is put. In the UK, the First Land Utilization Survey, carried out in the 1930s by L.D. Stamp, identified six areas of land use - arable, health and rough pasture, orchards and nurseries, meadowland, forest and woodland, and urban areas. Land use maps may be prepared either for rural areas or urban areas. Very often plot wise data on land utilization are collected at grass root level in due course of field work. In case of land use map for rural areas, the base map is the cadastral map collected from the settlement office, whereas in case of urban areas the ward map may be collected from the municipality itself. It is advised that at the time of field survey abbreviations are marked on the field map for each plot, e.g. 'W' for water body, 'A' for arable land, 'V' for vegetative cover, 'RI' for road, 'RF for railway line, etc. Ultimately a colour scheme is to be developed for depicting information related to different types of land utilization for representation of the field data on the neatly drawn final map, which contains appropriate labels and also a legend. This type of land use maps are very important to understand the existing condition of the land use pattern. Based on such maps, future plans and programmes may be prepared for the area under investigation.

2.2 Table showing land utilization

Table 1 : ***Plot*** *wise land use pattern of Aminpur Mouza (part)*

Plot No.	*Land Utilization*	*Plot No.*	*Land Utilization*
1	Partly settlement; partly plantations, etc.	51	Vegetable growing land
2	Settlement	52	Vegetable growing land
3	Settlement	53	Vegetable growing land
4	Bamboo grove, plantation, etc.	54	Vegetable growing land
5	Fallow land	55	Vegetable growing land
6	Bamboo grove, plantation, etc.	56	Vegetable growing land
7	Bamboo grove, plantation, etc.	57	Vegetable growing land
8	Bamboo grove, plantation, etc.	58	Partly Veg. land, Partly Sett.
9	Bamboo grove, plantation, etc.	59	Vegetable growing land
10	Vegetable growing land	60	Vegetable growing land
11	Bamboo grove, plantation, etc.	61	Water body
12	Vegetable growing land	62	Vegetable growing land
13	Vegetable growing land	63	Vegetable growing land
14	Vegetable growing land	64	Water body
15	Bamboo grove, plantation, etc.	65	Vegetable growing land
16	Water body	66	Play ground
17	Water body	67	Partly Fallow, Partly Temple
18	Fallow land	68	Water body
19	Bamboo grove, plantation, etc.	69	Water body
20	Bamboo grove, plantation, etc.	70	Vegetable growing land
21	Bamboo grove, plantation, etc ..	71	Vegetable growing land
22	Partly settlement; partly temple	72	Settlement (part), veg. land (part)
23	Settlement	73	Primary school
24	Water body	74	Bamboo grove, plantation, etc.

Plot No.	*Land Utilization*	*Plot No.*	*Land Utilization*
25	Veg. growing land (part), Fallow(part)	75	Water body
26	Fallow land	76	Vegetable growing land
27	Vegetable growing land	77	Settlement
28	Vegetable growing land	78	Vegetable growing land
29	Vegetable growing land	79	Vegetable growing land
30	Vegetable growing land	80	Settlement
31	Bamboo grove, plantation, etc.	81	Settlement
32	Vegetable growing land	82	Settlement
33	Settlement	83	Settlement
34	Settlement	84	Settlement
35	Settlement	85	Settlement
36	Settlement	86	Settlement
37	Settlement	87	Settlement
38	Settlement	88	Vegetable growing land
39	Water body	89	Vegetable growing land
40	Vegetable growing land	90	Vegetable growing land
41	Fallow land	91	Vegetable growing land
42	Vegetable growing land	92	Vegetable growing land
43	Vegetable growing land	93	Vegetable growing land
44	Water body	217	Settlement (part) veg. land (part)
45	Settlement	377	Vegetable growing land
46	Settlement	373	Settlement
47	Settlement	378	Bamboo grove, plantation, etc.
48	Settlement	398	Vegetable growing land
49	Water body	403	Plantation, etc.
50	Vegetable growing land	448	Vegetable growing land

2.3 Interpretation

Mouza	:	Aminpur
J. L.No.	:	71
Thana	:	Haripal
Block	:	Haripal
District	:	Hoogli

A land use map for Aminpur Mouza has been prepared on the basis of plot wise data collected from the field. The total mouza is much bigger, and only a part of it has been mapped for our present exercise (Fig. 1). It is a typical rural area, where

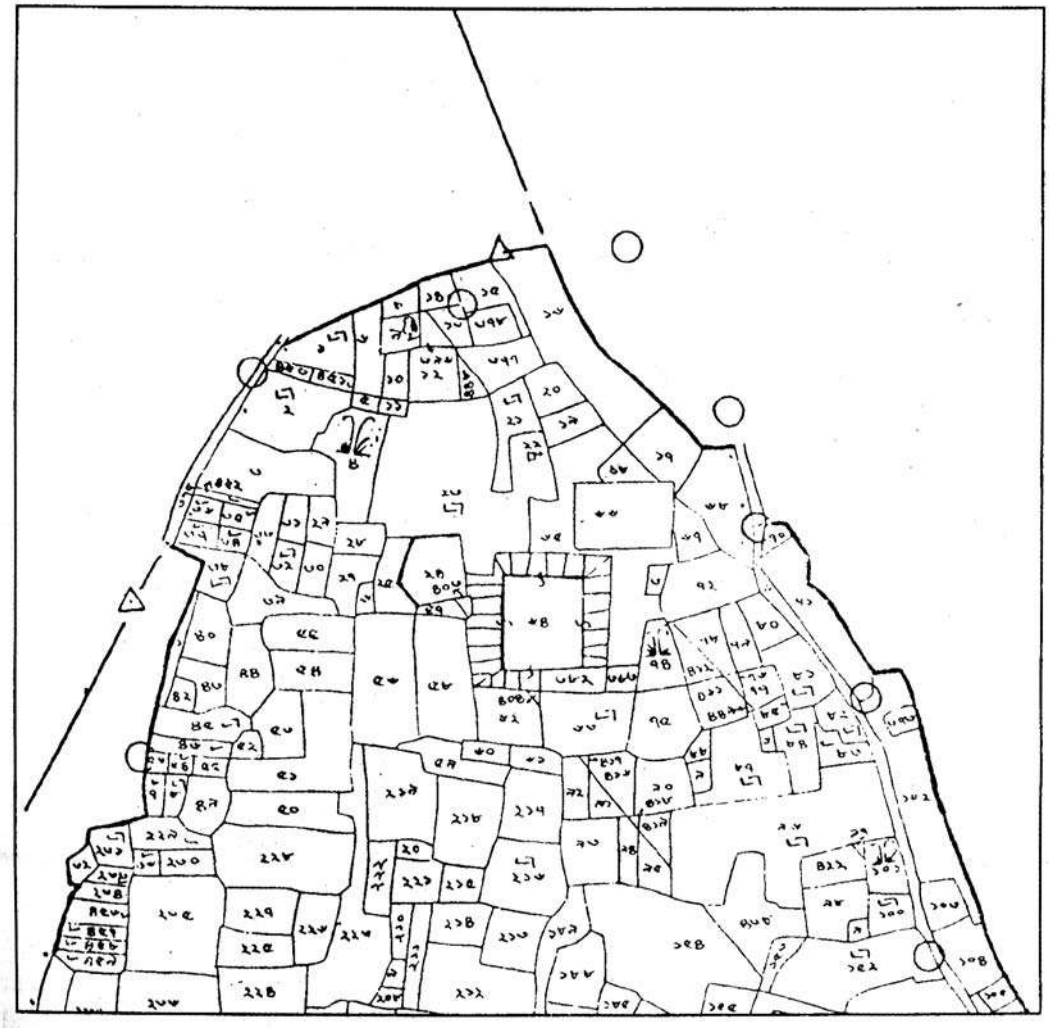

Fig. 1. *Base Map : Aminpur Mousa (Part)*

shuna land is comparatively upland in character. This is a typical vegetable growing land, where apart from different types of vegetable crops, potato, jute, etc. are also grown in plenty. The northern most part is predominately orchard and plantation area. This category of land is also found scattered in other parts within the mapped area. Bamboo groves are also found in these areas. High land areas are the homestead or *bastu* lands, where settlements have been developed. Almost at the center of the mapped area a big sized pond exists, which is used for domestic purposes by the villagers. It is paved all around. Otherwise small and shallow water bodies, known as *doba* are scattered at different places. A canal flows along the eastern part of the mouza, which irrigates agricultural lands. Other water bodies scattered at different parts are also used for irrigation purpose. Adjacent to the playground the famous *than* (temple) of Lord Panchanan exists, which attracts devotees even from far away places. Another *Shih* temple has been established nearby. Most of the lands of the mouza are well-utilized, excepting a few fallow land areas. The only metalled road runs along the western most part of the mouza. On the other hand, to the eastern part the un-metalled road runs partly parallel to the canal. Otherwith footpaths along the *aal* (parceling of land) and brick roads are the only means of communication system within the area under study (Fig. 2).

To conclude, the area under investigation is agriculturally prosperous, where variety of crops are grown. Agriculturally it is surplus area, and after meeting domestic demand, the excess amount is sold away for outside requirement.

For this purpose, at the very beginning the particular topographical sheet(s) should be carefully examined for demarcating the particular basin under investigation (Fig. 3). The demarcated river basin is to be divided into equally spaces square grids, say 2 km. x 2 km. Then the drainage density for each grid is to be calculated with the formula :

Drainage Density (Dd) = Length of Channels/area

The drainage density data thus available is to be grouped in terms of suitable class intervals. Appropriate colour shades are to be assigned to each class for the purpose of visualization of gradation (Fig. 4). It is also possible to draw isoline with the help of grid wise data, and isopleth map would be the end product.

DENSITY MAP OF RIVER BASIN

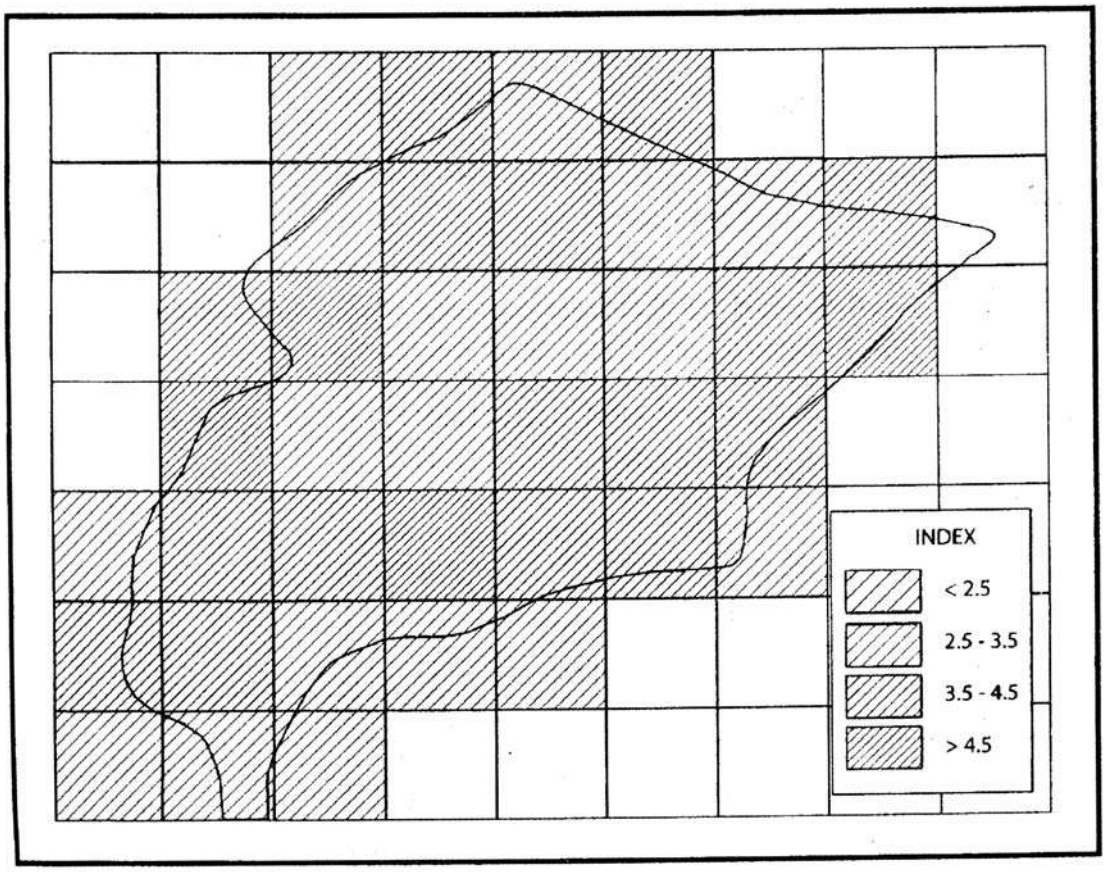

Fig. 4. *Drainage Density : Klwgadara Nata Basin*

UNIT 4 ❑ TREND SURFACE MAP (ISOPLETH METHOD)

Structure

4.1 Introduction

Isopleth maps may be mono dimensional or multidimensional in character. By applying isopleth technique, it is possible to prepare *trend surface maps* with three dimensions. Trend surface analysis is usually done with the multivariate regression analysis but only one parameter can also be chosen according to importance. In such a case the subject concerned is taken as dependent variable (y) and parameters are taken as independent variable (x) [Fig. 5].

Regression equation $\ddot{O}Sy = na + bSx$

$Sxy = aSx + bSx^2$

$y = a + bx$

Predicted y values are to be plotted on the geocentres of the districts or any unit division and then isolines are drawn to obtain the trend values.

4.2 Morbidity Record of Pulmonary Tuberculosis in Govt. State Hospitals (2005)

Table 2

District	Pop. Density/km^2 (x)	No. of Cases (y)
Darjeeling	510	7261
Jalpaiguri	547	3356
Koch Behar	732	2554
Dinajpur (U&D)	727	3470
Maldah	881	4338
Birbhum	663	5090
Barddhaman	985	7103

UNIT 5 ❑ ENVIRONMENTAL MAPPING (HAZARD AND POLLUTION)

Structure

5.1 Definition

A *natural hazard* is an unexpected or uncontrollable natural event of unusual magnitude that threatens the activities of people or people themselves. It may be mentioned here that the other type of calamity is *natural disaster,* which is also a natural hazard event that actually resulted in widespread destruction of property or caused injury and/or death.

Hazards can be classified into several groups based on their occurrence. In recent contributions on disasters, such unexpected events include *earthquakes, floods, hurricanes, droughts, tsunamis,* etc. But thematic mapping in this direction needs an approach signifying distributional aspects in order to formulate the local, regional or natural strategies for hazard mitigation.

5.2 Example

In our present context, only one type of hazard, i.e. *flood* has been taken into consideration.

By defining a *flood* is a body of water, which rises to overflow land, which is not normally submerged. The following maps may be prepared to show flood condition :

- Flood vulnerable zones (high, medium, low)
- Flood frequency Zones (more than once a year)
- Flood rise zones : flood with high (<2 m) water level, flood with moderate (1-2 m) water level, flood with low (max 1 m) water level.

Table: 3
Air Quality in 15 Stations of Kolkata (Yearly average) (μgm/m^3)

Station	SMP	SRPM	SO_2	O_2
Dunlop Bridge	244.76	121.52	12.59	67.81
Shyam Bazar	246.24	124.49	9.90	60.11
Beliaghata	207.66	98.91	8.63	50.16
Moulali	240.03	121.24	10.47	70.59
Salt Lake	195.36	91.69	5.88	49.65
Ultadanga	236.63	117.18	9.22	61.17
Minto Park	209.28	99.98	6.84	57.65
Gariahata	225.61	110.63	7.35	64.79
Mominpur	218.46	104.53	8.17	57.04
Hyde Road	220.27	107.05	8.50	58.81
Behala	220.22	107.77	8.29	61.63
Tollygunge	198.30	94.47	5.88	54.77
Baishnabghata	172.25	78.50	4.80	45.38
Picknic Garden	209.03	100.43	7.48	51.51
Topsia	239.70	119.72	12.93	62.36

Source : West Bengal Pollution Control Board

5.3 Selected Readings

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GROUP-B

UNIT 6 ❑ MAP INTERPRETATION AND FIELD TECHNIQUE

Maps are the best tools available to geographers for portraying the geographical information into graphical formats. It is said that maps should be self explanatory. But for practical purposes, it is observed that the map reader should acquire certain skill so that the map may be read at ease. Moreover, by interpreting the base map, variety of maps may be prepared. Nowadays with the advancement of various technologies, base maps are also considered as data. Initially traditional ground survey techniques were in use to prepare topographical sheets. Nowadays, remote sensing products in the form of aerial photograph and satellite imagery are used extensively for preparation and revision of topographical sheets. The main advantage of the toposheet is its annotation part. Moreover, with the help of conventional symbols it is easy to read the map. On the otherhand, the identification and recognition of objects from aerial photograph or satellite imagery depend upon the readers' knowledge about the characteristics of the photolimage recorded in terms of *tone, texture, pattern, shape, size, shadow, situation, resolution* and *spectral sensitivity,* etc. Different colour clues are also important to open the secrecy of colour images. Repetitive coverage, synoptic view and uniform data set are the main advantages of satellite images. But spatial resolution is the main constrain for such products. Moreover, neither aerial photograph nor satellite imagery contains any annotation.

UNIT 7 ❑ INTERPRETATION OF TOPOGRAPHICAL SHEET

Structure

7.1 Definition

A topographical map is a map that represents the form of Earth' s surface. A topographical map contains information related to physical parameters like drainage, natural vegetation, topography, etc. along with man made features like communication network, settlement patter, etc. Geographical coordinates in terms of latitude and longitude, administrative boundaries, contour lines along with values, spot heights, etc. are also available in a topographical sheet. Amenities and facilities like hospital, places of work ship, rest house and bunglow, market place, etc. also find place in a topographical sheet. All these information are represented in terms of different colours, symbols and texts. Thus to interpret a topographical map one should thoroughly acquire the knowledge of map reading skill, which is available as marginal information in each and every map. One can identify the adjacent map with the help of map index. The legend helps the reader to understand different features within the map area. Thus proper interpretation of a topographical map would help the map reader to understand the grass root information of the topography under investigation.

It is also possible to prepare series of maps and diagrams based on a particular toposheet to extract specific information. Thus apart from preparation of Broad Physiographic Divisions, other specific maps and charts like vegetation map, ruggedness index, dissection index, relative relief, transact chart (to show the relationship between different topographic features), long and cross profiles, etc, can also be prepared with the help of a topographical sheet.

7.2 Model Interpretation

In the following paragraphs, a model interpretation of a particular topographical map is being presented.

Introduction

Reference No. 65J/9

Administrative Jurisdiction : Koraput District, Orissa

Latitudinal extension : 18°45' N - 19°00' N

Longitudinal extension : 82°30' E - 82°45' E

Scale : 1 : 50,000

Contour interval 20 metres

Year of Survey : 1980-81

Year of publication : 1983

Published by : Survey of India

Relief

This is a typical example of plateau topography. The general slope of the region is towards west. The highest altitude Auramali (1077 metre) is located at north central part of the region whereas the lowest altitude is 560 metres contour lines, which are observed at places towards extreme western part of the toposheet. A cross section drawn between places of altitudinal differences helps to identify *break in slope,* which separates two contrasting slope forms. Thus on the basis of *break in slope* at 600 m., the entire region may be divided into two broad physiographic divisions: *dissected plateau region* and *erosional plain region* (Fig. 1).

Dissected Plateau Region : The aerial extension of dissected plateau region may be observed from the eastern to central and also to the south-western portion of this map. This dissected plateau region is characterized by flat topped hills, steep slope sided landforms, erosional hills, rounded hills which are covered up with dense vegetation. Some conical hills are to be found dissected along the high elevated plateau region.

Erosional Plain : This region is washed out by rivers Telungary Nadi, Kolab River and Putra Nadi forming an erosional plain area. Due to concentration of

parallel to some extent ultimately join together to form Telungari Nadi. This combined drainage system serves the east central part of the region. Otherwise Kolab River and Putra Nadi act as main drainage system serving southern part and western part respectively. All these rivers are perennial in character, Most of these livers contain sand deposits, whereas rock deposits are also found in case of Putra Nadi. Numerous small rivers of different orders join these rivers. The course of Putra Nadi appears to be controlled by the structure of region, thus it flows along the southern margin then turns to the north, again takes a u-turn towards south and ultimately flows west ward. Numerous springs and water falls exist at different places within dissected plateau region. Artificial reservoirs have been constructed particularly in the plain region by damming small rivers. Otherwise *Jagannatha Sagar,* adjacent to Jaypur, the most important settlement in this area, is a lake with appreciable spatial extension.

Natural Vegetation

The dissected plateau region is characterized by plenty of natural vegetation. These areas are mostly reserved forest in character. They are either open, dense or fairly dense mixed jungle. At the periphery of the forest areas, dense or open scrub areas exist. At places, particularly to the south, extensive areas have been devoted for eucalyptus plantation. At suitable locations coffee plantations have also been experimented.

Agriculture

Agricultural activities are in practice in the western part of the region. Mostly rain fed cultivation exists. Occasionally tank and canal irrigation system facilitates the agricultural activity.

Settlement

The rugged terrain condition restricts development of settlement in the dissected plateau region. However, scattered huts do exist in isolation at places within this region, which are recognized as dispersed settlements. Koraput and Jaypur are the two big agglomerated urban settlements which have been developed to the eastern and western part respectively. Koraput is the district head quarters and possesses different amenities and facilities like police station, hospital, veterinary hospital, dispensary, market, post office, rest house, inspection bunglow, etc. The town is surrounded by hills and possesses strategic location. Orissa Military Police Colony and Railway Colony have been- established at the outskirt of the town. The town is

served by South Eastern Railway and several roads including NH 43. Jaypur, the other town located to the west, is equally important where amenity and facility like hospital, market, guest house, inspection bunglow, court, police station, post and telegraph office, etc. are available. The place can be reached by metalled road from all the directions. NH 43 also serves as a connecting road between Jaypur and Koraput. Clustered rural settlements have, been developed in different parts of the region, particularly in the erosional plain region.

Communication

Railway and road are the two important communication system within this region. The region is a show piece to exhibit the skill of railway engineering. The South Eastern railways' s Kottavalas Kirandu branch railway enters tile region from north western part and negotiates tile central massif region with many loops and ultimately passing through Koraput, exits tile region in south eastern direction. This railway serves to transport huge quantity of minerals from mining areas to the factories. It also connects Koraput with other parts of tile country. National Highway 43 also serves the region extensively. Otherwise, particularly tile western part of the region, is served by various metalled and unmetalled roads. However, the dissected plateau region is devoid of communication system excepting foot path connecting isolated hutments.

Conclusion

A sharp contrast is noticed in between two regions, i.e. *dissected plateau region* and *erosional plain region.* The former is rich with forest resources and partly plantations, on the other hand tile later region is agriculturally rich and also overall development took place in this region.

UNIT 8 ❑ INTERPRETATION OF AERIAL PHOTOGRAPH

Structure

8.1 Introduction

$\frac{518A}{287-30}$

Photographs taken from an aircraft are commonly termed as *aerial photographs* (Fig. 2). To interpret an aerial photograph, the user should have enough skill regarding photo characteristics in terms of *tone, texture, pattern, shape, size, shadow, situation, resolution* and *spectral sensitivity.* However a model interpretation is presented here in below :

The given aerial photographs bear numbers $\frac{518\,A}{287-29}$, $\frac{518\,A}{287-30}$ & $\frac{518\,A}{287-31}$

The middle photograph, i.e. is to be interpreted. The interpretation of photographs can be seen as a process that can be divided into number of phases. For all purpose we can say that it is a three phase operation.

Firstly, the examination of the photographs.

Secondly, the identification of objects or features.

Thirdly, the classification of objects identified.

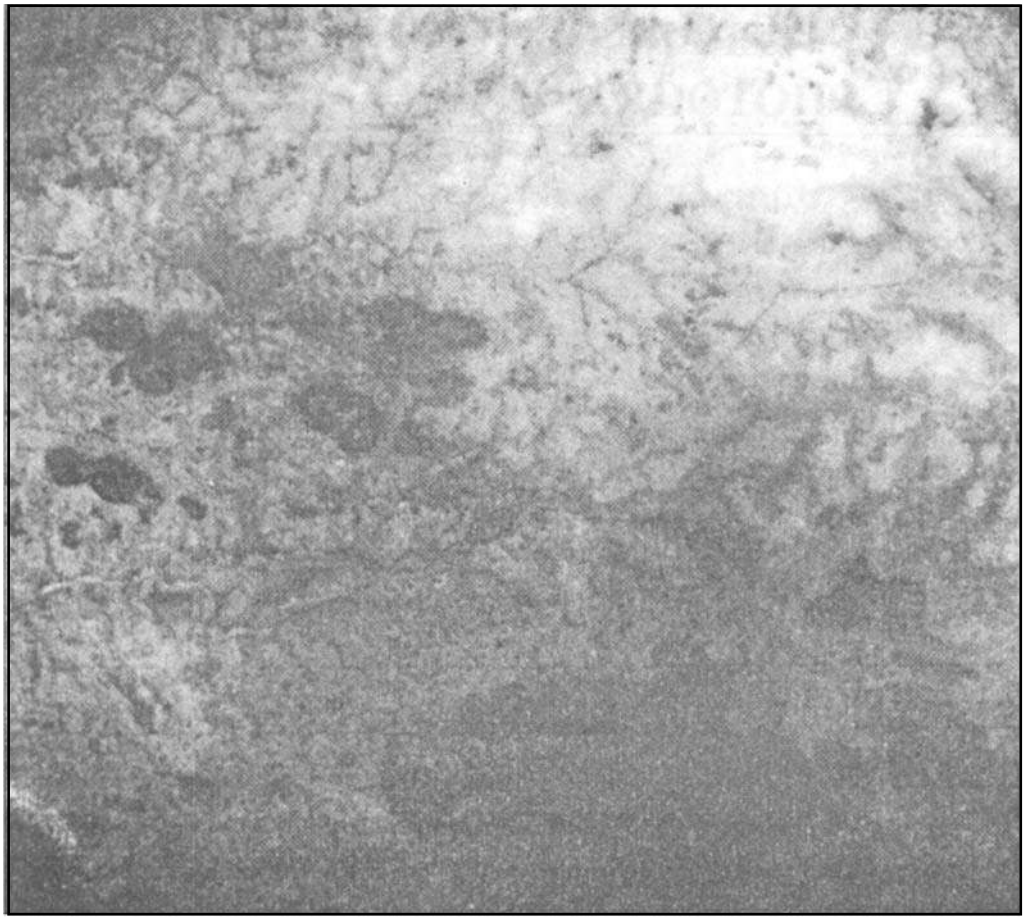

Fig. 2. *All Aerial Photograph*

8.2 Procedure

1) Placing photographs under the stereoscope with overlapping parts of the photographs next to each other.
2) Locating & marking of *principal point* on each of photograph. This is done by aligning opposite sets of *fiducial marks* with a straight edge & the intersecting point is considered as principal point.
3) Transferring of principal point from the adjacent overlapping photograph with the help of a minor stereoscope. By connecting the principal point & the transferred principal point the *flight line* may be obtained.

4) Placing the stereoscope over the stereo pair in such a way that the line joining the center of the stereoscopic lenses is parallel to the flight line.

5) Although the photographs should be seen three dimensionally now, a little adjustment in distance between the photographs may still be necessary. So the photographs may be moved side ways until the spacing between the corresponding images produce comfortable stereoscopic viewing.

8.3 Reference Data

Survey of India topographical sheet number *73E/15* & 73113 with scale of 1 : 50,000 have been used as reference data.

8.4 Administrative Index

From the topographic maps & the photo index it is known that the area under investigation covers parts of Puruliya district of West Bengal and Rachi District of Jharkhand.

8.5 Scale

The scale of the photograph is 1 : 60,000

8.6 Landforms

So far as the broad physiographic unit is concerned, the area covered by photograph belongs to Ranchi Plateau. Except the narrow strip of land along the both sides of river Suba marekha, the entire region is a plateau fringe. Based on image characteristics the following landforms can be identified in the photographic region (Fig. 3).

(1) Hills, (2) *Monadnocks,* (3) *Uplands,* (4) *Undulating Plains* and (5) *Gully.*

1. *Hills :* The hilly areas are well marked in the north western part and also in the south, south eastern part. In the north west there is a dome shaped hill with appreciable height. In the southern and south eastern portion there are hilly areas characterized by appreciable length and height. It appears that

the monadnocks are residual parts of hard rocks which were intluenced by fluvial action. They are the remnants of peneplain formation.

3. *Upland :* The areas which are higher in elevation but the surface is not plain is upland. This landform is the result of fluvial erosion conducted by *Salda Nadi* and its tributaries. The area is almost covered by hard rocks.

4. *Undulating Plain* : Major part of the photograph is covered by undulating plains. This region is characterized by uneven plain topography which is rolling in nature.

5. *Gully :* Particularly in the north and central part of the map where the 1st order streams have been originated, such landforms may be identified. The topography has been well dissected due to erosion. Small streams follow the direction of slopes in straight fashion.

8.7 Land Use

Information regarding different land use pattern have been extracted from the same photograph, i.e. *518A/287* : 30. The following land use features have been identified based on characteristics of image pattern (Fig. 6).

1. *Settlement :* Settlements are found scattered all over the all over the area. Most of them have been developed along the roads but they are not linear in pattern. Sometimes they have been formed at the junction of roads. The availability of water is also a predominating factor controlling the development of settlements. Most of the settlements are rural in character. Patjhalida, Masina, Khatjuri, Bengo, etc. are some of the important rural settlements. At the center of the photograph, the only compact urban settlement Jhalida can easily be identified.

2. *Forest:* The southern portion of the mapped area is characterized by dense forests. Extension of forest areas are also noticed in the north western part. Moreover, isolated hills or monadnocks located at the central or west central parts are covered with open mixed jungle. The vegetative cover can be recognized easily with the help of photographic tone, which is dark enough due to chlorophyll content denoting health vegetative cover.

4. *Waste land :* Waste lands are found either in rocky waste parts or along gully erosion areas. The former has been caused by deforestation whereas the later is the result of fluvial erosion.

5. *Water bodies :* There are numerous streams along with their tributaries traversing the photographic region. Sapahi Nadi. and Salda Nadi are the major livers, which flow almost parallel to each other. Both of them originate from the east and ultimately join Subarnarekha River further south (outside the photographic area). Scattered tanks are found in different parts of the area. It may be mentioned here that water bodies are recognized with the help of dark tonal expression of the photo image.

6. *Communication systems :* Communication network in the form of railway and road traverse the photographic region. They may be recognized by means of tonal variations along with geometric shape. South eastern railway passes along the central part of the photograph, parallel to the main highway.

UNIT 9 ❑ INTERPRETATION OF SATELLITE IMAGERY

Structure

9.1 Introduction

Three band satellite data are used to generate colour composites. The channel selection is restricted to three additive primary light beams i.e. blue, green and red. True colour representation for visual display of an image can be bade by using three band satellite data representing blue, green and red channels: In such a case blue band is projected in blue, green band is projected in green and red band is projected in red for preparation of the output image. But such true colour composites are having some constrains in terms of inadequate contrast, clarity problem, interpretability problem, etc. Hence images are generated in terms of *false colour composite* or *FCC.* Any combination of bands not representing the true colour of the objects in the output image is termed as FCC. They are generated with the purpose of better interpretation of the multi-band satellite data.

In case of standard false colour composite, the combination of bands and the respective colour assignments are well defined. Hence they are known as *standard* FCC. The most commonly seen standard false colour images display the very near infrared as red, red as green and green as blue (Fig. 5).

9.2 Analysis

However the satellite imagery under investigation is a typical geocoded linage which has been generated by matching with Survey of India toposheet No. 73M/7. It is a merged data of SPOT (PAN) and Landsat-5 TM where high degree of spatial resolution of SPOT (PAN) has been merged with Landsat TM' s colour mode, thus different object' s spatial detail can be visualized in false colours. Here it may be

The data was acquired on 8 November, 1991 whereas the image was generated by NRSA on 4 May, 1992. By applying different rules of image characteristics, various features within the area under investigation could be identified. Here it may be noted that SOI toposheet No. 73M / 7 has been used as reference data for extraction of information related to annotation, etc. Ultimately the Land Use / Land Cover Map has been prepared by interpreting the geo-coded hard copy output. Here land use refers to man made features like road, railway, arable land, settlement, etc., whereas land cover denotes natural features like forest cover, scrub areas, liver system, wet land, etc. (Fig. 6).

Due to good amount of chlorophyll content, healthy vegetation absorbs energy strongly and appears as deep red in FCC. Bilaspur protected forest, situated at the north eastern comer of the image is a typical examples ill this regard. At places, forest areas have been degraded and they appear in terms of lighter tone. These are typical examples of fairly dense scrub areas.

Water bodies appear either as deep blue / blackish or powder blue in colour depending upon depth/clearness of water. In case of deep / clear water, absorption of light is more, hence the apparent colour is blue/blackish blue. On the other hand in case of turbid/shallow water, the ret lection of light is more and the appearance of the object is powder blue. To the south-western comer, *Damodar River* can easily be identified. The channel of the river is characterized by braided nature with numerous bars and spits. The water is mostly sediment laden and the apparent colour is powder blue. Sand deposits within the course of the river reflect more light, hence they appear ill terms of light tone/white colour. Due to sediment deposit, even an island has been formed inside the liver, where crops are grown. However, in the present image, the *DVC Left Bank Main Canal* enters the region from the west and passes through the central part and curves towards the south. At the extreme western part of the image, *Damodar Branch Canal* originates from *DVC Left Bank Main Canal* and moves northward. *Panagarh Branch Canal* branches off from *Damodar Branch Canal* and runs in between the railway line and the *Grand Trunk Road.* Actually several linear features, viz. *DVC Left Bank Main Canal, Eastern Railway Main Line* and *Grand Trunk Road* run parallel to each other from north-west to south-east. The canal, if contains water, can be recognized with the help of dark blue colour, fine texture and also the typical geometric shape. Generally speaking, the tonal expressions of railway lines and road ways are darker and lighter respectively. Moreover, unlike road, railway takes typical curvature at the turning point and tries to avoid rural

settlements. On the other hand roads link up different settlements and can take any type of turning. Both sides of highways are generally associated with trees. All these factors provide clues to recognize different types of linear features. However, these are the general rules, and exceptions are there, depending upon the real world situation and also quality of the hard copy output.

Good or moderately good agricultural lands are wide spread within the area under investigation, which appear as light pink colour with fine or medium texture. In case of poor agricultural land the appearance is in terms of whitish gray with coarse texture. Rural settlements are associated with water bodies and vegetation cover and they are represented in terms of dark blue with fine to medium texture. *Sonal* and *Gopalpur* are two examples of rural settlements, which are easily identifiable to the east-central and north-western parts of the image. On the other hand, in case of urban areas, due to *Rayleigh* scattering, blue or gray cast appear on the image. *Panagarh*, located at the center of the map is an example of urban settlement, although gray/blue casting is not that prominent for this urban area.

UNIT 10 ❑ PREPARATION OF QUESTIONNAIRE SCHEDULE

Structure

10.1 Concept

Data collection is an important job of the geographer in due course of field investigation. The data may be available from primary source or secondary source. III case of secondary source, the data is collected from existing literature, journals, reports, bulletin, etc. On the other hand primary data collection means collection of the information directly from the field by the investigator. It may be soil sample collection, study of the soil or geological profile, conducting ground survey to measure the cross or long profile across or along a valley, etc. But to study socio-economic parameter, elaborate questionnaire needs to be prepared. Actually the success of geographical investigation partly depends upon well prepared questionnaire schedule. The aims and objectives of the particular project determines the type of questionnaire to be prepared. Thus specific questionnaire is to be prepared for specific project. However, some model questionnaires have been annexed herein below.

10.2 Model 1: Plot to plot land use and cropping pattern data

Name of the investigator
Name of the village

Crop season

Plot No.

Area of the Plot

Land use category
Irrigated / un-irrigated
Source and type of irrigation
Energy used
Crop grown
Yield of crop
Whether locally consumed or marketed else where

10.3 Model 2 : Socio-economic survey

Name of the investigator
Name of the village
Name of the head of the family
Religion / caste
Mother tongue
Own / rented house
No. of domestic animal
Details of family members
(for each member)
Age
Sex
Educational qualification
Occupation
School drop out, if any
Monthly income
Monthly expenditure on
Food
Clothing
Rent / Maintenance of house
Education
Transpo rtation

Medical

Repayment of loan

Miscellaneous

Deficit / excess income

10.4 Model 3 : Rural Market

Name of the investigator

Name of the market

Day / days

Wholesale or retail

No. of vendors

No. of customers

Commodities sold

Commodities brought from

Customers coming from

Mode of transport to bring commodities

Mode of transport used by the customers

Nearby other market with distance and day

Total transaction of the market

10.5 Model 4 : Tourism

Name of the investigator

Name of the tourist spot

Type of tourist spot

(e.g. hill resort, sea resort, religious place, historical place, etc.)

Total No.of Hotel, guest house, holiday home, etc.

(For each of the hotel, etc.)

Available room

Room tariff

No. of occupant

Peak season

Lean season

No. of employees

Available infrastructure (e.g. transport, conducted tour facility, etc.)

Annual income

Total No. of shops serving tourist *(for each shop)*

Type of item sold (e.g. souvenir, handicraft, etc.)

No. of customer visited

No. of employees

Total income

Tour operator (for each tour operator)

No. and type (e.g. car, luxury bus, micro bus, etc.) of vehicle available

No. of employee

No. of customer

Visiting points

Tariff

Income

*** Schedules are to be prepared in tabular form*

10.6 Selected Readings

- Howard J.A.(1970), Aerial Photo Ecology
- Lillesand, T.M., *et el.* (2004), Remote Sensing and Image Interpretation, Wiley, *5th Edition,* New York.