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Slope Suitablity and Agricultural Production of Lidder Valley

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Abstract:- An attempt has been made to study the slope suitability and agricultural production of Lidder valley.Slope as an important geomorphic aspect has profound influenceon the production of different food crops of the region. The slope imposes restriction on the use of machinery and irrigation facilities in higher reaches of the valley. The agricultural activities of the study are mostly controlled by slope because of its hilly terrain. Lidder valley in the production of food grains has made a grand progress during the past two decades. The area under food grains varies in different slope categories. The regional variations in the production of food grains are related mostly to slope aspect,climatic conditions, adequate irrigational facilities and socioeconomic factors, improvement in production technologies, improved seeds, higher use of fertilizers, insect and pest control and better management practices are helping to get higher levels of production.

Keywords:- *Slope, Irrigation, Production, Machinery, Fertilizers, Lidder valley.*

I. INTRODUCTION

Slope is specifically most powerful physical determinant in agricultural land utilization, affecting the existence, depth, structure, texture and stability of soil, possibilities and pattern of irrigation, field pattern distribution and size of holding, cropping pattern, transport etc. (Ahmad, 1985). The slope is considered as an important criterion in almost all areas for agricultural suitability in evaluation studies. Therefore, the slope degree could be considered a restriction to land capability particularly for irrigated agriculture (Sauer et al 2010).Slope is frequently used as a criterion to assess capability and suitability of land for agriculture (Van Orshoven et al,.2008, Lacko and Bunday,2013).Hilly areas are handicapped by a shot growing season due to high altitude, of by steep slopes or by the combination of the two (Eliasson et al 2010).Slope is considered as one of the important geomorphic aspect which influences the agricultural land use of an area. The world food problem is rapidly emerging as one of the most contemporary issues and every effort will be necessary to raise production and to meet the demands of growing population The slope analysis of the study region has been calculated from relative slope assessment based on Wentworth's (1930) method.

Introduction of technology factors, especially application of irrigation, fertilizers and seed technology in the process of agricultural yield is considered to have far greater impact on agricultural yield increase compared to its natural growth. It means that a plant gains comparatively better environmental conditions for its seed germination, growth and production when suitable and required application of irrigation and fertilizer dozes are given. Lidder valley in the production of food grains has made a grand progress during the past two decades. The area under food grains varies in different geomorphic regions. The regional variations in the production of food grains are related mostly to climatic conditions, adequate irrigational facilities and socioeconomic factors, improvement in production technologies, improved seeds, higher use of fertilizers, insect and pest control and better management practices are helping to get higher levels of production. In the study region, many crops are grown, but only four major crops of rice, maize, pulses and oil seeds have been discussed as for as their importance is concerned. Rice is the first ranking crop of the region, followed by maize during the kharif season, whereas mustered is the dominant crop of the rabi season.

II. MATERIAL AND METHODS

The study is based on a detailed mapping of 1272 km^2 of the area on the scale of 1:50,000 accompanied by systematic sampling. Results are based upon extensive field observation and intensive laboratory work. The slope analysis of the study region has been calculated from relative slope assessment based on Wentworth's (1930) methodderived from the following formulae.

$$\tan \theta = \frac{VN}{0.6366K}$$

Where V = Vertical Contour interval in meters /feet,

N = Number of contour crossingKm/mile and K = a numerical unit; its x value is 100 for metric Units.

The agricultural data used in the present work have been taken from the unpublished revenue records of revenue and agriculture departments. In the study region, the climatological data of four stations have been obtained to study the temperature conditions of all months. The test of the soil samples of the Lidder valley has been carried out by soil testing laboratories at SKUAST Srinagar.

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III. LOCATIONAL SETTING

The Lidder valley lies between 33°48′ to 34°15′ North latitude and 75°5′ to 75°33′ East longitude. It comprises whole Pahalgam Tehsil and some villages of Bijbehara and Anantnag Tehsil of Anantnag District. The valley is 40 km away from the capital city Srinagar. It occupies the southeastern part of the giant Kashmir Himalayan synclinorium and forms part of the Middle Himalaya. The valley lies between the PirPanjal range in the south and southeast, the north Kashmir range in the main Himalayan range in the northeast and Zanskar range in the northwest (Fig.1). The study region is surrounded by Saribal-Katsal ridge on the east, the Wokhbal on the west and Kazimpathbal on the north.

The study region begins from the base of the Kolahoi and the Shishnag glaciers. The two main upper streams the Kolahoi River and Shishnag River originate from these glaciers and joins near Pahalgam. The Lidder forms a braided valley in the plains.

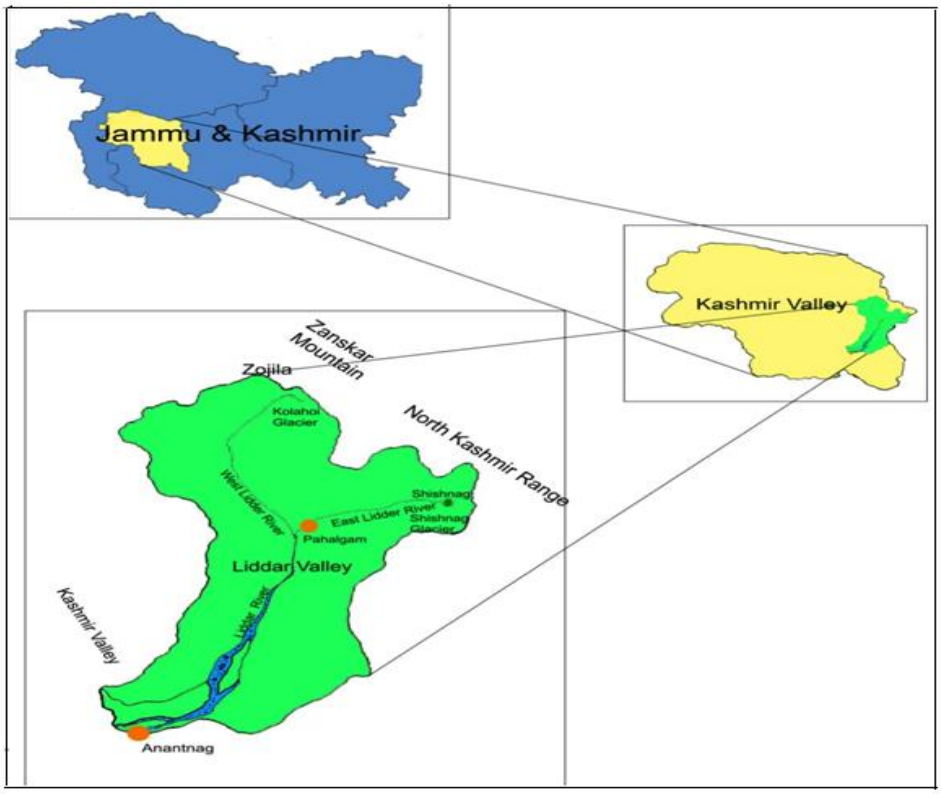

Fig. 1: Locational Setting of Lidder Valley

IV. PHYSIOGRAPHIC CHARACTERISTICS

Lidder valley is primarily a mountainous country and is confined in PirPanjal extending from south to north and buttressing in the north with main Himalayan range and northeast with Zanskar range. Complex mountains, ranges, hills and valleys of various dimensions, distributed in an intricate manner in all directions of the main Lidder valley characterize the physiography. There are many important ranges some regional and some sub regional in dimensions, stranding the Lidder terrain and creating multitude of ecological areas. The altitude of the valley ranges from a minimum of 1590 to a maximum of 5500 m. The valley is drained by the principal Lidder River which originates from Kolahoi and Shishnag glaciers. The valley comprises 16 glaciers of about 52.2 km^2 of area. Kolahoi and Shishnag are two major glaciers located at an altitude of 5000 m asl. The major part of the glaciated section of the valley is covered with the moraines arranged in ridges which are approximately parallel to the sides of the valleys. The moranic ridges stretch from Ganshibal terminus to Kolahoi and Shishnag snouts. Lidder River from its source and down to its confluence at Gour constituted a fluvial landscape. The valley constituted four physiographic regions of flood plain, basin floor, mountain rim and high Himalayan flank. These regions are crisscrossed by Kolahoi River and Shishnag River and its hanging valleys, streams and large number of Govt. and private canals.

V. METEOROLOGICAL OBSERVATIONS

It is vital to monitor the climatic conditions of the mountainous regions because these areas are considered to be the early indicators of climatic change. The location of the Lidder valley at higher altitude and enclosed with mountain ranges gives distinctive characteristics within its own climatic peculiarities. The atmospheric conditions of the valley are controlled by altitude, latitude, complex terrain, vegetation and western depressions which visit the valley during the winter months. The valley experiences diverse climatic conditions ranging from cold arctic in the north, moist sub humid in the mid valley and humid climatic condition along the plain region. Wide variations are observed in temperatures at different altitudes of the valley. January and February are the coldest months whereas June,

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July and August are the hottest months. The heavy snowfalls in winter months are common phenomena in the higher reaches of the valley and the agricultural activities therefore remain suspended. March is the rainiest month of the year and the highest amount of rainfall and rainy days are observed in this month.

A. Temperature

As far the study of climate of an area is concerned, the temperature holds a key position, because it determines the character of local weather. In the study region, the climatological data of four stations have been obtained to study the temperature conditions of all months. The study area experiences very low temperature as compared to plain areas of Kashmir. January is the coldest month of the year. In this month the mercury falls down up to -18ºC on a particular night. The mean monthly temperature of January & February varies between -13.2ºC to 6.4ºC. From March, the temperature values start increasing progressively. This condition continues up to June. The month of June, July and August are considered as the hottest months of the year. The average mean monthly maximum temperature in these months ranges between 24.4ºC to 25.4ºC and the mean minimum temperature of the coldest months fluctuates between -7.4ºC to -1.4ºC at Pahalgam. In the study region there is an increasing trend of night temperature from April to August. From August both the maximum and minimum temperature starts decreasing. The highest extremes of temperature in the study region occur in the months of June, July and August and the lowest extremes of temperatures occur in the month of January and February. The highest extreme value of temperature in the region is 32.6ºC, which was recorded on 2nd of August 1990. The lowest value of temperature in the region is -18.6ºC which was recorded on 11th of January 1986. The variability in extremes of temperature ever recorded during the past two decades has been due to extreme western disturbances that cause cold wave conditions in the study region due to its mountainous terrain. According to India Meteorological Department, Kashmir valley has shown rise of 1.45ºC in average temperature and maximum temperature has increased by 0.5ºC per-year in Kashmir valley. The temperature in Kashmir during winters, as per official figures, now happens to be above average weather temperature, with the Valley recording lesser snowfall even in hilly areas. During the past several decades the Lidder valley has shown rise of 1ºC in average temperature.

B. Precipitation

The study region receives precipitation throughout the year. The rainfall shows a regular increasing trend from southern flood plain to the northern mountainous area. This is mainly due to variation in altitude, topography and vegetation and the western depressions which frequently visit the valley during the winter months. The mountains are the major topographic obstacles to weather systems and prevent the regular air flow between the low land and high land areas of the region and leads to the difference in moisture content. The agricultural activities remain suspended during the winter season due to snowfalls. The peak precipitation events in the study region in basin floor ranges between 34.2 - 137.53 mm, as against to 25 -75 mm in the flood plain. The tendency of precipitation leads to large number of storms each year, sometimes with intensive rainfall episodes have considerable geomorphic significance, especially in terms of production of debris flow and catastrophic mudflow in the Lidder valley at higher altitude. The high precipitation during the winter is dominated by the western disturbances in the vicinity of Pahalgam and in the higher reaches of the Lidder valley. The winter and spring are the rainy seasons. The rainfall recorded during these seasons at Pahalgam has been 72 percent of the annual rainfall, whereas the Anantnag receives 68.4 percent of annual rainfall in these seasons.

VI. SOILS

Soils of the region can be conveniently divided into glacial soils, immature mountain soils, basin floor soils, and soils of flood plain. Mountain soils are mostly confined along the highland of the region. These soils are deficient in bases and are mostly acidic. This is primarily attributed to extensive weathering caused by thermal variation. The highlands have developed a very thin soil profile and soils are very immature. In the highlands there are small valley basins where the thick soil layer is developed due to high humus content. The soils of this group are mostly sandy in nature produced by sesoxide and are skeletal in nature. Glacial soils extend from the present day snout of Lidder glaciers to post terminus of glaciers. These soils are primarily composed of morainic matter having unassorted sediments ranging from clay to boulder. Most of the morainic soil has stabilized during Pleistocene time and have produced two types of soils meadow soils and alpine humus soils. The morainic soils are found within the main valleys as well as hanging valleys of the mountain. The morainic material is heterogeneous in nature with sand, silt and clay as fine particles and large boulders and pebbles as coarse sediments. The meadow soils are mainly confined near the tree line and have produced large pasture lands rich in nutrient content most favourable for cattle grazing in summer season, such type of soils are further helped in their growth by organic matter.

The basin floor soils are Pleistocene and post Pleistocene deposits. The soils of this group are classified as udalfs and orchrepts. These soils have medium fertility status and are yellowish brown to very dark brown in colour. The valley contains a wide variety of textural classes. The dominant in the basin floor are silt clay loam, clay loam and silt loam. The flood plain area is the largest fertile stretch of low land confined within the elevation of 1591 to 1750 m. The soil of this physiographic region is mostly transported which have been brought down by the principal Lidder River and deposited in the plains.

VII. RESULTS AND DISCUSSION

The Fig.2 provides information of slope distribution over the entire study area. In general, the acclivity increases from south to north. The highest slope of the terrain is generally marked on the high altitude of the region. The Table 1 shows the area-slope distribution as the share of the total surface falling within each group of slope.

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Slope class	Area (km^2)	Percentage	Slope categories
Below 5^o	72	5.6	Gentle
5-10	120	9.4	Gentle
$10\text{-}20^o$	200	15.7	Moderate
$20\text{-}30^o$	360	28.3	Steep
Above 30^o	520	4O.8	Very steep

Table 1: Area Slope Distribution of Lidder Valley

A. Below 5o

This slope zone of gentle category covers mostly the southern part of the study region. It is an aggradational tract confined to the southern section of the Lidder valley and is an outcome of sediments brought down by the Lidder River. It has a low dissection and ruggedness indices. The agricultural zones of Mattan, Srigufwara and Zirpora of flood plain come under this zone. It covers an area of about 5.6 % (72 sqkm) of the total area of the region. The slope does not face any serious problem of soil erosion. The soils of this zone are alluvial in nature and high turnout of crops is observed. This region produces high yield per hectare particularly due to the adaptation of scientific technology and secondly the region gets assured water supply from govt. and private canals reducing the dependence on rainfall. About 75 percent area of this zone is cultivated. Rice is the principle food crop of this zone.

B. 5o -10o

The slope between 5^o -10^o covers an area of about 9.4 % (120 sqkm) of total area of the study region. The agricultural zones, which come under this zone, are Salia, Aushmuqam and Wularhama. This slope zone lies between the flood plain and mountainous region and has rolling terrain. Both rabi and kharif crops are cultivated in this zone. At some places, terrace fields are found parallel to the Lidder River which flows through this zone. This slope zone faces slight problem of soil erosion. The important crops cultivated are rice, maize, oilseeds and pulses. The climate and soil conditions favour the cultivation of crops.

C. 10o -20o

This slope zone of moderate category lies between 10o to 20o and covers an area of 15.7 % (203 sqkm) of the total area of the study region. This zone comprises mostly the unirrigated portion of the foothill region. It has an average elevation of 2200 m. This region is surrounded by PirPanjal range in the east and Zanskar range in the northwest.

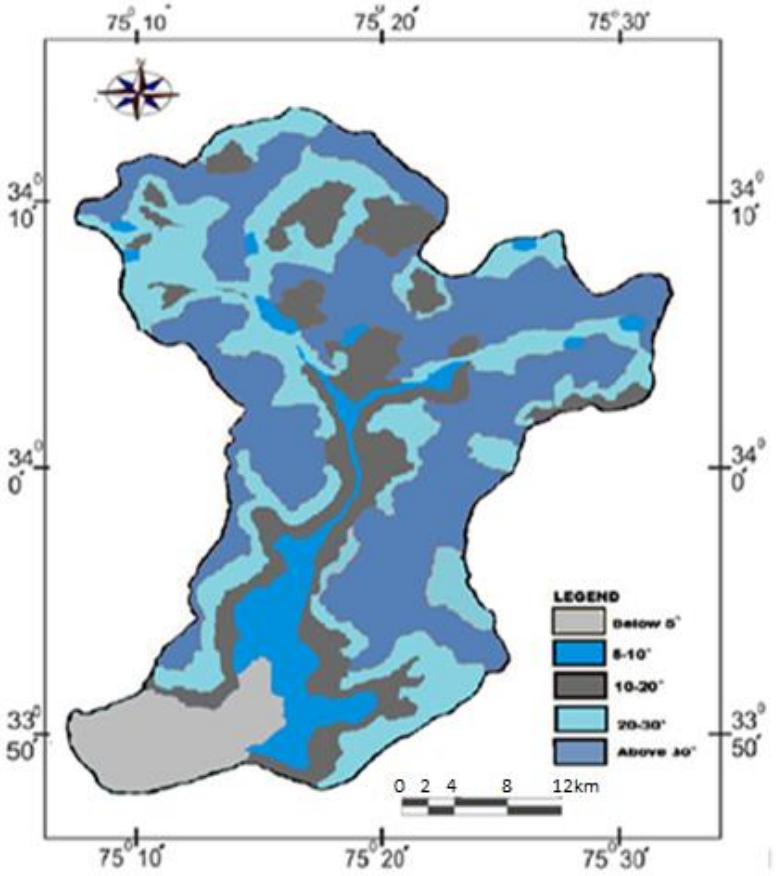

Fig. 2: Slope Analysis of Lidder valley

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Dissection and ruggedness indices are moderate. This region faces problem of soil erosion particularly along the riverbanks, which gets momentum during the rainy season. Wide gravely channels are found in the sloppy areas of this zone. Maize is the dominant crop of this zone. It is a degradational tract and faces moderate problem of soil erosion.

D. 20o -30o

This slope zone of steep category occupies about 28.3 % (360 sqkm) of the total area of the study region. This zone comprises mainly forests and with increasing elevation summer grazing lands are present. It is a degradational tract having the elevation between 2500 to 4000 m. This zone has high dissection and ruggedness indices. The slope ranges between 20º to 30º. This zone has numerous rills and gullies. The dissected and undulated topography restricts the agricultural practices up to limited areas.At some places maize is cultivated near the river banks. This tract faces moderate to severe problem of soil erosion

E. Above 30o

The slope of very steep category of above 30º covers most of the mountainous area of the valley. It covers an extensive area of about 40.8 % (520 sqkm) and has a special coverage of the northern section of the Lidder valley. This zone lying above the tree line is mainly confined in the form of meadows and merges like Satlangan, Liddarwat, Chandanwari and Zajpal. The higher reaches of his slope zone remains covered with snow for most of the year, which is the source of river water. Large snowfields in the form of glaciers cover most of the protected parts of this slope zone. These glaciers are the main water banks of Lidder River. They provide water in the form of glaciers melt to the different tributaries and distributaries of Lidder and are the main source of irrigation, generation of hydroelectric power as well as water for human consumption. The tract faces severe problem of soil erosion.

VIII. CONCLUSION

The slope suitability has enormous importance for the development of agricultural operations. Slope as an important geomorphic aspect has profound influence on the production of different food crops of the region. The slope imposes restriction on the use of machinery and irrigation facilities in higher reaches of the valley. The physical conditions of this region permit the cultivation of rabi&kharif crops in certain periods of the year, because the agricultural activities remain suspended during The remarkable progress in production of rice, maize, oil seeds and pulses clearly reflect that farmers have switched over modern techniques particularly using hybrid varieties of seeds supplemented with optimum dozes of fertilizers and required assured irrigation facilities, further farmers have adopted mixed farming practices arising cereal along with leguminous crops to nourish soil with necessary nutrients particularly fixed nitrogen. During the past two decades, the different crops of the study region have displayed an appreciable change in yield per hectare. The average yield of rice has increased from 48 to 59 qtls, maize 42 to 51 qtls, pulses 20 to 27 qtls and oil seeds 5.2 to 9.57 qtls per hectare during the past two decades (1983-84 to 2003-04).

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