

Land Form and Landuse Analysis of Liddar River Basin, Kashmir

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Abstract

Based on the visual interpretations of topographic maps, LANDSAT imagery and field checks, different types of landforms have been identified in the study area; on the basis of the magnitude these landforms are divided broadly into two landform order categories i-e, second and third order landforms that are utilized by man and nature for different purposes. The landuse/landcover status of liddar basin 1974-75 and 2001 have revealed that there has been drastic change in the forest area as well as agricultural sector and other classes. The main reason behind this change is mainly due to large scale deforestation, erosion and biotic interference that has increased manifold with the passage of time.

Keywords: landforms, geology, landuse classification, Hills and Mountains, Valleys, Flood Plains, Alluvial Fans, Terraces, Liddar, Kashmir

Introduction

The Liddar basin having catchment area of 1134km² lies between (33° 45' N to 34° 15' N; 75° E to 75° 30' E) fig. 1. Adjacent to the basin lie the basins of Arpat Kol on the south, Sindh on the north and Harwan Arpat basins on the north west. The relief of the basin is diverse comprising of high mountains, steep slopes, alpine meadows (margs) and alluvial fans.

The high mountain ranges of middle Himalayas form the drainage divide, separating Liddar basin from the other adjacent basins.

Physiographically, the study area is partly mountainous and partly plain and can be divided into three regions:

a) Hilly and mountainous Region: It is characterized by the high mountain ranges of middle Himalayas comprising of steep and rocky slopes, glacial zones and dissected uplands of the study area.

b) Piedmonts: It is found all along the foothills, sloping karewas and side valleys of numerous streams and are dominantly consisting of pebbles, boulders, cobbles and matrix derived from hill slopes and down under the influence of gravity by the Liddar basin and its side valleys of numerous streams.

c) Plains: It is characterized by better physical conditions overlain by alluvial soils brought down by the river and its tributaries, which have been divided into two i.e., older alluvium and the younger alluvium. Older alluvium is deposited on either sides of Liddar basin, mainly on the south western side and occurs at lower elevations than the pediment zone. The younger alluvium occurs all along the river bed and at the lower elevations than the older alluvium. It is dominantly composed of variable size material and viz sand, silt to very fine clay-size sediments.

Geology of the Study Area

The geological formations occurring in the area comprise the Sonamarg, Panjal Volcanics, Liddar, Chorgali and Hapatnar groups. Different Litho-units along with their brief description are given in table I.

- i) **The Hapatnar Group:** It is named after Hapatnar stream which cuts through an excellent section of this group. The Hapatnar group, in the ascending order is divisible into a) Shumhal formation b) Rangmal formation and c. Rishkopal formation, named after the localities in the Liddar valley where they are best developed. This group is stratigraphically delimited by muth formation of demonian age.
- ii) **The Chorgali Group:** The group is named after the Choragali saddle where

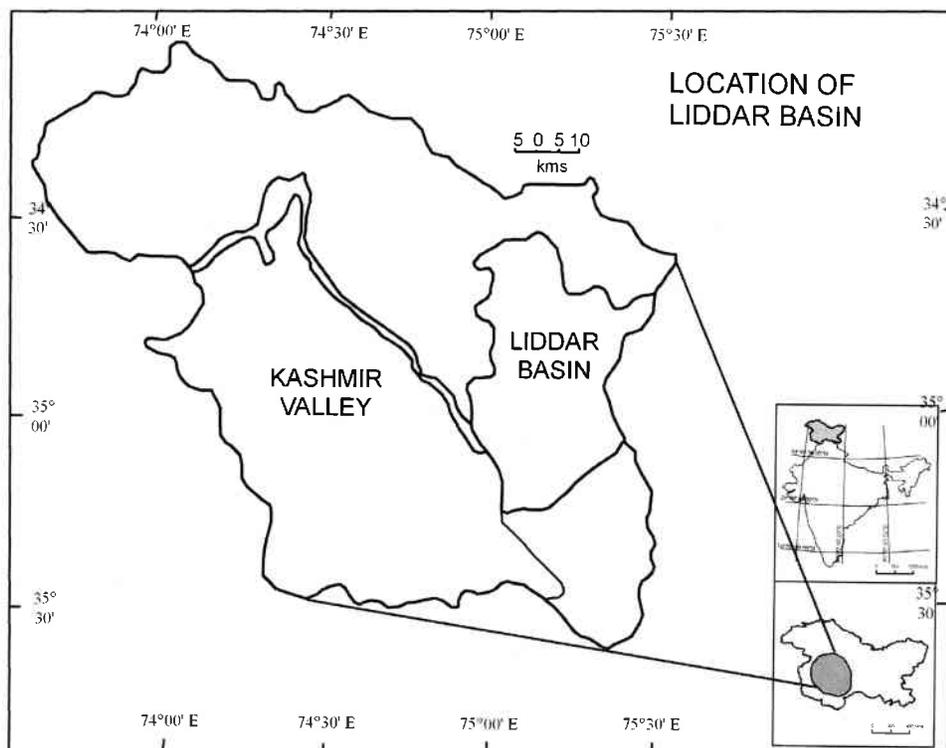
its two formations are exposed viz the Muth and the Wazura formations are exposed. The quartz-arenite is composed of well rounded and spherical quartz grains bounded by minor siliceous cement while as the quartz arenite of wazura formation is poorly sorted, excepting the snow –white type and contains subrounded to subangular grains of varying size from 1 to 2mm. The fossils like brachiopods, corals, pelecypods, gastropods, trilobites and cephalopods of Devonian age form what he described as the “Muth Quartzites”.

- iii) **The Liddar Group:** The name Liddar groups has been now assigned to a sequence of formations earlier refered to as the

Table 1: Litho-Stratigraphic Succession of Liddar Basin.

Age	Group	Formation		
Triassic	Sonamarg	Zewan		
Upper Permian				
Lower Permian	Panjal Volcanics	Upper lava flows lower volcanogenic association	2000 250	Volcanic rocks, Sittstone, Argillite Arkosic wacke Dioncillite and lavas.
Lower most Permian to carbonifers	Liddar	Pindobal Ganeshpur Aishmuqam	700 1800 700	Gray blackshale, gray quartz-arenite, gray Calcarenite and Limestones, Fenestella shales.
Devonian	Chorgali	Wazura Muth	500 1000	Dolomitic limestones green to pale quartz- arenite, gray dolomites, greenish shales
Lowermost Devonian to Cambrian	Hapatnar	Rishkopal Rangamal Shumahal	500 400 3500	Grey and siltstones, purple and green shale, flat pebles and cobbles of greenish shale.

Source : Srikanta and Bhagava 1970.



“Syringothyris limestones”. “Passage beds” fenestella series and agglomeratic slate now reclassified as the Aishmuqam formation, Ganeshpur formation and the pindobal formation in the ascending order. It derives its name from the Liddar river which flows through and excellent section of this group. These formations have yielded plant fossils while as fauna from the pindobal formation.

i) Panjal Volcanic Group: This group comprises of lower and upper part. The lower part consists of a mixed zone of volcanic and volcanogenic rocks together into minor sediments and the upper part is made up of basalt – andesite lava flows, local agglomerates, gabro, lithified ash and various sediment layers.

ii) Sonnamarg Group: This group is proposed to designate the entire segment of carbonate rocks with subordinate quartz-arenite-argillite, irrespective of faunal element that succeeds the Zewan formation as the Sonamarg group, after the famous tourist resort of Kashmir where the best development of sequence is observed.

Methodology

The study was carried out from the visual interpretation of topographic map 1974-75 with toposheet no’s 43N/4, 43N/8, 43N/12, 43O/1 and 43O/5 and lansat imagery (2001) on a scale of 1:50, 000 covering the entire Liddar basin. Completion of individual overlays was done by radial triangulation method. The information from the overlays

was transferred on a map showing landform and landuse patterns by chorochromatic method.

Results and Discussion

Land forms and Landuse

Earth's surface is constantly modified by a number of endogenic and exogenic processes, which lead to the formation of different types of land forms. Howard and Spock (1940) defined land forms as "any element of the landscape, characterized by a distinctive surface expression, internal structure or both and sufficiently conspicuous to be included in a physiographic description of all the surface forming processes, rivers play an important role in shaping the earth's surface. Man and nature utilize these landforms for various purposes, even though there is often confusion between the two terms landuse/landcover. Land cover or the surface cover refers to all the physical (man made) and biological (vegetation cover) features over the earth's surface and landuse is the total arrangement and activity that human beings undertake on the landforms. According to the changing needs of the society, time to time, use of the land also changes. In order to fulfill the changing needs man has been using, misusing/over using and under-using the land.

The Landforms

The term landform refers to the morphology and character of the land surface resulting from the interaction of physical processes and crustal movements with the geology of surface layers. Various types of landforms identified in the basin are based on visual interpretation of topographical maps,

LANDSAT imagery on 1:50,000 scale and field checks. On the basis of the dimensions, these landforms are classified into the two landform orders i.e., second and third landforms.

a) Second Order Landforms: The landforms that are large enough that can be identified on the topographic maps and the LANDSAT imageries are categorized as second order landforms. These land forms are identified on the basis of variations in and tonal and textural patterns, on LANDSAT imagery and variations in the contour patterns on the topographic maps and are verified by ground checks. These landforms of the study area include, hills, valleys and flood plains.

i) *Hills and Mountains:* The relief of the basin is diverse comprising of high mountains, rocky slopes, glacier zones, hillocks and dissected uplands from all the sides produce a variety of slopes through their descent to the valley floor, thus producing ideal conditions for erosion by sub-areal agents of denudation. The average altitude of the mountains is above 4200 meters covers an area of 60km². The hill ranges in the study area are the product of diastrophic forces like folding and faulting and shaped by the Liddar river and its tributaries. They occur as a series of straight ridges with their height ranging from 2400-3200 meters covers an area of 17.46 of the Liddar river basin.

ii) *Valleys:* After Hills, the next important landform is valleys. The valleys are carved by the river is a significant landforms. The shape and dimensions of fluviially originated valleys change with the advancement of the stages of fluvial cycle of erosion. The valleys in the

study area are the products of erosion of weak zones like fold –axes, fault planes, fractures, joints and bedding planes by the Liddar river and its tributaries. The valley is very deep and narrow at the floor and thus water always touches the valley sides. The valleys are gradually widened due to lateral erosion with the advancement of the stage of cycle of erosion. Middle and lower reaches of the valley are characterized by the presence of alluvial fans and terraces. In the plain area, the valley is relatively wider with steep sides suggesting youthful stage.

- iii) *Flood Plains and Associated Features:* Deposition develops a flood plain just as erosion makes valleys. Flood plain is a major land form of river action. Large sized materials are deposited first when stream channel breaks into gently slope. Thus, normally fine sized material like sand, silt and clay are carried by relatively slow moving waters in gentler channels usually found in plains and deposited over the bed and when the waters spill over the banks during flooding above the bed. A river bed made of river deposits is the active flood plain. The process elevates the river banks above the level of the flood plain. These raised banks are known as levees, and lower portion behind them as swamps.

In the study area, the presence of flood plain and associated features has been observed in the lower reaches of the Liddar river, before its confluence with river Jhelum. Major portion of the flood plain is utilized for agriculture and settlement. Part of the flood plain is marshy and covered with grasses.

a) *Third Order Land Forms:* Due to their relatively smaller size, third order landforms could be recognized on the LANDSAT imagery. However they are interpreted and mapped on the basis of changes in the contour pattern on the topographic maps and by field survey. These landforms identified in the study area include smaller alluvial fans, terraces, point- bars and channel-bars etc.

- i) *Alluvial Fans:* Alluvial fans are formed when streams flowing from higher levels break into foot slope plains of low gradient. Normally very coarse load is carried by streams flowing over mountain slopes. This load becomes too heavy for the streams to be carried over gentler gradients and gets dumped and spread as a broad low to high cone shaped deposit called as alluvial fan. In the study area small size fans are found in middle reaches of the river where valley becomes relatively flat and is joined by the tributaries along the foot hills. These fans are utilized for settlements and terrace cultivation.
- ii) *Terraces:* Terraces are flat or gently inclined land surfaces produced by fluvial action. They have been classified into erosional and depositional ones on the basis of their genesis (Russel, 1940). Lot of work has been conducted on the terraces of Himalayan rivers and it has been reported that they comprise of five to seven levels (Khan et al., 1981). Joshi et al., (1973) were first reconstructed quaternary history of Pahalgam area from the terrace deposit. Terraces occur in fragments in the east and west of Liddar river and are located between the river Pharsulan and chandanwari along the east Liddar river and Mundluna and Aru along the west Liddar river

respectively. These extend in north west–southeast and north–east to south-west direction. These terraces are well developed through the entire belt of middle reaches of the Liddar river.

iii) *Point Bars and Channel Bars*: A variety of landforms develop with in the river channel. Many of these features depend upon the complex interaction between the stream velocity and sediment sizes. When the river channel becomes wide it loses the carrying capacity, thus coarser sediments are deposited in the middle of the channel, forming channel bars. In the liddar river point-bars are common at the lower level reaches of the river.

Landuse Classification of Liddar River Basin

There are many schemes for landuse and land cover classification, suggested by different organizations and authors. On the basis of the literature survey and data generated from the visual interpretation of

the topographic maps and LANSAT image. A variety of landuse/landcover have been observed in the vicinity of the liddar basin.

Analysis of table 2 reveals that significant changes have occurred in the landuse pattern since 1974-75 to 2001. It reveals that there has been considerable change in the forestry found as well as agricultural sector and other classes. The degradation of land has definitely caused the loss in the productivity of land. Dense and moderately dense forests an altitude ranging between 3200-4200 meters with an average slope ranging between 30⁰-40⁰ were observed in the sothern and central parts of the basin i-e, Botkot, lidroo, Shumbal, Hassan Noor, Laripora, Wajipora and Chatruss Budroo villages. The high mountain areas of Liddar basin (over 400meters) consisting of upper parts with rugged slope are divide of vegetal cover with an average slope of over 40⁰. The slopes of hilly areas facing the river beds are however occasionally used for pasture and grazing purposes. The agricultural land that comprises of cultivated land under

Table 2: Area under different landuse/landcover categories of Liddar basin (1974-75 to 2001).

Landuse category	Area in hec. (1974-75)	Percentage of total area (1974-75)	Area in hec. (2001)	Percentage of total area (2001)
Forests	30286.12	26.70	28746.10	25.34
Shrubs and rare forests	32146.13	28.34	25110.12	22.15
Agriculture	3412.20	3.00	16122.24	14.21
Barren	25735.13	22.68	20249.10	17.85
Plantation	1452.36	1.27	4924.46	4.34
Meadows	11248.24	10.40	9466.32	8.34
Snow covered	8914.61	7.46	8368.45	7.29
Built up	25.21	0.15	413.11	0.48
Total	113400.00	100	113400.00	100.00

Source: S. Shakeel and T. A. Kanth 2009.

the cultivation of Paddy, Maize, Rajma and horticulture have been considered under this category. The total area under agriculture in 1974 was 3412.20 hectares which accounts for about 3 percent of the total area of the basin. While in 2001 it was 16122.24 hectares which accounts for about 14.21 percent of the total area of the basin. The increase of 11.21 percent is quite visible from the fact that forests have been encroached and in majority of the cases, this land has been brought under agricultural purposes. Presently this area is under the cultivation of the 97 villages of Tehsil Pahalgam i.e., Batpora, Hugam, Yanier, Salar, Malikgand and Bedigam etc.

The forests in the Liddar basin forms a linear belt all along the valley slopes of Laginala, Legipur, Dabyum Kolar and alpine pasture lands. The total area under forests in 1974-75 was 30286.12 hectares, which accounts for about 26.70 percent of the total area of Liddar basin. But in 2001 it was 28746.10 hectares only, which is 25.34 percent of the study area. So the net decrease in total area was 1540.02 hectares during last 25 years. The main reason behind this change in forest cover of the area is mainly due to the large scale deforestation and biotic and interference that has increased manifold with the passage of time. The management status has also remained unmanaged to poorly managed. There has been found declining trend in area of shrubs and rare forests from 1974-2001. There has been drastic change in the barren land area between 1974-2001. In 1974-75 the barren land was 25735.13 hectares constitutes about 22.68 percent of the total area of the basin while as in 2001 it has remained 20249.10 hectares which forms 17.85 percent of the study area. It is mainly because most of the barren land

has been put under the cultivation of Maize and Rajma on the hill slopes. The rate of erosion in the upper parts have increased considerably. It has caused not only siltation of the low lying areas but also disturbed the ecological balance of the entire catchment and consequently, is a major threat to the wildlife of the area. The area under built up in 1974-75 was 25.21 hectares which has increased to about 413.11 hectares in 2001. The alluvial fans in the study area are found in the middle reaches of river where valley becomes flat. The considerable area is utilized under the settlements and terrace cultivation which is done on flat or gently inclined land surfaces produced by fluvial action.

CONCLUSIONS

The Liddar river basin originating from the Kolhi Glacier and Sheshnag lake is comprising of diverse relief features of high mountains steep slopes, alpine meadows (mergs) and alluvial fans. The slopes facing the basin are covered with thick forests. Pahalgam is situated at the confluence of east and west. Liddar segments are the largest of all these tracts with one and half kilometer breadth is a world famous attraction place due to its scenic beauty.

Geologically the basin is the region where most of the strata are well preserved in succession. From Cambrian to recent almost all formations are represented in one or the other part of the basin. The Hapatnar group consists of grey and green siltstones, purple and green shale, flat pebbles and cobble of greenish shales. The overlying chorgali group of rocks are characterized by the flesh coloured dolomitic limestones, green to pale quartz-arenite, grey dolomites and grey greenish shale with warm trails. The

liddar group of rocks are characterised by the grey to black shale, grey quartz-arenite, grey calcarenite conquina limestones, synringothyris and fenestella shales etc. The panjal volcanic group of liddar basin is characterized by volcanic and volcanogenic rocks i-e siltstones, Argillite, Areleosaic wacke and Dianicte etc and lavas. Sonamarg group consists of carbonite rocks with subordinate quartz-arenite-argillite. During the present survey no attempt was made to classify the rocks of the Sonnamarg group and it is left to future workers to sort out the same.

On the basis of magnitudes, landforms of the study area have been divided into landform orders i.e., second and third landforms. The second order landform includes: hills and mountains, valleys, flood plains and associated features. While as the third order landforms are represented by alluvial fans, terraces, channels and point bars etc.

Different types of land-use/land cover in the Liddar basin are classified on the basis of visual interpretation of topographic maps (1974) and geo-coded. LANSAT –ETM image of (2001 Sept.) on 1:50, 000 scale and confirmed by a field checks. The different types of landuse/landcover identified in the study area forests, shrubs and rare forests, agriculture, barren, plantation, meadows, snow covered and buildup. During last 25 years there has been found considerable change in their patterns from 1974-2001. The forests shrubs and rare forests were developed in the areas with moderate relative relief and moderate slope. Agriculture and built up are found in the areas with low relative relief and gentle slope. Moderate to high relative relief and high slope is found in barren and snow covered areas. In order to minimize the erosion in the catchment area and siltation of lowlying areas it is necessary

to use scientific means of agriculture during the cultivation of Maize and Rajma and should be practiced in the moderate to gentle hills slopes. The high hill slopes should be kept for forests low-lying areas adjacent to the basin are basin are best suited for agriculture purposes especially the paddy cultivation.

REFERENCES

- Howard, A.D., and Spock, (1940). A Classification of Landforms, Jour. Geomorph, 3.
- Joshi, R.V. et al., (1973). Quaternary Glaciation and Palaeolithic Sites in the Liddar Valley (Jammu and Kashmir), World Archaeology 5, 369-379.
- Khan, A.A. and Srivastava, M. C. (1981). An Evaluation of Textural Parameters of Quaternary Terraces, Dhauli Ganga, Garwal, Himalaya, U.P. Symposium on three decade development in Peterology, Minerology and Petrochemistry in India.
- Russel, R.J. (1940). "Quaternary History of Louisiana" Bull Geol. Soc. of Am. 51, 1214.
- Shakeel, S. and Kanth T.A. (2009). Indian Journal of soil conservation, 37, 172-174.
- Shakeel, S. and Kanth T.A. (2009). Landuse/landcover Change in and Around the Liddar Basin in Kashmir Himalaya. "Science Technology and Society, pp. 215-220.
- Srikanta and Bhagavana (1970). Kashmir Tethys Basin, Liddar valley, pp. 364-380.

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