Neo Geographia (ISSN-2319 – 5118) Vol. IV, Issue. II, April 2015 Impact factor 1.092 (IIFS)

HYDRO GEOMORPHOLOGIC ANALYSIS OF UPPER KIILE RIVER BASIN USING REMOTE SENSING TECHNIQUE

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Abstract:

The hydrogeomorphological units of the Upper Kiile river basin have been analysed using IRS- LISS III – FC of 2000 on the scale of 1:50,000 with ground verification. The geomorphological condition and the ground water potentiality have been identified on the basis of forming materials both erosion and depositional work and its geological characteristics. The major hydrogeomorphological units that have identified are weathered hill, dissected hill, isolated hill and intermontane valley floor. The lithology of basin comprises gneiss, schist, phyllites and quartzite. Quaternary deposit includes pebble, boulder, sand and clay underlain by the Lesser Himalayan deposits. The ground water potential has been categorized as very poor, poor, moderate and good.

Key words: lithology, potential, geological, Himalaya

INTRODUCTION:

The hydro geomorphology deals with the aspects of water, rocks and earth's morphological characteristics. The knowledge of hydrogeomorphology is important for any planning and management activities especially in the field of watershed development, agricultural landuse, etc. which directly deals with the surficial features of the earth. For the proper demarcation of hydrogeomorphological units, the demarcation of geomorphic units is important as the geomorphological features manifest the underlying parent materials and the associated nature and duration of geomorphic processes. The geomorphological mapping of a terrain and analysis of their processes also help in soil resources mapping, groundwater potential zones identification, landscape ecological planning, hazard mapping and other environmental applications. The basin appears like an intermontane valley dotted with small isolated hills and presents a typical geomorphological configuration. In this area wet rice cultivation is very popular for which a small perennial river and its tributaries provides sufficient water for irrigation.

The canal network for irrigation has been developed by applying indigenous knowledge in such a way that not a single agricultural plot is left without water. The main agricultural area is concentrated in the flat valley and its elevated surroundings. It appears that the ground water table is very shallow as dug well presence supports this fact. However, a detail survey is needed to substantiate this fact. Except for the few dug wells where the water level is higher, maximum is found almost parallel to the surface water level. Therefore, any low lying area in the valley appears like marshy land which indicates the presence of a huge amount of sub- surface water. The region is known for its good agricultural production but at present it is facing problems from many areas like increasing in population that leads to major change in the existing landuse/landcover of the area. Many of the agricultural land are now converted for either commercial or for house construction purpose. These changes in the later part may lead to huge shortage of agricultural crops for the increasing population.

STUDY AREA

The study area is extending in between 27°30′ to 27°38' North latitude to 93°45" to 93°55' East longitudes covering an area of about 152.172 Km² (Fig.1). The study area is drained by a small Kiile river which is a sub- tributary of Ranga river in Lower Subansiri district, Arunachal Pradesh. The altitude of the study area ranges from 1540m to 2684m above mean sea level. The weather and climatic condition of the study area is quite unique from the rest of the Arunachal Pradesh. It presents a humid sub-tropical to temperate type of climatic condition, due to which it gets sufficient amount of rainfall in summer season.

OBJECTIVE

The present study is undertaken to prepare hydro geomorphologic units of the study basin area and to observe the prospect of ground water potential.

DATABASE AND METHODOLOGY

The hydrogeomorphic characteristics of the basin have been studied using the survey of India toposheets with the scale of 1:50,000 and Indian Remote Sensing IRS - 1C LISS III – False Color Composite generated from band 2, 3 and 4 of year 2000 on scale 1:50,000. The IRS – 1C imagery has been visually interpreted after making ground verification. All the available conventional information like physiography, geology, drainage and ground water data are used for the delineation of hydrogeomorphological units and its associated features. All the major lineaments are traced as seen in the satellite imagery and their directions were measured for the preparation of rose diagram. The base map of the study area has been prepared by using the survey of topographical maps which is superimposed over the satellite data. The geomorphologic and ground water potential units have been identified and interpreted on the basis of erosion, depositional and geological characteristics during field work.

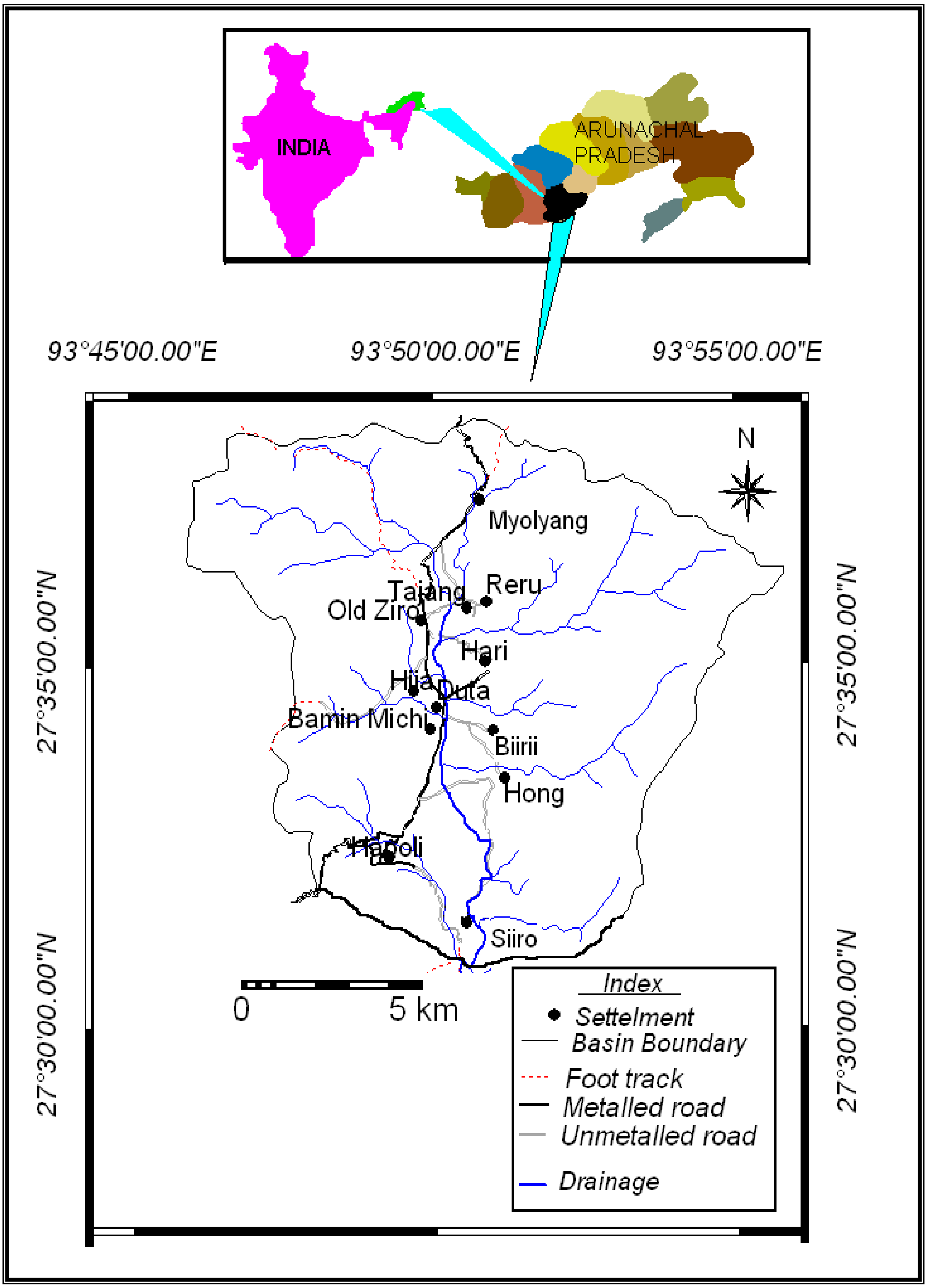

Figure 1: Location of Upper Kiile basin

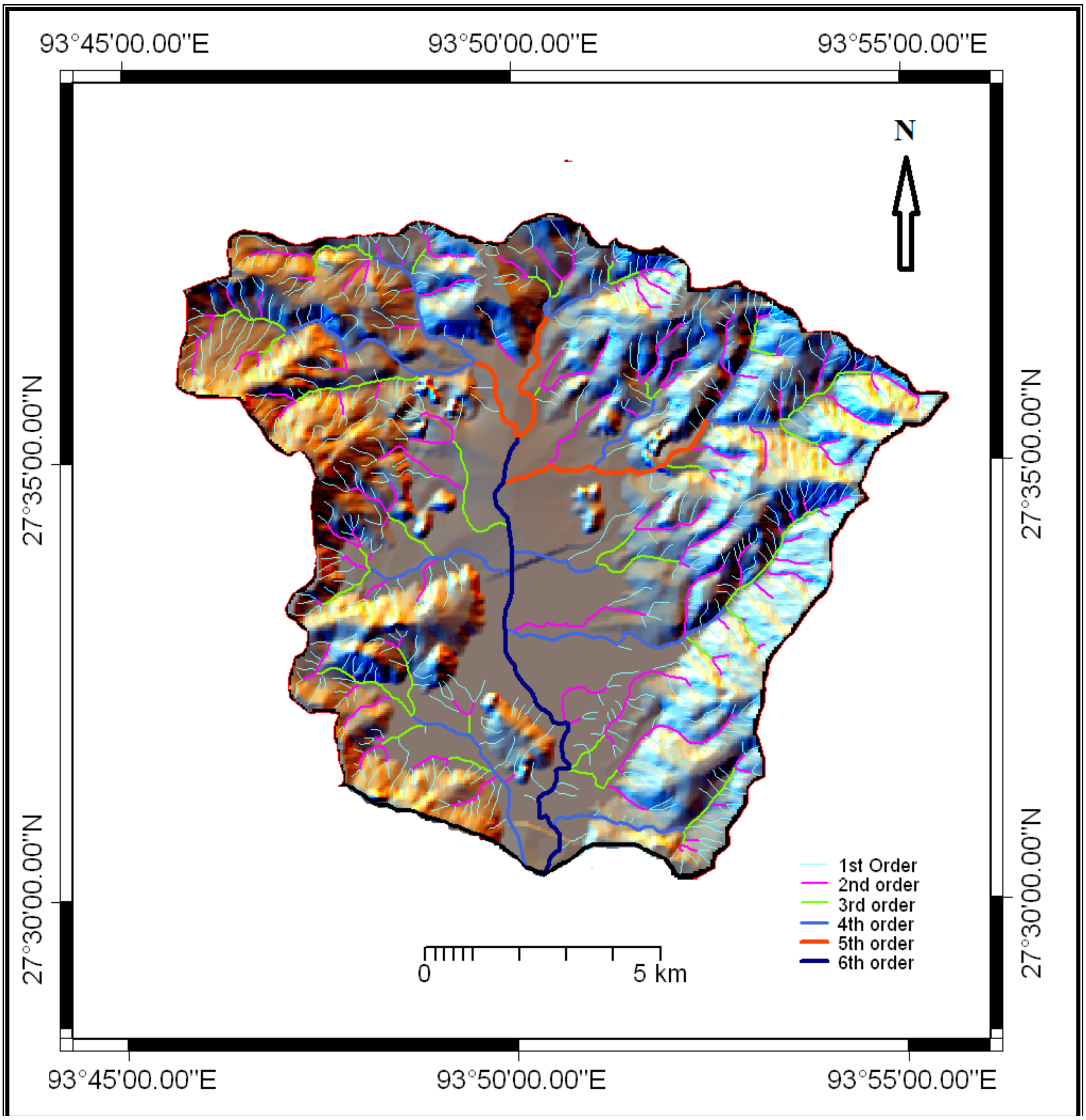

Figure 2: Digital Elevation Model of Upper Kiile Basin

RESULT AND DISCUSSION:

Geology

Litho structural set up of the study area falls under the Lesser Himalayan part. The area comprises gneiss, schist, phyllites and quartzites. Lesser Himalayan rocks are separated in the south from Siwaliks at Lichi locality and in north from Great Himalaya at Taliha locality by Main Boundary Thrust (MBT) and Main Central Thrust (MCT) respectively (Singh, Trilochan). The Kiile river basin comprises gneiss, schist, phyllites and quartzite. Quaternary deposit includes pebble, boulder, sand and clay underlain by the Lesser Himalayan deposits.

Lineaments is a mapable simple or composite linear feature of the surface which parts are aligned in a straight or slightly curved and differ distinctly from the pattern of the adjacent features. It reflects the sub – surface phenomenon (Bharktya and Gupta, 1982). The basin is crisscrossed by numbers of fractures/lineaments, which are the good sources of ground water potential. Total number of lineaments were counted falling under the six group direction (0º - 360º) at the interval of 30º. Maximum lineaments (34%) falls under 30º - 60º to 210º - 240º direction group. General trend of lineaments indicates two patterns:

i. Parallel to Major Structural trend of the Himalaya i.e. extension of Main Boundary Thrust (MBT) and Main Central Thrust (MCT) and
ii. Across the Major structural trend.

Table 1: Kiile River Basin: Lineament

Direction (In Degree)	Frequency
0 - 30 to 180 - 210	250
30 - 60 to 210 - 240	311
60 - 90 to 240 - 270	154
90 - 120 to 270 - 300	182
120 - 150 to 300 - 330	186
150 - 180 to 330 - 360	38
Total	1121

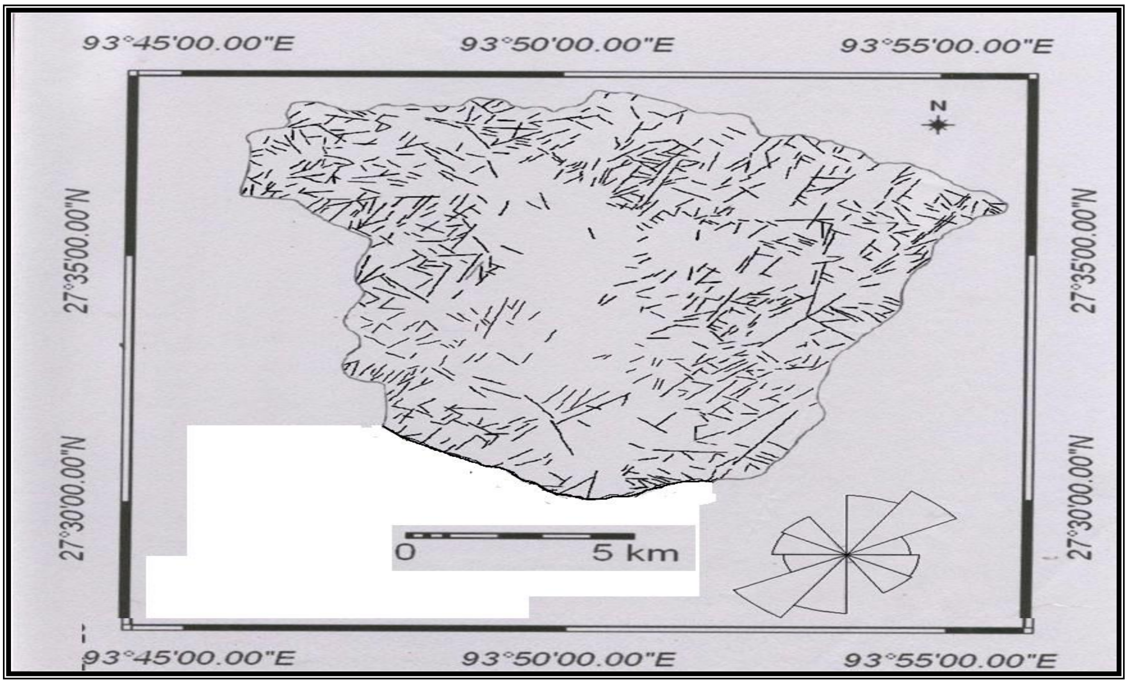

Figure 3: Lineament map

Hydro morphological Units:

Visual interpretation of the satellite data was carried out for analyzing the litho logical, drainage characteristics and tentative units have been demarcated which was verified through intensive field check. The major hydrogeomorphic units found in the basin area are divided into weathered hills, dissected hills and isolated hillocks and intermontane flat valley (Fig.2). The ground water prospect of the basin has been studied on the basis of its geological characteristics like, lithology, fold, fault, lineaments, etc. The ground water potential has been grouped as very poor, poor, moderate and good.

Weathered hills

This unit covers the maximum area of 77.830Km². The quartzitic gneiss are found in this unit having well foliated plane with NW to SE strike line. The rocks are dipping in NE direction with 50º inclination. This unit is made of weathered micaceous and quartzitic gneiss. These deep weathered gneiss flow with water along the slopes and finally deposited in the low lying areas of the valley. In the eastern part of the basin area weathered crystalline rocks are visible. Weathering depth is observed upto 10m. Crystalline boulders are seen embedded in weathered material. It appears these are corestones and sliding along the slope towards downhill due to gravity. Structurally foliated and fractured with joints and lineaments, the prospect of ground water in this unit is very poor.

Dissected hills

This unit comprises of hard micaceous gneiss with very high amount of quartz and mica flakes. River flowing along the hills have dissected this area which is clearly visible in the satellite images. It covers about 43.111K² of the basin area. Rocks are having cross bedding made of fresh clay and boulders and eroded joints that are filled with quartz matter. There are river terraces and alluvial fan at the margin of this unit comprising of well sorted alluvial deposit. In the western part of this unit apart from gneiss, quartzitic rocks are also seen with a vertical to near vertical dip in the south-east direction. The strike and dip attitude indicate north-west to south-west towards east. This trend indicates the dip direction of rock towards valley floor. Few dug wells have been located in the transitional zone between this unit and intermontane valley. The groundwater potential is poor to moderate.

Isolated hills

Within intermontane valley, there are numbers of small and big hillocks are present. This unit covers an area of 7.04Km². From a distant view these hillocks appears as islands which are surrounded by agricultural fields. These hillocks are made of gneiss, rocks that are overlain by weathered material and small semi angular pebbles embedded in soil. Large hillocks are basically used for settlement, pine and bamboo grooves and for rain fed agriculture. At the margin the alluvial deposits of alternate sands, silt and pebbles are seen. This forming material indicates there might have been deposition and later on receding stagnant water isolated the area. In some parts of unit huge crystalline boulders which width varies from 6ft to 11 ft embedded in yellowish soil with quartz crystals. Many of the dug wells are located in this unit in the form of localized perched aquifer. The ground water potential is moderate to high.

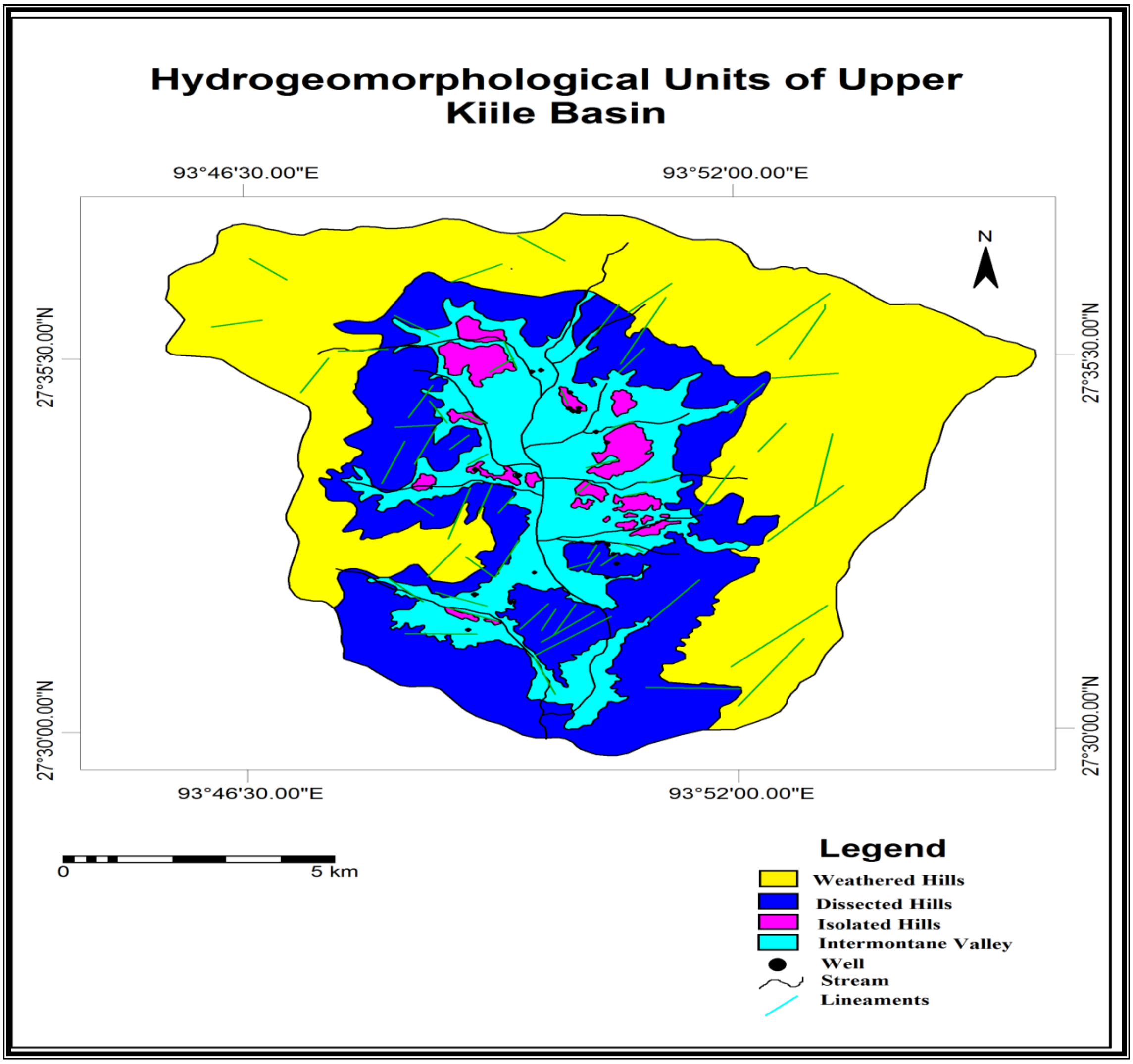

Figure 2: Hydrogeomorphological units of the Upper Kiile basin

Table 2: Hydrogeomorphological units of the Upper Kiile river basin

Geomorphic units	Lithology	Structure	Groundwater prospect	Percentage of basin area
Weathered hill	Quartzitic gneiss, weathered micaceous	Foliated plane and fractured joints, lineaments	Poor	77.830 Km²
Dissected hills	Hard micaceous gneiss (high amount of quartz &	Cross bedding (fresh clay & boulders) joints filled with quartz		43.111 Km²

	mica flake)	matters, dipping of rock towards valley floor, lineaments	Poor to moderate	
Isolated hills	Gneiss, overlain by weathered material & pebbles embedded in soil	Crystalline boulders with quartz crystals	Moderate	7.04 Km^2
Intermontane valley	Thick alluvium (lacustrine origin), peaty soil layer (glacio- fluvial process)	Two to three levels of terraces, alluvial fan remnants	Moderate to high	24.191Km^2

INTERMONTANE VALLEY

The intermontane valleys are found in depressions between mountains, generally broad and linear shaped filled with colluvial deposites of varying grain sizes. From a distant view though the valley surface appears almost plain, but presence of small isolated hillocks and river creates undulation. Otherwise intermontane valley floor area is almost plain. This area is under intensive wet rice cultivation. Ass this area is having almost plain surface dissected by the main river and its tributaries is delimited and named as intermontane valley. The lithology consists of thick alluvium of lacustrine origin. The forming material is unconsolidated clay, sand and pebbles which are seen along the sides of river. A 6ft thick peaty soil layer is found along the river Siya which is not having any correlation with the river terraces that is just few meter ahead the river. This observation indicates the involvement of glacio-fluvial process in its origin. The ground water potential varies from moderate to high due to presence of water logged or marshy area and some dug wells but it depends on the thickness of filled materials.

CONCLUSION

Based on the hydrogeomorphological analysis of the Upper Kiile river basin using remote sensing data and available conventional information and field verification, the study basin area is divided into different units on the basis of geomorphology, lithology and ground water prospect. About 84% of the basin area is dominated by hills with very poor to moderate ground water potentiality. The intermontane valley makes the 16% of the basin area with moderate to high ground water potential. Rapid population growth and rising demand for settlement area reduces the forest cover in hilly area which degrades the environment and indirectly curtail the source of drinking water which affects adversely on the supply of drinking water in the study area. During the field study it was observed that most of the existing dug wells are either abandoned or use only for the washing purpose. Therefore, the ground water utilization at some extent can resolve this water problem in the valley. Thus, the present or future population will depend on ground water source for potable water to quench their thirst.

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