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GEOMORPHOLOGICAL AND LINEAMENT STUDIES OF KANJAMALAI USING IRS-1A LISS 1 DATA WITH SPECIAL REFERENCE TO GROUNDWATER POTENTIALITY

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ABSTRACT Remote sensing plays an important role in geomorphological and lineament studies. Geomorphology and lineaments of Kanjamalai and surrounding areas near Salem are investigated using IRS-1A LISS 1 imagery with limited field checks. In this study, influence of geomorphology and lineament on groundwater characteristics are inferred and the groundwater potentiality is deduced. The influence of geomorphology on the groundwater occurrence is found dominant while the influence of lineament isfound active in groundwater movement in the study area.

INTRODUCTION

The areal extent of the study area is about 648 sq.km., comprising Kanjamalai, Bodamalai and Jarugumalai in Salem District of Tamil Nadu. It lies between 11°45' and 11°30' N latitudes and 77°55' and 78°15' E longitudes. It is covered by the Survey of India toposheets 58 I/2 and 58 E/14 on 1:50,000 scale (Fig.1).

CLIMATE AND RAINFALL

Salem is classified under Semi-arid climatic zone. The hottest months of the District are March, April and May. The year may be divided into four major seasons : Dry seasons from January to March; hot season during April and May; South-west monsoon season from June to September and North-east monsoon season from October to December. Though the area recevies rainfall from south-west and north-east monsoons the chief rainy season is during the months of October and November.

OBJECTIVE OF THE STUDY:

The objective of the investigation is to analyse the geomorphology and lineaments of the study area using remote sensing data products, toposheets and field study and to throw light on the potential zones for groundwater exploration.

METHODOLOGY

To interpret geomorphic units and lineaments of the study area, the IRS-1A LISS 1 imagery (path 25 row 60) of false colour compostie (FCC) on 1:1000,000 scale was studied visually. Survey of India toposheet of 1:50,000 scale was used for base map preparation.

The IRS-1A LISS 1 satellite imagery was enlarged to 1:50,000 scale using Procom instrument. The enlarged scene was interpreted visually to identify geomorphic units and lineaments. In addition to the interpretation, limited field checks were carried out.

LOCATION MAP

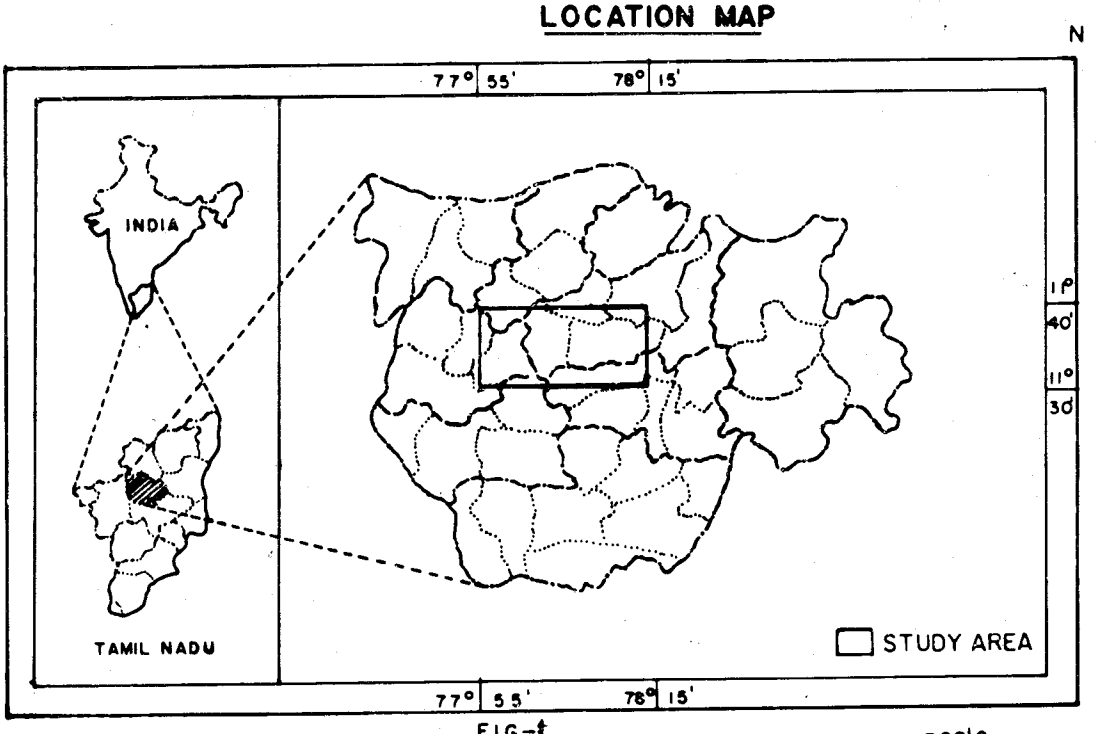

FIG-1

scale
0 14 24 KM

GROUNDWATER FAVOURABLE ZONE DEDUCED FROM GEOMORPHOLOGY MAP

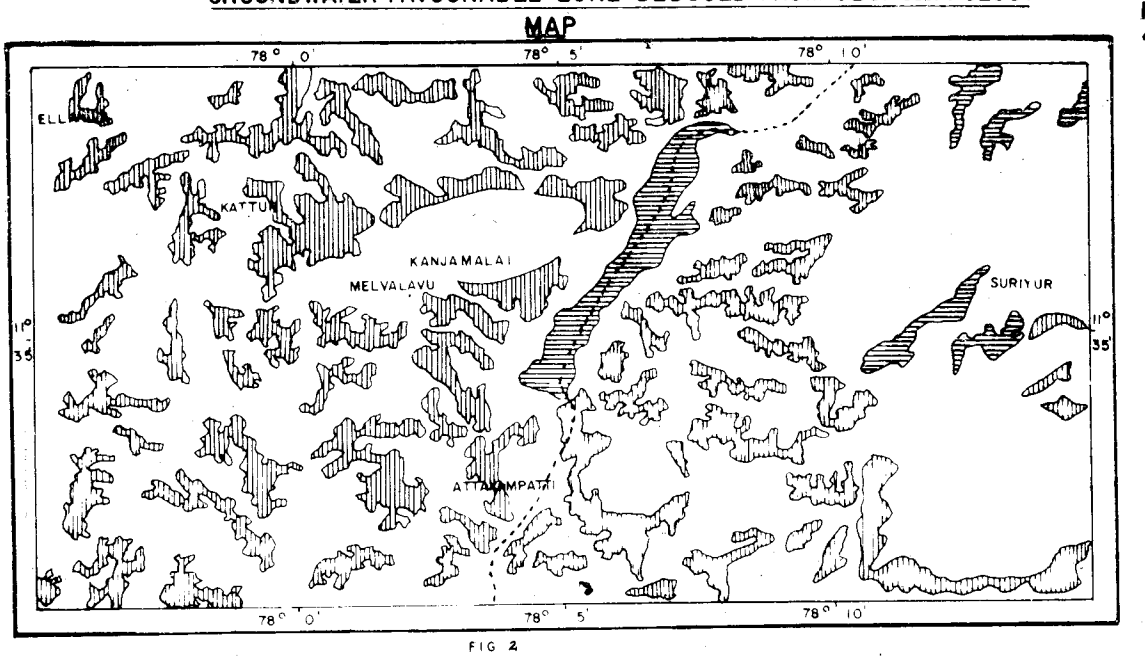

FIG 2

LEGEND

FAVOURABLE ZONE

MODERATELY FAVOURABLE ZONE

SCALE
0 1.6 3.2 Km

GEOMORPHOLOGY

The area reveals very interesting geomorphic features. A geomorphological map of the area is prepared and interpreted. The geomorphic map portrays the surface configuration, nature and proportion of material and intensity of the proceses in operation. On the basis of image interpretation elements like tone, texture, size, shape, relief, pattern, association etc., various geomorphological units were indentified. They are

a) Structural hills
b) Erosional plateau
c) Composite slope
d) Bajada
e) Valley fill
f) Pediment
g) Buried pediment
h) Buried channel
i) Flood plain

a) Structual Hills

The structural hills could be identified with the help of their strucutral trends. The structural hills present in the study area show a trend in the NE-Sw direction. The structural hills present in the area are folded. In typical FCC (bands 1,2 and $) imagery it exhibits brownish green tone. These hills can be recognised with the help of composite nature of the slope, irregular and controlled fringes. One third of the area is covered by structural hills. All the hills present in the study area are strucutral hills.

b) Erosional Plateau

It is a vast planar feature formed by erosion and are seen on hill tops. Microlevel anticlines and synclines are exposed from erosion and are converted into planation surfaces. Such planation surface forms an extensive flat topography on hill tops and they are called erosional plateaus. Therefore identified in satellite imargery by their light gray tone and amoeboic shape. Since it is a planar surface, there is possibility of rain water to stay and infiltrate to reach t he water table.

c) Composite Slope

Composite slopes are formed along the edge of structural hills having very steep slope. In the structural hills, the rock is highly jointed and fractured. So the erosional activities act along the jointed zones, pealing out blocks of rocks leaving behind vertical cliffs, which forms the composite slope. These areas are devoid of groundwater because a major quantity of the water goes as runoff. When subjected to erosion, the soft rocks are eroded away easily and the hard rocks are exposed. These types of composite slopes are present in the charnockite formation.

d)Bajada

Bajada zones are those zones found where the hills meet the plain. In these zones eroded materials brought from the hills, get settled all along foot hills. Around the structural hills, in the foot hill region, the deposition by the fluvial action and the presence of vegetation is giving a red colour in the FCC imagery by which bajada is delineated. There is a relationship between composite slope and bajada zone. If the inclination of composite slope is high, the extent of bajada zone is also high and; where the slope has gentle inclination, the area covered by bajada zone is also small.

Since the bajada zone is composed of transported materials from the uphill, it will be having only less amount of compaction and also large amount of boulders, high range of grain size all of which in turn favour high

permeability. So there will be more infiltration. Thus, it makes the bajada zone a suitable area for groundwater exploration.

e) Valley Fills

The unconsolidated materials partly filling a valley, forming valley fills, are occuring in the vicinity of hill ranges and are found in the valleys. The Valley fills are formed by depositional processes. Valley fills are composed of loose sediment deposits having boulders and small grains. They show high range of grain size and less amount of compaction expressing high permeability resulting in high infiltration. Large amounts of recharge make this area a good groundwater favourable zone. IN satellite imagery, it is identified by red tone and fine texture.

f) Pediment

Pediments refer to a broad and gently sloping rock-floored erosion surface of low relief extending from the periphery of the debris slope of the hill till it meets the next geomorphic unit. It is a clear rock cut surface with or without soil cover which normally encircles a hill. Pediment is a vast feature present in the study area. It is demarcated from satellite imagery by light gray tone with sparse vegetation and fine texture.

g) Buried Pediments

Buried pediment comprises the thick weathered rock surpace with good groundwater potential. This unit is occupying shallow depressed low relief areas connected with good drainage network of streams and tanks. In IRS-1A FCC is shows red tone due to thick vegetation. The soil is well developed in this unit.

h) Buried channel

Using satellite imagery, the buried channel of Tirumanimuttar river, the tributary of Cauvery is clearly demarcated. Buried landforms have probably attracted more attention than any other type of palaeomorphic features. In satellite imagery the buried channel shows distrinct darker tone. Flood plains are seen on either side of the buried channel. This is observed in the central part of the study area. They form favourable area for groundwater extraction.

i) Flood Plain

Flood plain is formed due to the dumping of the sediments on either side of the river banks. Flood plain will have loose sediments and hence retain good moisture and facillitates more vegetal cover and agriculture. In IRS-1A LISS 1 data, flood plain shows red tone on either side of the buried channel. This red colour is because of the natural vegetation.

LINEAMENTS

Lineaments are linear or curvilinear features of tectonic origin observed in satellite imagery. It could be a fault, fracture, master joints, axial plane fracture, dyke system, long and linear lithologies, straight courses of stream, vegetation alignment or topographic linearity. Lineaments are identified by long, narrow, relatively straight tonal alignments, visible in satellite imagery.

When the lineaments are the result of faulting and fracturing, they represent areas and zones of increased porosity and permeability in hard rock areas. This type of zones may have significance in the accumulation and movement of groudwater.

Commenting on the lineaments present in the study area, totally 114 lineaments are identified and marked. They are having varying dimensions and the smallest of them is 1.4 km. long and some of them extended as much as 9 km. In the study area four different orientation of lineaments are observed. One along NE-

SW direction, the second along NW-SE direction, the third along N-S direction and the fourth along E-W direction. Majority of fractures are oriented in the NE-SW direction. The intersection of lineaments is more in the western part of the area. In the central part, one large lineament having a length of about 9 km. is observed, which is having a trend of NE-SW direction through which Thirumanimuttar river is flowing. The lineaments are more in Kasapatti and Suriyur area.

LINEAMENT DENSITY LSOLINE MAP

After preparing 1cm x 1cm gride, the total length of lineament for one square cm. areas were measured. These are plotted in the respective grid centre and such values are interconnected by isolines and then lineament density diagram was prepared. In the areas of higher values of lineament density isoline, there is a development of secondary porosities like joints and fractures. These are the main factors controlling the occurrence of groundwater. The lineament density map shows that the density is more in western and eastern part of the study area. By using the lineament density map, groudwater favourable zones were indentified.

GEOMORPHOLOGY AND GROUDWATER

The geomorphological map prepared from satellite imagery is helpful in identifying groudwater favourable zones. Among the various geomorphic units, some are grouped as favourable zones and some as moderately favourable zones. In general, flood plains, buried channels and valley fills are covered by thick alluvium and weathered products. There will be more recharge in these areas. Hence, these areas are marked as favourable zones for groundwater exploration. In the geomorphic map prepared from satellite imagery, it is clearly marked that the favourable zones are flood plains and buried channels. They are distributed along the central portion of the area, having NE-SW direction. The valley fills are distributed along the eastern part of the study area.

Bajada zone and buried pediments are also having more infiltration and act as recharge zones. Bajada zones are observed on the foot hills of Bodamalai. Buried pediments occur in the shallow and low lying areas. Buried pediments are distributed almost along the entire study area. As this geomorphic unit indicates more infiltration, it can be classified as moderately favourable zone of ground water. Bajada zones and buried pediment do not favour as much infiltration as much as flood plains, buried channels and valley fills (Fig.2).

LINEAMENTS AND GROUNDWATER

Based on the lineament map of the area, lineament density isoline map was prepared. In the density isoline map it was observed that the groundwater high was located in the region of Kottamedu and Suriyur. Attayampatti, Tumbatulipatti and Ellanur are the other groundwater potential zones. Theselocations are indentified mainly on higher lineament density being equal to two or greater than two. In the Kottameud and Suriyur region, it was also observed that the lineament intersection density was high. The NE-SW trending lineaments were the predominent ones which control the potential groudwater bearing zones of the study area. (fig.3).

GROUNDWATER FAVOURABLE ZONES FROM GEOMORPHOLOGY AND LINEAMENTS

The groundwater favourable zones deduced from geomorphological and lineament map was synchronized to form an integrated map,

LINEAMENT DENSITY MAP

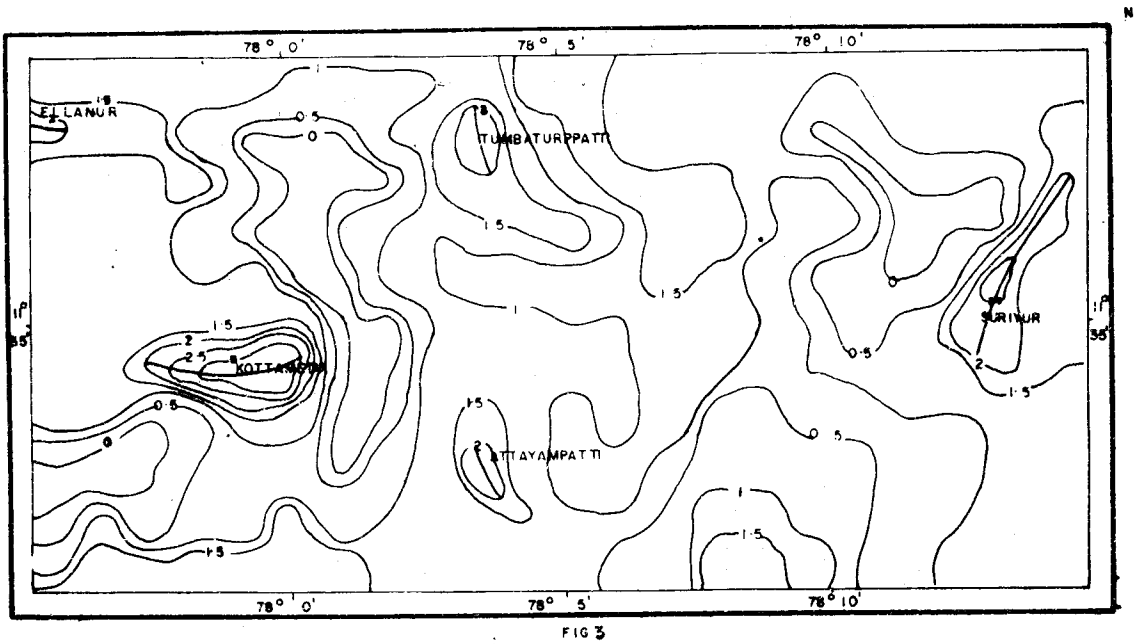

FIG 3

SCALE

0 1·6 3·2 Km

LEGEND

2 TOTAL LENGTH OF LINEAMENTS IN Kms PER 2·56 Sq·km

GROUND WATER HIGH AXIS

GROUND WATER FAVOURABLE ZONE - GEOMORPHOLOGY VERSUS LINEAMENT

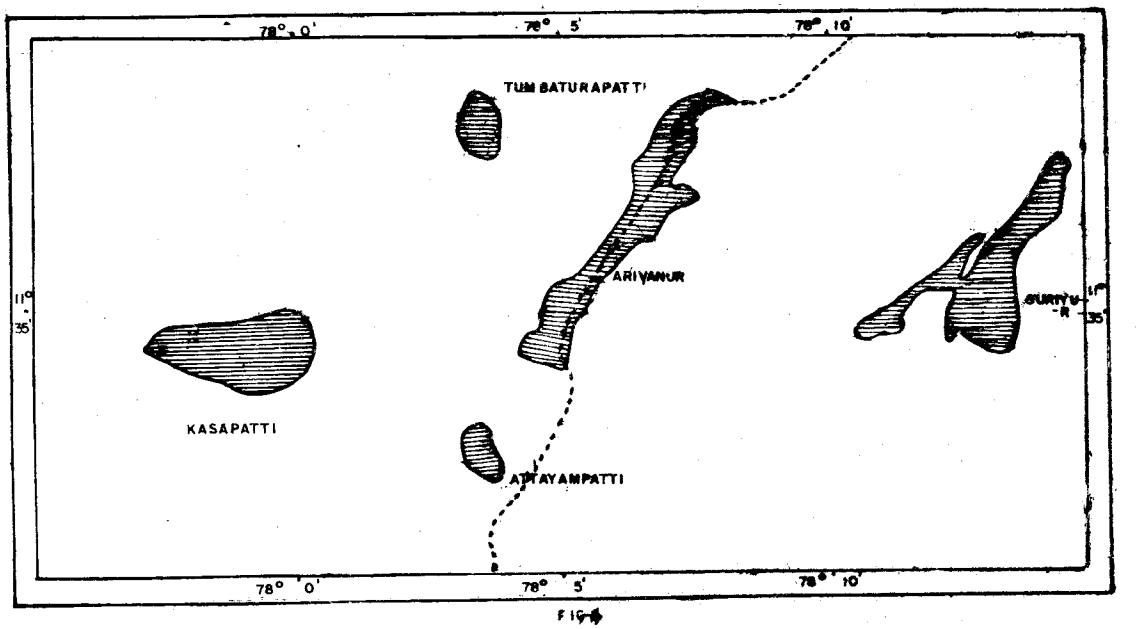

FIG 4

SCALE

0 1·6 3·

LEGEND

GROUNDWATER FAVOURABLE ZONE

BURIED CHANNEL OF TIRUMANIMUTTAR RIVER

which reveals more groundwater favourable zones. The integrated map shows that the area with high lineament density and geomorphological features such as flood plain, buried channels and valley fills are having more groundwater feasibility. Along the eastern side of the area, valley fills and high density of lineaments are seen and it is observed near Suriyur area. The other areas where there is groundwater probability are Ariyanur, Attayampatti, Kasapatti and Tumbaturapatti (Fig.4).

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