

Remarking An Analisation Distribution and Orientation of the Glaciers of Suru-Zanskar Valley, District Kargil, Western Himalaya

Abstract

Suru -Zanskar valley comprises of 268 glaciers out of which 131 glaciers are located in Greater Himalaya and 137 glaciers in Zanskar Mountains. The region is a glacier landscape of the geological past and presently remnants of the glaciers namely Durung Drung, Haptal, Yaranchu, Haskira, Hagshu, Mulung, Kange, Sumche, Lechal, Tidu, Khapang etc. are located between the altitude of 4000 meters and 6478 meters altitude main sea level. The study area is a fifth order basin of fourth order Indus. There are thirty six Sub-basins in Suru-Zanskar basin, out of which 19 sub-basins are glacierised spread over an estimated area of 1221.43Km² (17.44%) of the total area.

Keywords: Glaciers, Suru-Zanskar, Inventory, Lungnak, Stod.

Introduction

The Himalaya, the fragile and the youngest mountains of the earth has direct influence on the climate control, water and environment of our country. The Glaciers occupy about 17% area of mountains (Dobhal, 1999). The glaciers are an important source of fresh water on the earth as nearly seventy five percent of the fresh water is locked in the form of glaciers. Only three percent of the permanent snow and ice is distributed over mountains outside Polar Regions (Flint, 1971). In the last few decades Glaciers retreat throughout the world which results rise in global sea level, water resources and hydropower potential in many regions of the world (Khalsa, 2004). The India Himalaya glaciers cover approximately 23,000 Sq. kms area and have one of the largest concentrations of glaciers stored water outside Polar Regions. The fresh water from Himalayan Glaciers has special significance for India. Glaciers are an important source of water for the northern rivers. During the monsoon, the rains feed these rivers and in the winter ground water sustains them, but in the lean period of summer most of their waters comes from melting snow and glaciers. Glaciers are dynamic bodies of ice that move in Himalaya under the influence of variable temperature gradient. The temperature of ice plays a significant role in its movement and morphological activity. The Himalayan glaciers are both warm and cold type. The warm type glacier are confined to narrow valleys of Uttaranchal, Himachal and Kashmir Himalaya, where temperatures of ice is close to melting point throughout its thickness except the upper accumulation part where temperature is far below freezing conditions and melt water is at the base of debris covered glaciers. The cold glaciers are located in cold desert of Ladakh. They are characterized by temperature below melting through their thickness. The surface and basal melting occurs in short ablation season and supra glacial channels temporally appear in the lower ablation zone. The glaciers are large, clean and are confined to broad valleys. Suru-Zanskar valley of the southern Ladakh is the glacier landscape of the past and presently the existing glaciers of the valley are relics of their mighty predecessors formed during the Pleistocene epoch. Presently they are located at higher altitudes between 4000 meters to 6478 meters. In the present paper an attempt has been made to investigate the orientation, distribution and geomorphology of the glaciers of Suru-Zanskar valley.

Aim of the Study

The aim of the present study is to identify the total number of glaciers located in the Suru-Zanskar valley and to investigate the lengthwise distribution and orientation of the glaciers in the area under study.

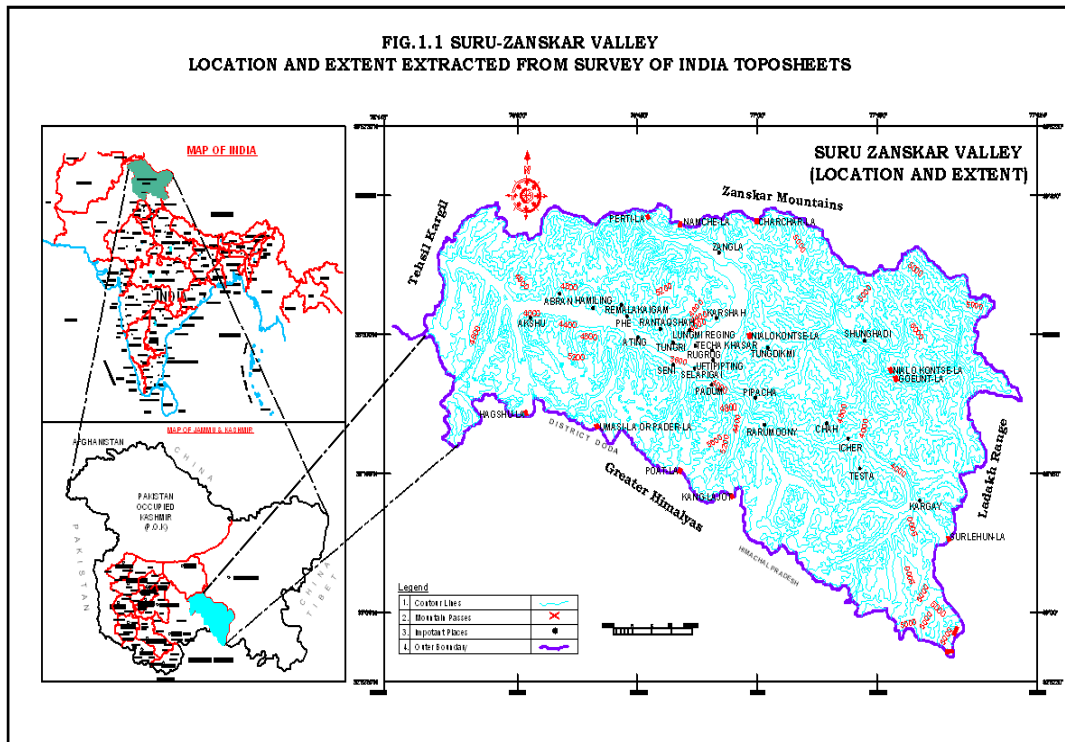
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Study Area

The area under study is situated in the southern part of Ladakh between the greater Himalayan range to the southwest and the Zaskar and Ladakh ranges to the northeast. Suru-Zaskar valley lies on the northern fringe of the western Himalaya. It includes all the areas along the two great branches of the Zaskar river. It lies between 32° 52' 30" N to 33° 52' 30" N latitudes and 76 14' 5" E to 77° 32' 4" E longitudes covering an area of 7000 km². Its largest length is 116 km and its mean length is 90 km and its mean breadth is 89 km. It is confined between the altitudes of 3340 ms to 6478 ms above the mean sea level. The study region contains some of the highest and steepest mountain slopes. The relative relief of main valley is rarely less than 2500 meters even the tributaries have an elevation difference of 2000 meters in a horizontal distance of 2- 4 kms. (Fig.1.1).The highest area in the west and southwest

consists of spectacular pyramidal horns, peaks, serrated ridges and adjacent cols between the ice fields. More commonly, the ridge crests are about 0.5 km wide. Snow and ice covered avalanche, slope of high peaks and ridges descend precipitously to glacier basin. Valley walls are covered with rills, gullies and mud channels, Massive debris slope covered with scree gradually merge with fans, low terraces, valley fills and channel gravels on the floor of the valley. The magnitude of the relief, the overall steepness of slopes and scale of debris accumulation provide an overwhelming sense of instability, mass movement and catastrophic events accentuated by aridity of the environment, which triggers the potential energy in a poorly utilized fashion. Thus the widespread sign of slope failure tends to mask the overall slow rate of geomorphological processes and emphasize high frequency and large magnitude of mass activity.



Methodology

The Research work involves interpretation of the Indian Remote Sensing Satellite (IRS) IC/D imageries covering paths 76.15-77.0 and rows 33.15-33.45 for the months of May and October 2001. In addition, the topographic sheets of survey of India of the year (1962-63) and surveyed in 1964-65 on the Scale of 1; 50,000 were used to delimit the glacier area of the study region. Comprehensive field observation and field measurement involves checking the authenticity of delimited glacial area and orientation of glaciers.

Results and General Appraisal

The glaciers are an important source of fresh water resource on the earth as nearly 75% of the fresh water is locked up in the form of glaciers. The glacier melt water contribution in the perennial Himalayan rivers was estimated to be about 60%. The need for accurate and update information of the perennial ice masses / glaciers all over the world necessitated the task of compiling glacier inventory. An attempt has been made to prepare the glacier inventory of the glaciated basins of Zaskar on the basis of the guidelines of the Temporary Technical Secretariat for world glacier inventory issued from time to time. Suru-Zaskar basin is a fifth order basin

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of fourth order Indus. There are thirty six Sub-basins in Suru-Zanskar basin, out of which 19 sub-basins are glacierised spread over an estimated area of 1221.43Km² (17.44%) of the total area. The present distribution of Glaciers in Suru-Zanskar valley depends upon (a) The elevation of the mountains, (b) orientation of the slope, (c) the amount of the precipitation and (d) characteristic of the summer temperature. (a) Altitude can be considered an independent variable at the regional or local scale, and it exerts fundamental control over the climatic parameters and hence the distribution of glaciers (Flint, 1971) summarized the local influence of the altitude thus: No one who examines the present day distribution of glaciers can fail to realize that glaciers are related to highlands. Without high and extensive mountains some are situated in the paths of moist winds, extensive glaciers cannot occur. The Suru-Zanskar glaciers have their origin and termination at critical elevation of 4000 meters to 6478 meters. The general rise in elevation at which the glaciers exists towards the south and southeast is the response to the southward decrease in temperature molded by heavy snowfall. The up-liftment of the Zanskar basin was affected during the Pleistocene period. The high elevation encourages low temperature and abundant snowfall. The rocks exposed at higher altitudes of Zanskar uplands are raked up into folds giving rise to protracted valleys and depressions that house the large number of Zanskar glaciers in the south and southwest of the study region. Their winter accumulation is greater as in the summer they receive less insulation because the glaciers are situated in the protracted valleys and depressions. In the north of Stod River and in the northeast of Lungnak River some of the higher elevations and slopes were devoid of ice. The annual snowline varies from one glacier to other in the Zanskar valley and ranges between 4000 to 4200 ms. (b) The orientation of the slopes plays a significant role in the growth of the glacier. This is mainly due to wind drifting of snow into high accumulation basin, but it is more effectively related to the difference in incoming radiation between northeast and southwest facing slopes. The south and southwest facing slopes have little ice cover due to high amount of received radiation. The southwest facing glaciers in the Suru-Zanskar valley are small in size than their counterparts in the south. The two largest glaciers namely Tingzumchu and Pholoklow are southwest facing glaciers in the Stod basin of the Zanskar region covers an area of 16.91Km² and 6.54 Km². These glaciers terminate at an altitude of 4700 ms above mean sea level. Most of the glaciers in the Suru-Zanskar valley are flowing towards the northeast due to very meager radiation received by the slope and prevalent cold air mass. The dry cold stagnant air prevents the decent of warm air towards the glacier and thus insulates the existing snowfield from ablation due to sublimation. (c) Precipitation is the powerful control over glaciations. The winter precipitation is most widespread means of accumulation and adds large mass of ice to the glaciers. The extent and nature of precipitation is directly related to the growth

and fluctuation of the glaciers. Since the region is confined in protracted zone of Himalaya as such monsoonal wind system do not intrude the region and only powerful western depression-al air masses traverse all along the valley intensively during winter season (November-May) and weak one during summer season (June-October). This result in heavy solid precipitation in the form of snowfall (360 cm – water equivalent 380 mm) and scanty rainfall in summer season (56 mm). (d) In summer the mean monthly maximum temperature fluctuates from +19.5°C to 12.6°C and mean monthly minimum temperature ranges from +0.65°C to -3.48°C. The highest and lowest maximum temperature ever recorded during last twenty years is 32.0°C (08 July 2006) and -17.5°C (16 January 1993) respectively. The trends in mean monthly maximum and minimum of temperature for the period 1987 to 2006 indicate that during winter period the maximum temperature shows decline trend during December, February and May where as minimum temperature shows marginal decreasing trend during February and March thereby indicating appreciable cooling during the late winter season particularly from February to May that results in Cementing of the glaciers and permafrost conditions in higher reaches. The Trend in monthly mean maximum and minimum temperature during June to October indicates an increasing trend in both mean maximum and mean minimum temperature resulting in warmer summer with smaller change in minimum temperature. This has further resulted in increasing trend in diurnal temperature range (19°C).

Distribution and Orientation of Glaciers

Suru-Zanskar basin is a fifth order basin of fourth order Indus. There are thirty six Sub-basins in Suru-Zanskar basin, out of which 19 sub-basins are glacierised spread over an estimated area of 1221.43Km² (17.44%) of the total area. The valley comprises 268 glaciers out of which 131 glaciers are located in Greater Himalayas and 137 glaciers in Zanskar Mountains. The remnants of the glaciers, namely Durung Drung, Haptal, Yaranchu, Haskira, Hagshu, Mulung, Kange, Sumche, Leachen, Tidu, Khapang, etc are located between the altitude of 4000 meters and 6478 meters above the sea level. Durung Drung is the largest glacier among the glaciers found in the Suru-Zanskar valley. The highest elevation of the glacier is 6050 meters asl where as its lowest elevation is 4182 meters asl. It is the second largest glacier in Ladakh after Siachen having a length of 23.75 Km. and mean width of 4.43 km. It covers an area of 72.53 km². The glacier proper begins from an altitude of 6050 meters and terminates at an altitude of 4182 meters. Out of the total 268 glaciers located in the region 98 glaciers are below one km in length, 90 glaciers are one to two km in length, 56 glaciers are two to five kms in length, 15 glaciers are five to ten km in length, 5 glaciers are ten to fifteen km in length, 3 glaciers are 15 to 20 km in length and only one glacier (Durung Drung) is above twenty km in length. (Table: 1.1). Large glaciers are located in the Greater Himalayas in the protected valleys and depressions while as the small niche glaciers are located in the

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sheltered cirques of the mountain flanks and in the niches which they have sculptured. Present day niche glaciers are hanging type and have developed broad foot at valley terminus where as large glaciers have extended to very low elevation and presently their snout is just in the vicinity of basin terminus there by clearly indicating minor oscillation during the recent times.

Table 1.1
Suru-Zanskar Valley: Lengthwise Distribution of Glaciers

S. No	Length in Kms	Greater Himalayas	Zanskar Mountains	Total Glaciers in the Basin
1	Below 1 km	23	75	98
2	1 km to 2 km	38	52	90
3	2 km to 5 km	46	10	56
4	5 kms to 10 km	15	0	15
5	10 kms to 15 km	5	0	5
6	15 kms to 20 km	3	0	3
7	Above 20 km	1	0	1
	Total	131	137	268

The study further reflects that out of the total 268 glaciers, 26 glaciers are north facing, 40 glaciers are south facing, 31 glaciers are east facing ,34 glaciers are west facing, 44 glaciers are north-south facing, 56 glaciers are north-east facing, 32 glaciers are northwest facing and only 5 glaciers are south-east oriented (Table1.2).

Table 1.2
Suru-Zanskar Valley: Orientation of Glaciers

S. No	Orientation	Greater Himalayas	Zanskar Mountains	Total
1.	North	13	13	26
2.	South	7	33	40
2.	East	22	9	31
4.	West	3	31	34
5.	North-south	21	23	44
6.	North-east	46	10	56
7.	North-west	19	13	32
8.	South-east	0	5	5

Conclusion

Presently there are 24 major glaciers (above 5 km. in length) in the study region. Out of them 15 major glaciers are located in the Stod basin of the study region. These glaciers are north-east facing except Tingzumchu and Pholkolow which are situated in the north of the study region between an altitude of 4760 meters to 5480 meters. In the Lungnak valley of the study region, major glaciers namely Tidu, Khapang, Korcomshe, Churalp, and Temasi etc. are located between the altitudes of 4000 meters to 6000 meters. These glaciers are flowing towards the north and north-east direction. Besides these largest glaciers there are small glaciers on either side of the Stod river, Lungnak river and main Zanskar river of 100 meters to 1000 meters long and are confined to the valley head of sub basins along a steep gradient with avalanche type of debris along the slopes thereby indicating avalanche type of glaciers They terminated at an altitude of 4200 meters to 4500 meters above mean sea level. The present distribution of the glaciers is notably asymmetric.

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