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Role of Satellite Data Identification of Groundwater Prospect Zones in Bhanpura Area, Mandsaur District, Madhya Pradesh, India.

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Abstract

The satellite image examination of ERTS LANDSAT and TM 4 data have been carried out by following techniques of visual interpretation.The satellite data analysis has helped in the preparation of different maps such as the geomorphology, drainage density, slope of the area, density and frequency of lineaments, vegetation index and groundwater potential of study area. The image identification reflects the existence of 108 lineaments, which are classified into two groups. Group L_1 = 62 Lineaments with NWto SEdirection and Group L_2= 46 Lineaments with NE to SWdirection.The plotting of measured lineament data on rose diagram display frequency and orientation. The Satellite data analysis has enabled to demarcate the locations of favourable groundwater potential sites, supporting the view of significance of lineaments in groundwater exploration in hard rock areas.

Introduction

Remote sensing is a modern technique of acquiring data and its interpretation in respect of a particular object or area through satellite image. Several workers particularly Gregory (1972),Verstapper (1977), Sabins Jr. (1978, 1987),Fussell *et al.*,(1986), Curran (1988), Mantovani and Marcolong (1997),Mather (1999), Joshi (1992), Jensen (1996), obi, Reddy *et. al.* (2001), Lillesand and Kiefer, (2002), Gupta (2003), Chandra and Ghosh (2006) and others,havedefined and described the remote sensing. The satellite data analysis has helped in the preparation of different maps such as the geomorphology, drainage density, slope of the area, density and frequency of lineaments, vegetation index and groundwater potential of study area.

Study Area

Bhanpura area located in Mandsaur district of Madhya Pradesh, India. The study area is limited to latitude $24^o30'$ to $24^o40'$ N and longitude $75^o38'$ to $75^045'$ E (Survey of India Toposheet No. 45 P/10; Figure 1). The area is approachable throughout the year both by road and rail. Geologically Bhanpura area is occupied by Kaimur Sandstone (Upper Vindhyan, Precambrian) and Basaltic lava flows of Deccan traps (Lower Eocene to Upper-Cretaceous).

Data Collection and Analysis

Remote sensing data analysis is based on the collection of satellite image ERTS LANDSAT DATA and TM 4 Satellite imageries image. The image examination has been carried out by following visual techniques of interpretation. The examined features from image data product have been subjected to ground truth verification in the study area. Later on, the identified features extracted from image and field verification have been used for the final preparation of the remote sensing illustrations.

The satellite imagery of Bhanpura area has been analyzed in the laboratory as per the usual

procedure of stereoscopic examination and preparation of data product (Figure 2). The flow chart of satellite examination is illustrated in figure 3.

Image Interpretation and Discussion

The deferent maps have been prepared on the basis of satellite data such as geomorpho-logy, drainage density, slope of area, vegetation index, lineament density and frequency, landuse and groundwater potential maps.

1. Geomorphological unit

Geomorphologically, the present study area is dominated by the occurrence of multi-landforms. The various landforms have been identified by using imagery data. The various landforms which have been formed due to different geomorphic process have been interpreted such as basaltic lava flows of Deccan traps, dissected hills, intermountain valleys, linear ridge, plateau, residual hill, valley fills and water bodies. Eight geomorphic units have been identified from the image examination (Figure, 4).

Dissected hill: The presence of dissected hill has been observed four places near Bhanpura town, Kotri, Pipalda and Lalganj. This unit consists of the joints, fractures and lineaments etc. It is formed by differential erosion and weathering, so that a more resistant formation or intrusion stand as mountains/hills. These hills indicate moderate groundwater prospects.

Intermountain valley: This geomorphological feature is witnessed in the sector from Kotri to Bhanpura. This is fracture controlled valley and consisting of colluvial deposits of varying lithology. The groundwater occurs in this zone as good to moderate depending upon the thickness of valley fills.

Linear ridge: This unit occurs as long and narrow relict with linear relief either independently or as part of a larger chain of hills. The groundwater occurrence is controlled by the topography and drainage network.

Plateau: In study area the northern part is comprised of the plateau consisting of the Vindhyan Sandstone. It is comprised of various litho units, characterized by extensive flat top and steep slope. This geomorphic unit indicates good to moderate groundwater prospects.

Residual hill: The residual hill is isolated low relief formed due to differentialerosion sothat a moreresistant formation stands as residue like small hills. The groundwaterprospect is in this zone poor to nil (Jhanwar, 1998).

Valley fills: The observed valleys are narrow and occur in the north-eastern and central sectors of the study area. The valleys are contained with adequate amount of sediments (fills). These valley fills include pebbles, cobbles, fragments of rocks and silts and deposited by stream. These valleys indicate the very good groundwater prospects depending on the thickness of fills.

Water bodies: The large surface water body is represented by the Gandhi Sagar reservoir and a few small water bodies are also noted in the Bhanpura study area. These features are of significant and may also be helpful as supporting evidence in selection of groundwater sites.

2. Drainage Density

The study area reveals the presence of dendritic drainage pattern. The low drainage density indicates high infiltration rate, whereas the high drainage density points out low infiltration rate (Figure 5).

3. Slope Map

The slope map has been finalized in the ARC GIS software. The slope map exhibits the presence of low to high slope areas. A low slope region causes less runoff and high infiltration, whereas very high slope reveals high runoff and less infiltration indicating very poor

groundwater prospects as compared to low slope part of the unit (Figure 6).

4. Lineament Data Analysis of the Study area

The satellite image examination of Bhanpura area reveals the presence of 108 lineaments. The field verifications of lineament have been carried out. The measurements of lineament variables carried out on the basis of satellite image have been graphically plotted (Figure 7, 8, 9, 10). The lineaments of the study area have been divided into two groups.

Group L_1 = 62 Lineaments (57.40 %) with direction NWto SE

Group L_2 = 46 Lineaments (42.59 %) with direction NE to SW

The frequency diagram of lineament (Figure 7) indicates that the lineaments are dispersed almost through out the Bhanpura study area, however in vicinity of Prempurwa. Kotri and Rewa river the lineaments are considerably more frequent in the area.

The lineament density zones areexamined and recorded (Figure 8). The lineament density map reflects a considerable rang of density from very low to very high indicating that higher density areas are having good potential for the presence of groundwater storage. The areas having very high density indicate excellent areas for groundwater exploration and exploitation in Bhanpura area. The measured frequency and direction data of lineaments have been exhibited on rose diagram (figure 9, 10).

5. Vegetation Index Map

The vegetation of the study area exhibits the development of different types of vegetation as low, medium, high and very high vegetation. The low vegetation is developed in vicinity of Bilkkeri, Lalganj and Prempurwa indicating very poor groundwater prospects. Generally, the green vegetation areas yield high values of the index, water yield negative values, whereas barren soil gives index value near zero. The low values are indicating the barren land (Figure, 11).

6. Groundwater Prospect Map

The groundwater potential zones have been identified by visual interpretation of the false colour composite (FCC) and TM 4 band data. The groundwater potential zones of the study area have been prepared by overlying all the thematic details upon each other. Some parameters of geomorphic features emerge suitable for the occurrence and movement of groundwater, which are demarcated as groundwater potential zones.

In study area, it has been observed that the groundwater potential is very high, high, medium, low and very low. The geomorphic unit such as the linear ridge indicates that the groundwater potential is very low. The plateau is indicative of the low to very low groundwater potential zone. The Bhanpura town, Dhamniya. Pipalda, Ralayata and Dudhli area yields medium groundwater potential prospects. The zones along the water bodies in the study area indicate that the groundwater potential zone is fairly high to very high (Figure 12).

Resultand Discussion

The groundwater potential zones of the study area have been prepared by overlying all the thematic details upon each other. Some parameters of geomorphic features emerge suitable for the occurrence and movement of groundwater, which are demarcated as groundwater potential zones. Eight geomorphic units have been identified from the image examination dissected hills, intermountain valleys, linear ridge, plateau, residual hill, valley fills and water bodies. The low drainage density indicates high infiltration rate, whereas the high drainage density points out low infiltration rate. The lineament density map reflects a

considerable rang of density from very low to very high indicating that higher density areas are having good potential for the presence of groundwater storage. The areas having very high density indicate excellent areas for groundwater exploration and exploitation in Bhanpura area. The Bhanpura town, Dhamniya. Pipalda, Ralayata and Dudhli area yields medium groundwater potential prospects. The zones along the water bodies in the study area indicate that the groundwater potential zone is fairly high to very high. The low vegetation is developed in Bilkkeri, Lalganj and Prempurwa are indicating very poor groundwater prospects.

Conclusions

The satellite data analysis has helped in the preparation of different maps such as the geomorphology, drainage density, slope of the area, density and frequency of lineaments, vegetation index and groundwater potential of study area.The integrated groundwater prospect map has been categorized into five classes on the basis of different features of the thematic maps. The Satellite data analysis has enabled to demarcate the locations of favourable groundwater potential sites, supporting the view of significance of lineaments in groundwater exploration in hard rock areas.

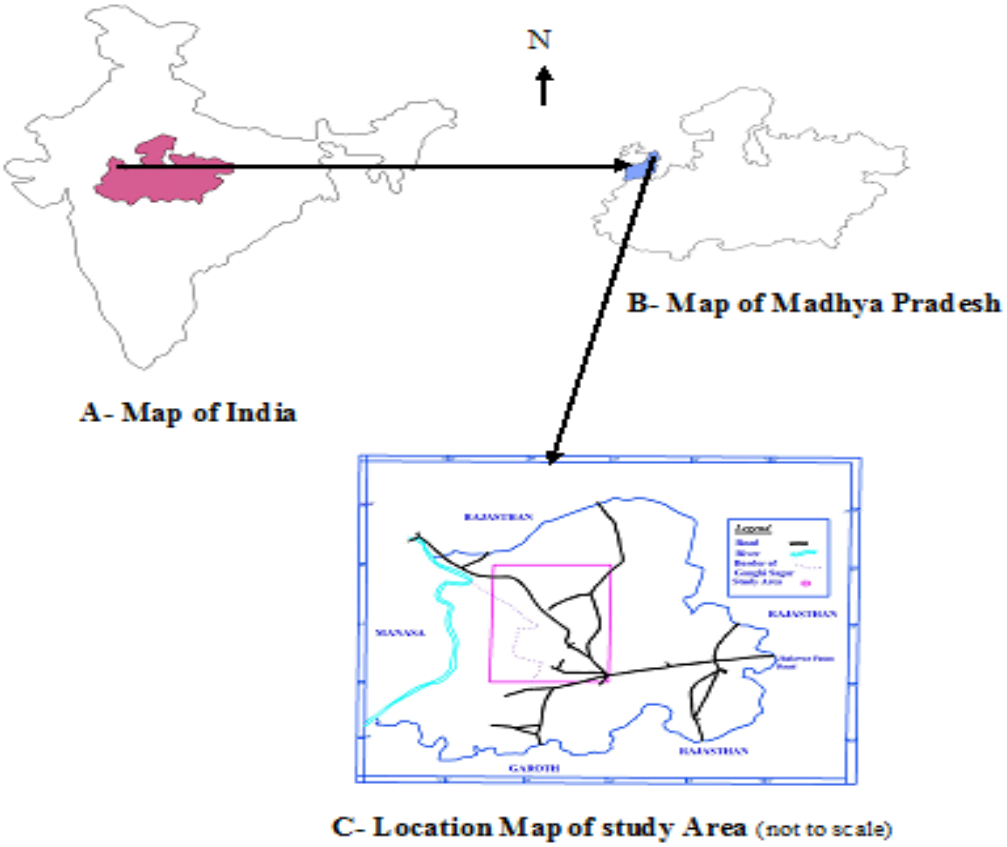

Figure 1 Location Map of the Bhanpura study area, Mandsaur district, M.P.

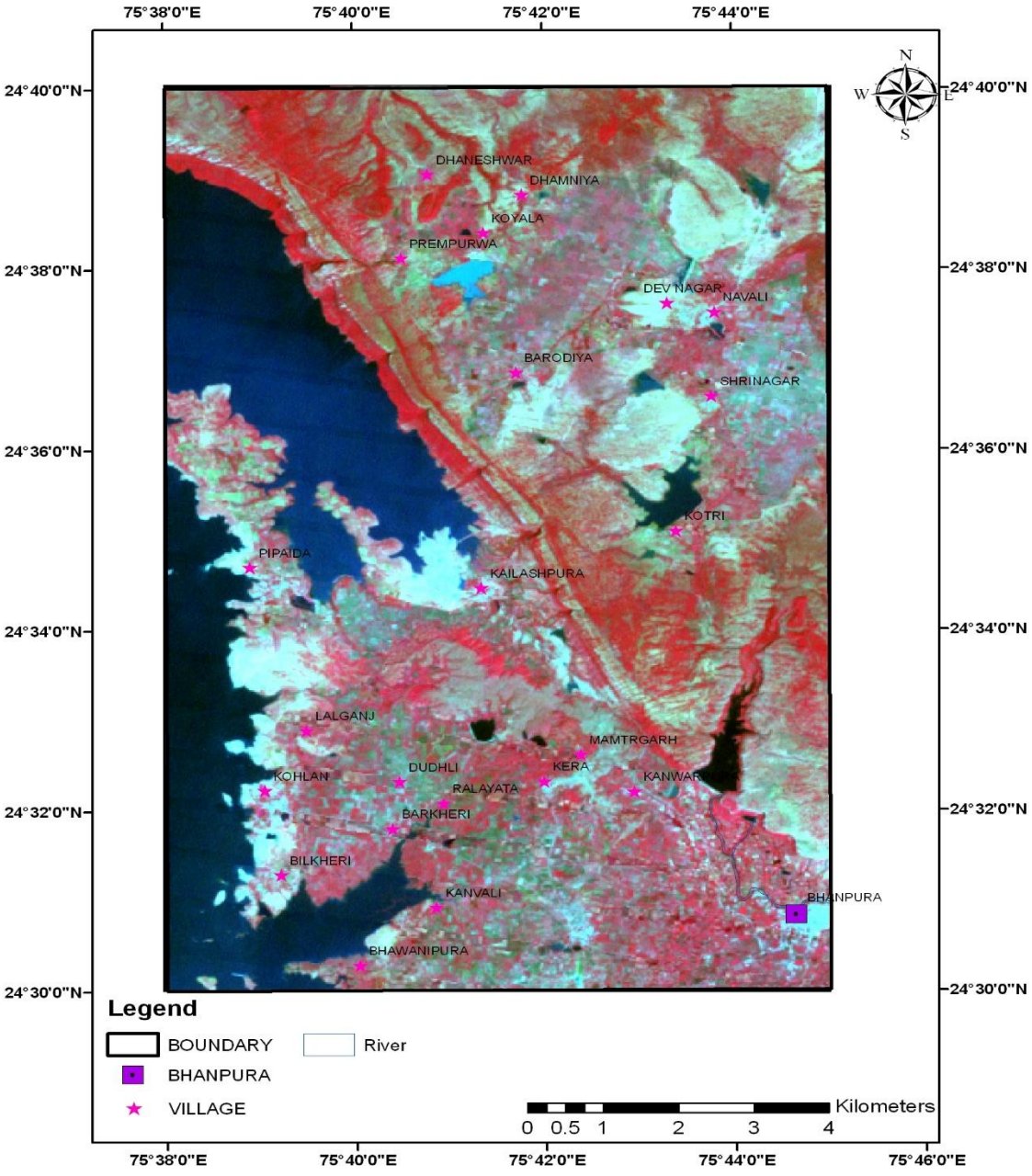

Figure 2 Satellite imagery of Bhanpura area, Mandsaur district, M.P.

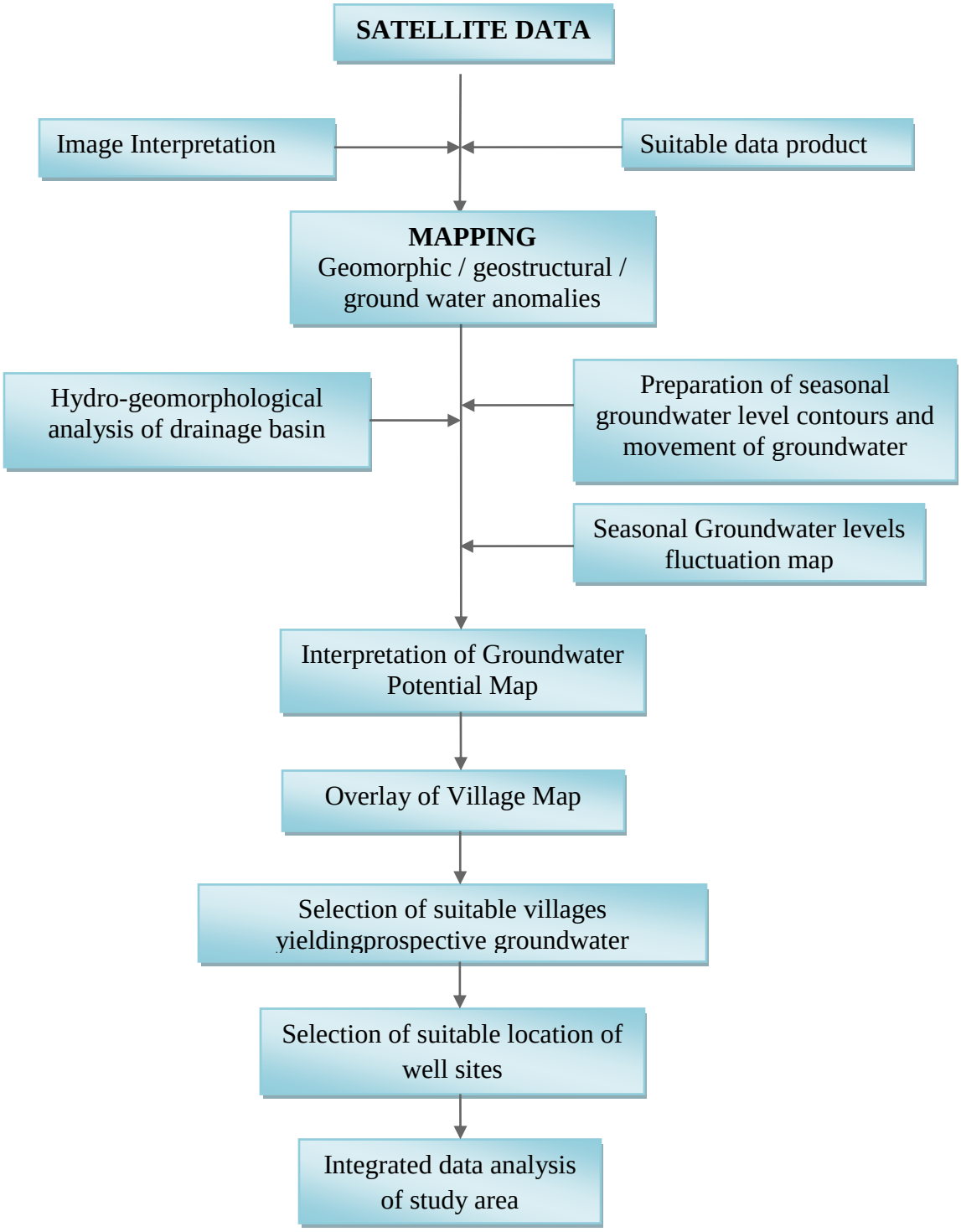

Figure 3 Satellite data based methodology chart for groundwater prospect zone mapping (Modified after Rao and Gupta, 1998).

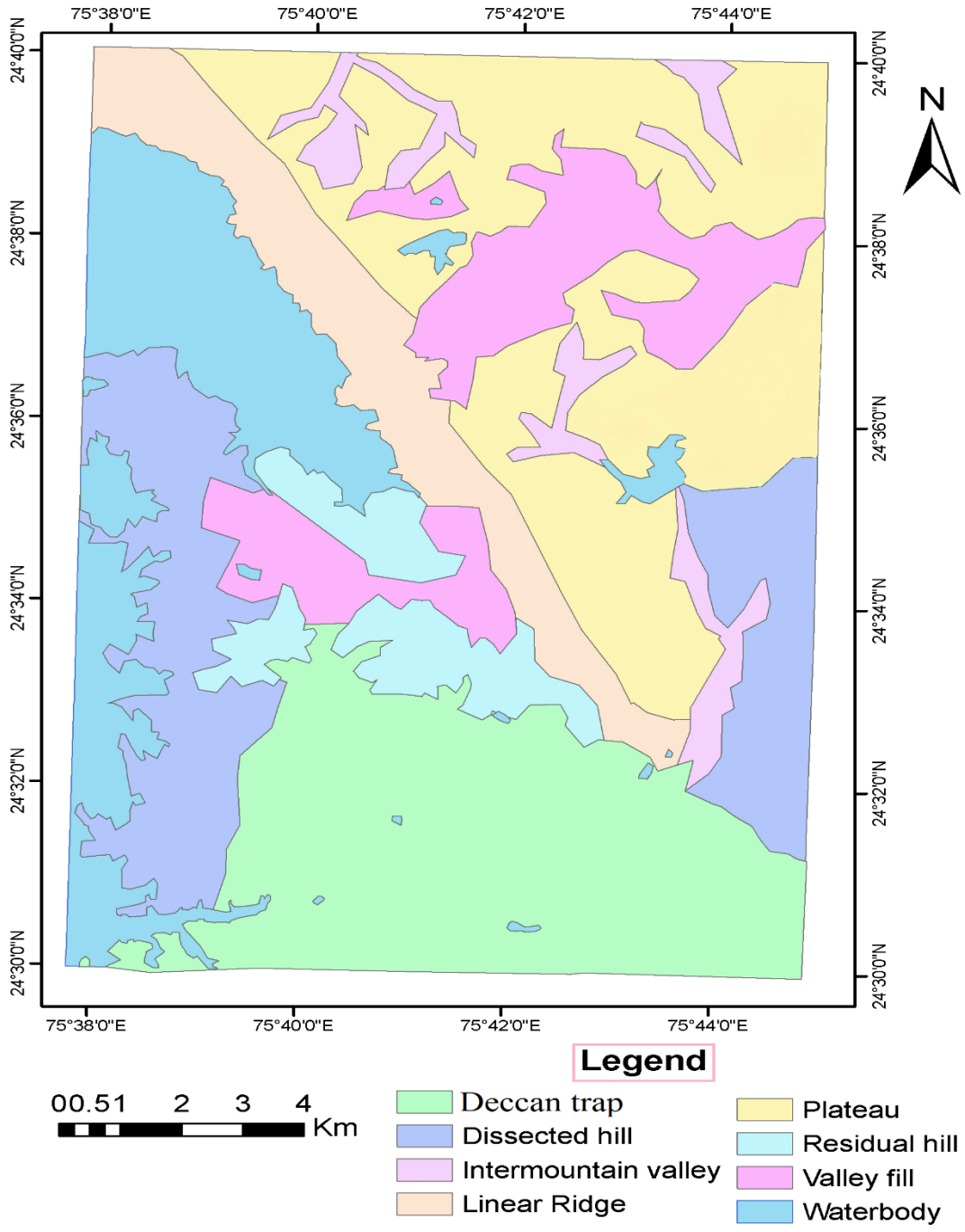

Figure 4 Interpretation ofGeomorphological map of the Bhanpura area, Mandsaur district, Madhya Pradesh.

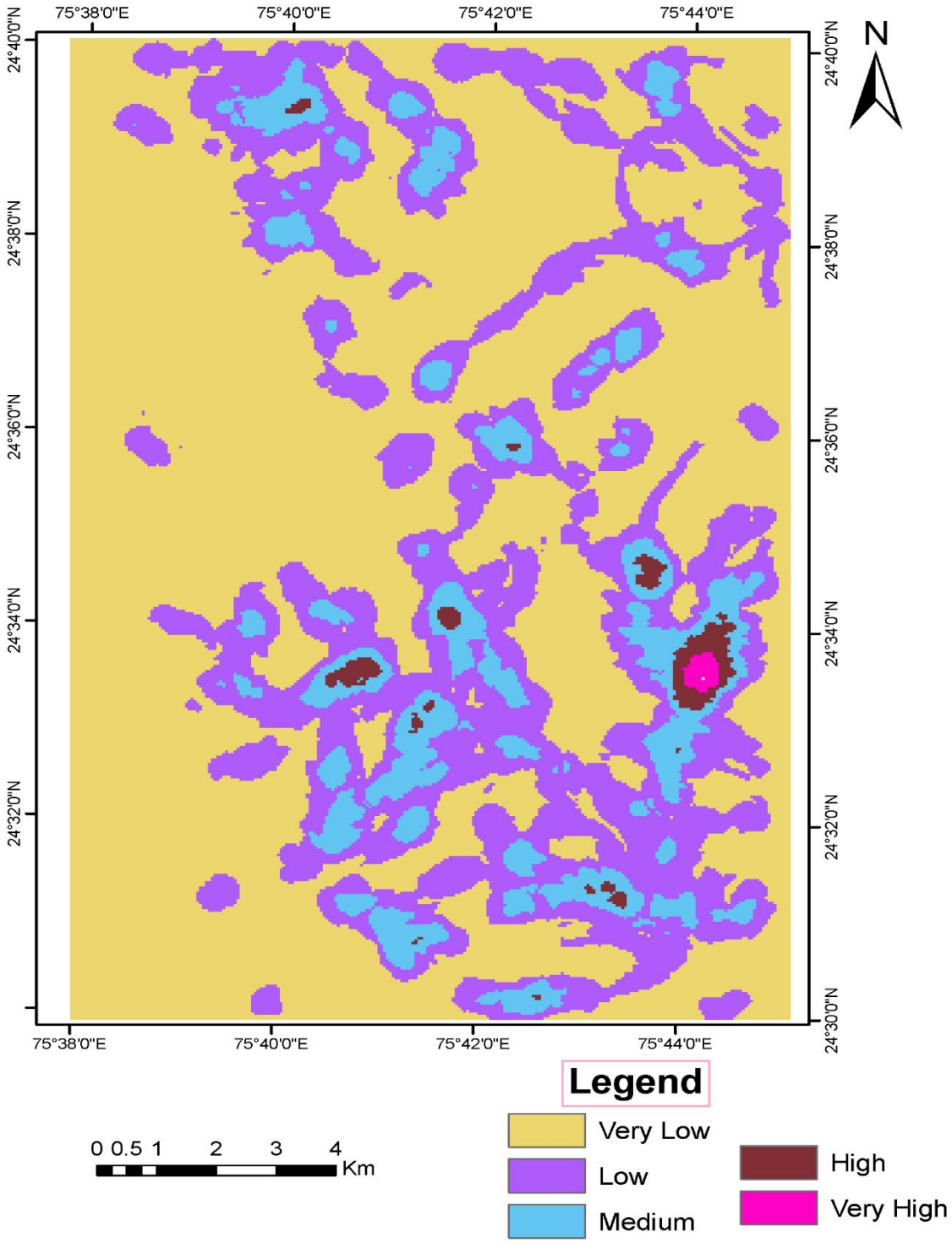

Figure 5 Drainage density map of Bhanpura area, Mandsaur district, Madhya Pradesh.

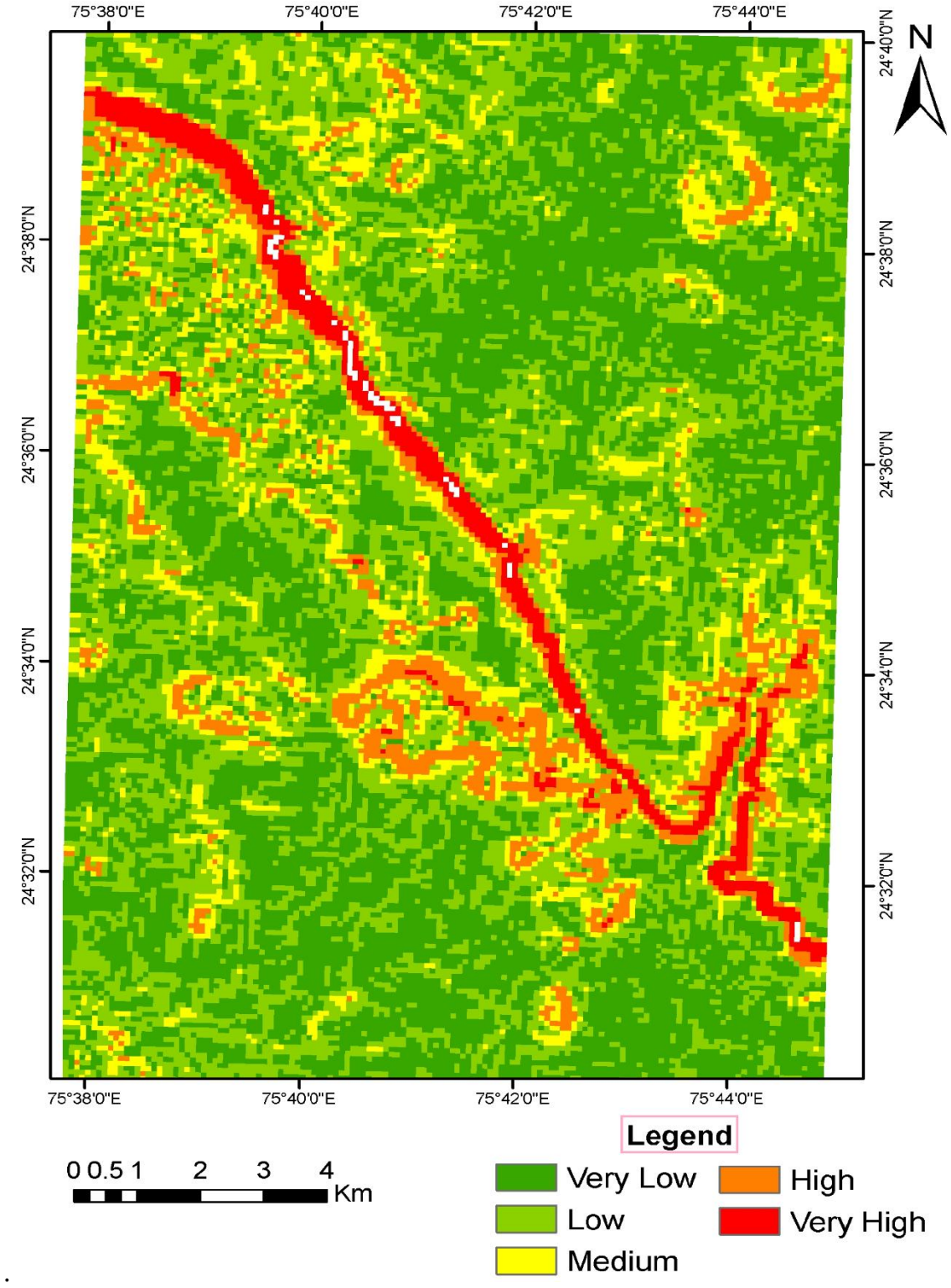

Figure 6 Slope map of the Bhanpura study area, Mandsaur district, M. P.

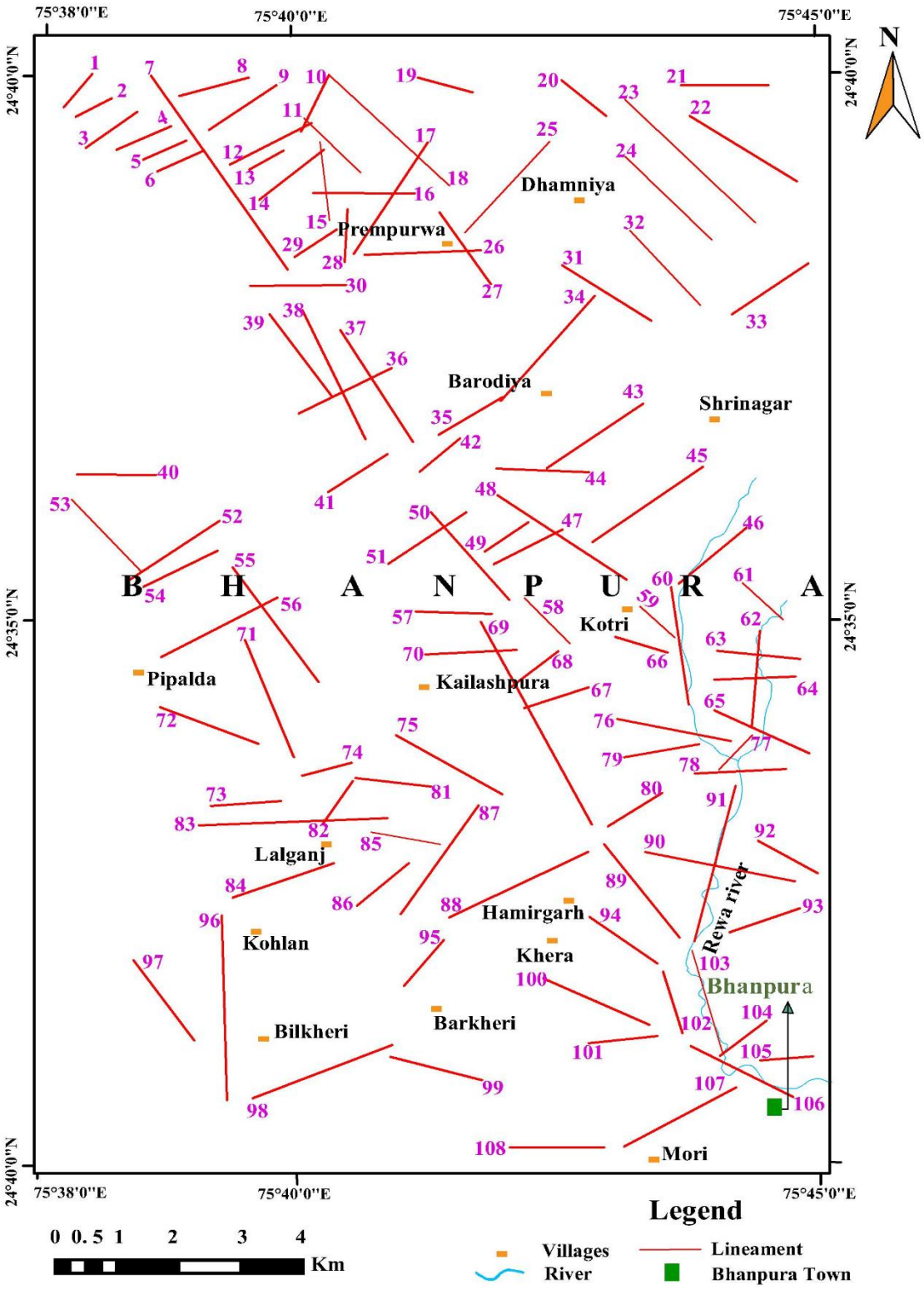

Figure 7 Lineament frequency map of the study area.

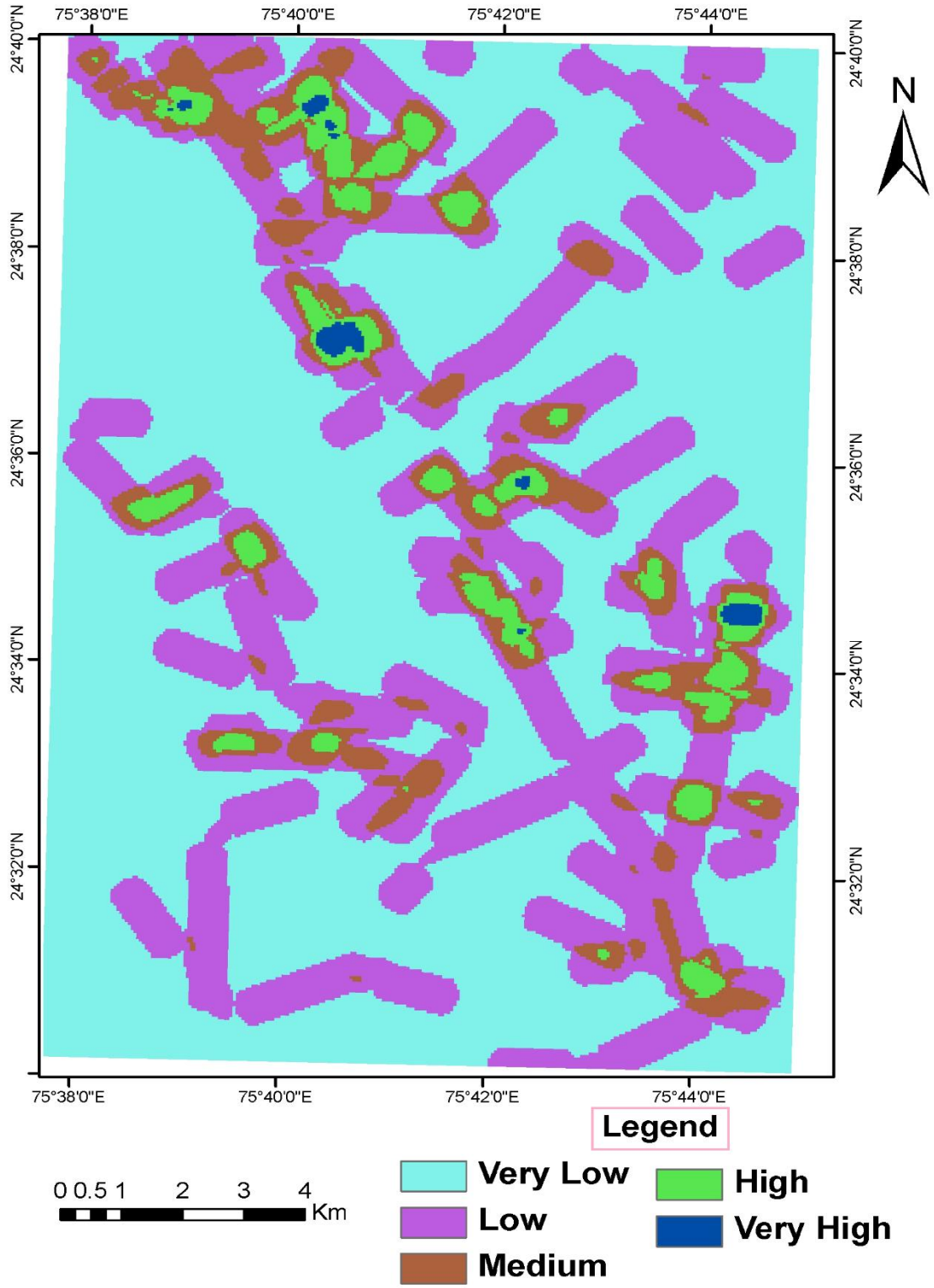

Figure 8 Lineament density map of the study area.

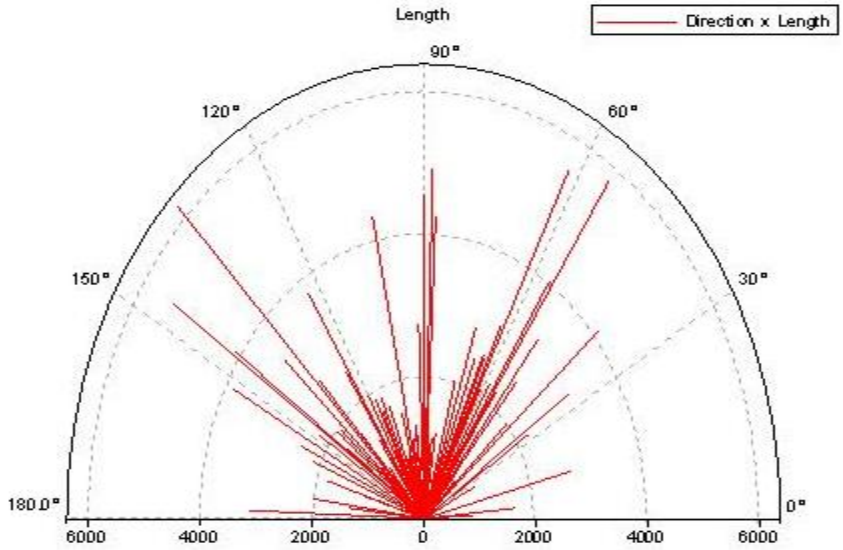

Figure 9 Rose diagram exhibiting length lineaments in Bhanpura area.

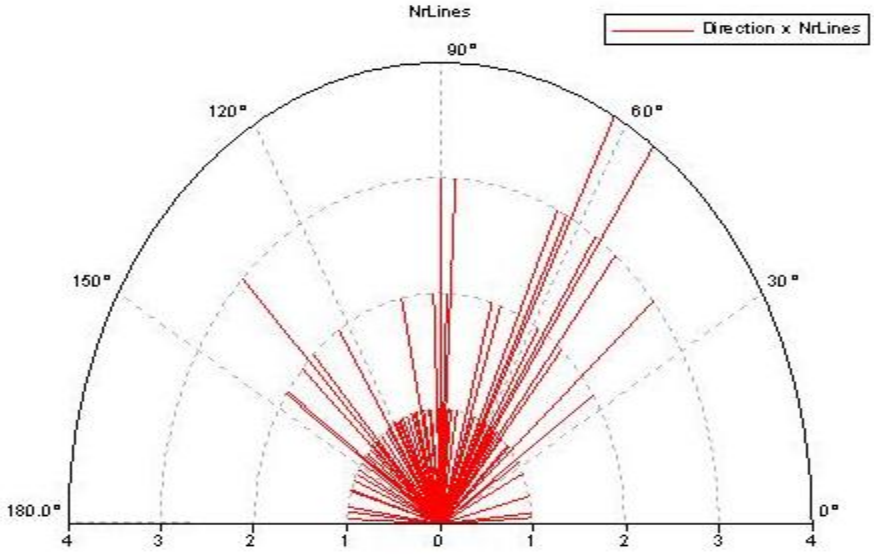

Figure 10 Rose diagram exhibiting direction of lineaments of study area.

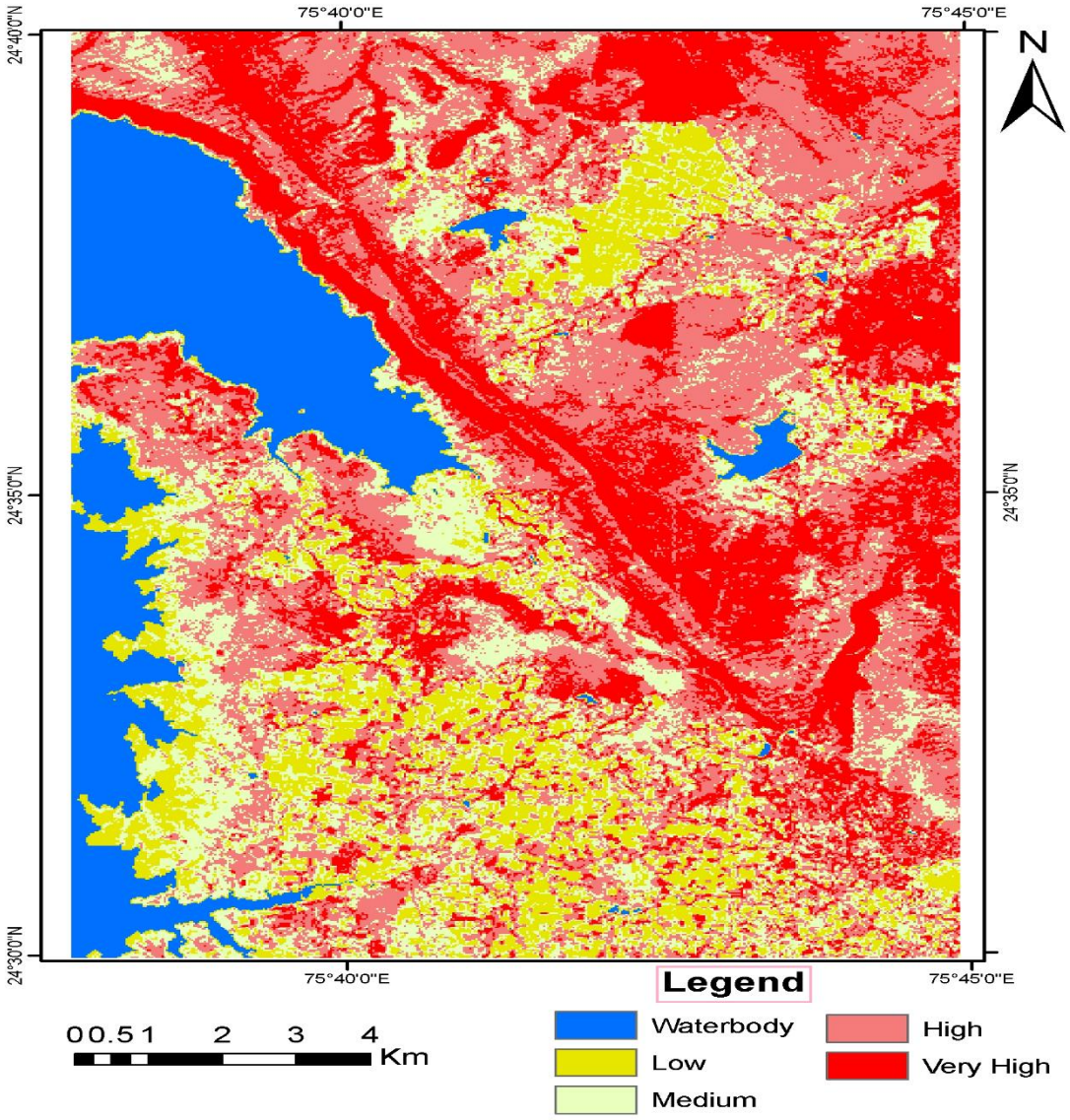

Figure 11Normalized different vegetation index map of the study area.

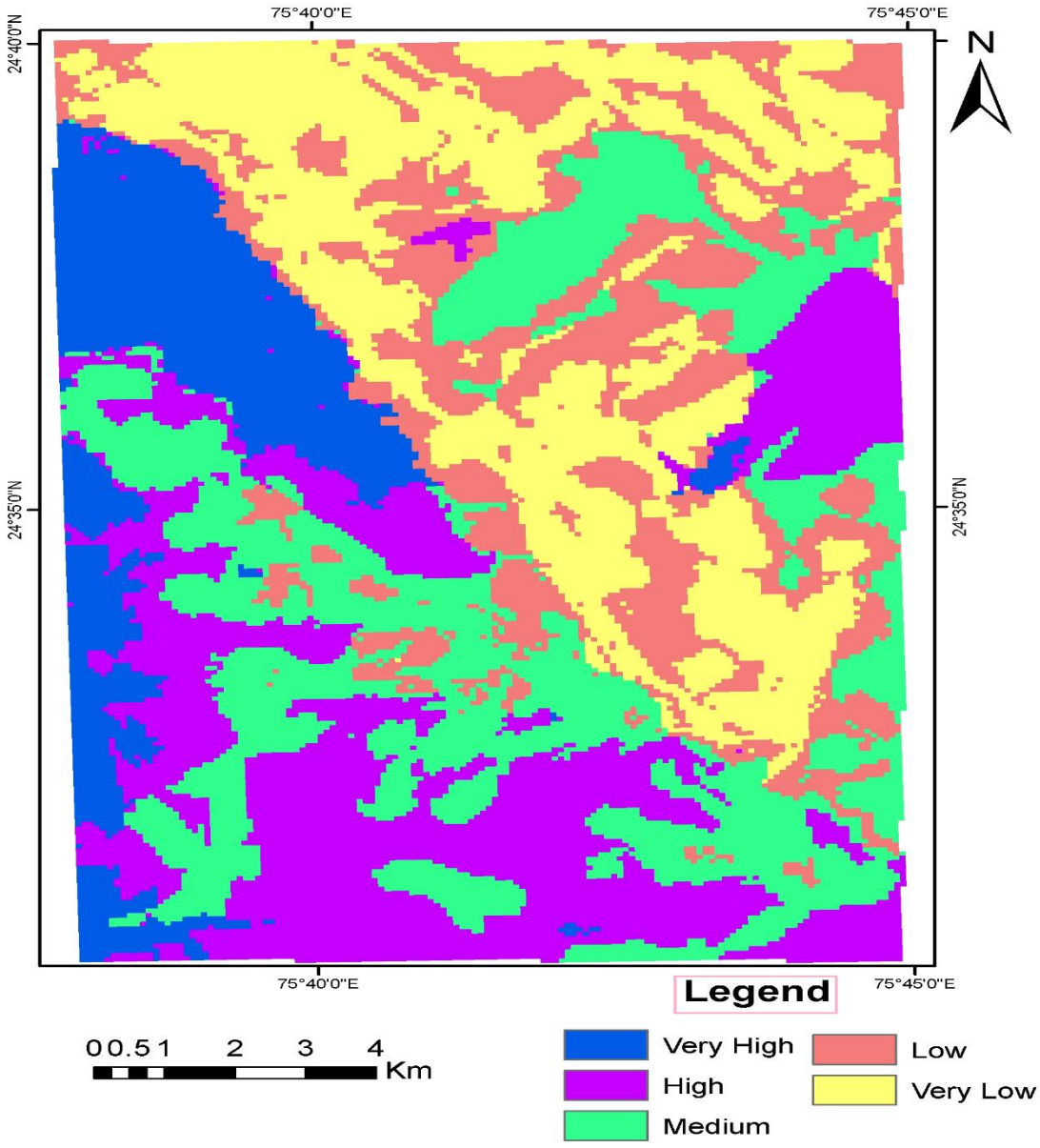

Figure 12 Groundwater prospect map of the study area.

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