Glacier Features and Their Variations in the Langtang Himal Region of Nepal

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Abstract

Existing glaciers of Langtang Himal Region are controlled by Indian Ocean Monsoon. Greater precipitation, higher glacial temperature, lower glacial firn line and glacial terminus and greater super-glacial debris are encountered than the northern slope of Mt. Shishapangma. Most glaciers in this region are maritime glaciers.

During Neoglaciation there are three great glacial advancing stages. Although many glaciers are still retreating recently, but also individual glaciers appear to be advancing.

1. Introduction

The Langtang Himal Region is located to the north of Kathmandu, the capital of Nepal. It is an alpine zone on the southern slopes of the Great Himalaya, where there are two ranges of snow mountains, the Kangjala Himal-Jugal Himal in the south and the Langtang Himal in the northwest, with many snow peaks, the highest of which is Mt. Langtang Lirung (about 7325 m a.s.l.). Many glaciers have termini down to about 4000 m a.s.l. near or into the forest zone. Melting water flows into the Sun Kosi River through the Indrawati Khola and the Balephi Khola, or into the Trisuli River through the Langtang River.

The Japanese-Nepalese Glaciological Expedition of Nepal led by Prof. K. Higuchi has built a glacier station (Base House) at 3920 m near Kyangchen Gompa (temple) in the Langtang valley. It conducts research on glaciology, climatology, geomorphology, hydrology and biology. Using data from field observations and analysis of results of satellite images and aerophotographic map (1:50,000), the glacial features and variations were studied and summarized. The results were herewith presented for discussion.

The investigated area is located south of Quson Zangbo, east of the confluence of Langtang River with Trisuli River and north of Changniba Glacier, (i.e., between 85°27'–85°58'E and 28°05'–28°22'N), where there are many glaciers with a total area of about 300 km^2. Among them are 10 valley glaciers over 5 km in length (see Table 1), but the glacial area of the Langtang River Basin is the largest, forming about 56% of the entire glacial area (Fig. 1). Langtang Glacier, the largest, is found on the southern slope of the 7205.5 m high peak on the west side of Mt. Shishapangma. About 20 km long, its firn line is at 5560 m a.s.l. and the terminus stretches down to 4450 m a.s.l. It is a compound glacier, consisting of 6 large ice streams from different basins, and also 9 glacierets supplying ice mass through ice falls or

Table 1. Statistical table of valley-type glaciers with length over 5 km and flat topped glaciers in Langtang Himal region

Glacier No.	Glacier name	Lat. (N)	Long. (E)	River basin	Glacier type	Orientation	Elevation (m/a.s.l.) Highest	Elevation (m/a.s.l.) Snow line	Elevation (m/a.s.l.) Lowest	Maximum length (km)	Mean width (m)	Surface area(S)	Debris covered area (D)	D/S (%)
L10	Langtang gl.	28°20'	85°42'	Langtang R.	Valley glacier—compound basins	SW	7205.5	5560	4400	20.00	850	58.87	12.42	21.11
L6	Shalbachum gl.	28°15'	85°39'	Langtang R.	Valley glacier—compound basins	SE	6601	5300	4150	12.08	500	12.57	1.53	12.17
L11	Langshisa gl.	28°12'	85°45'	Langtang R.	Valley glacier—compound basins	NW	6979	5350	4395	11.00	600	29.58	5.59	18.90
L4	Kyangchen (Kimshun) gl.	28°15'	85°35'	Langtang R.	Valley glacier—simple basin	SW	6350	5300	4200	10.75	600	5.57		
L3	Lirung gl.	28°15'	85°33'	Langtang R.	Valley glacier—simple basin	S	7225	4370	4020	6.45	400	10.55	4.00	37.91
L5	Yala (Dakpatsen) gl.	28°15'	85°37'	Langtang R.	Flat topped glacier	SW	6575	5200	5070	4.5	1500	7.82		
Q10	Qusongdo gl.	28°20'	85°39'	Qusongdo R.	Valley glacier	SW	6609	5420	4627	11.33	600	10.47		
L21	Kangjala gl.	28°10'	85°36'	Langtang R.	Flat topped glacier	N	5935	5100	4930	3.5	1200	3.75		
B6	Balephi gl.	28°10'	85°44'	Balephi R.	Valley glacier—compound basins	SW	6586	5250	4240	7.18	400	8.73		
P3	Dorje Lakpa gl.	28°10'	85°48'	Pulm Thang R.	Valley glacier—compound basins	SW	6979	5020	3900	9.05	500–1500	13.18		
P5	Phurbichach-umb (Jogol) gl.	28°10'	85°50'	Pulm Thang R.	Valley glacier—compound basins	SE	6753	5150	3850	10.50	350–1000	15.74	0.08	0.51
D4	Zhojang gl.	28°17'	85°30'	Dongling Zangbo R.	Valley glacier—compound basins	NW	5768	4000	3400	6.33	300	7.58		

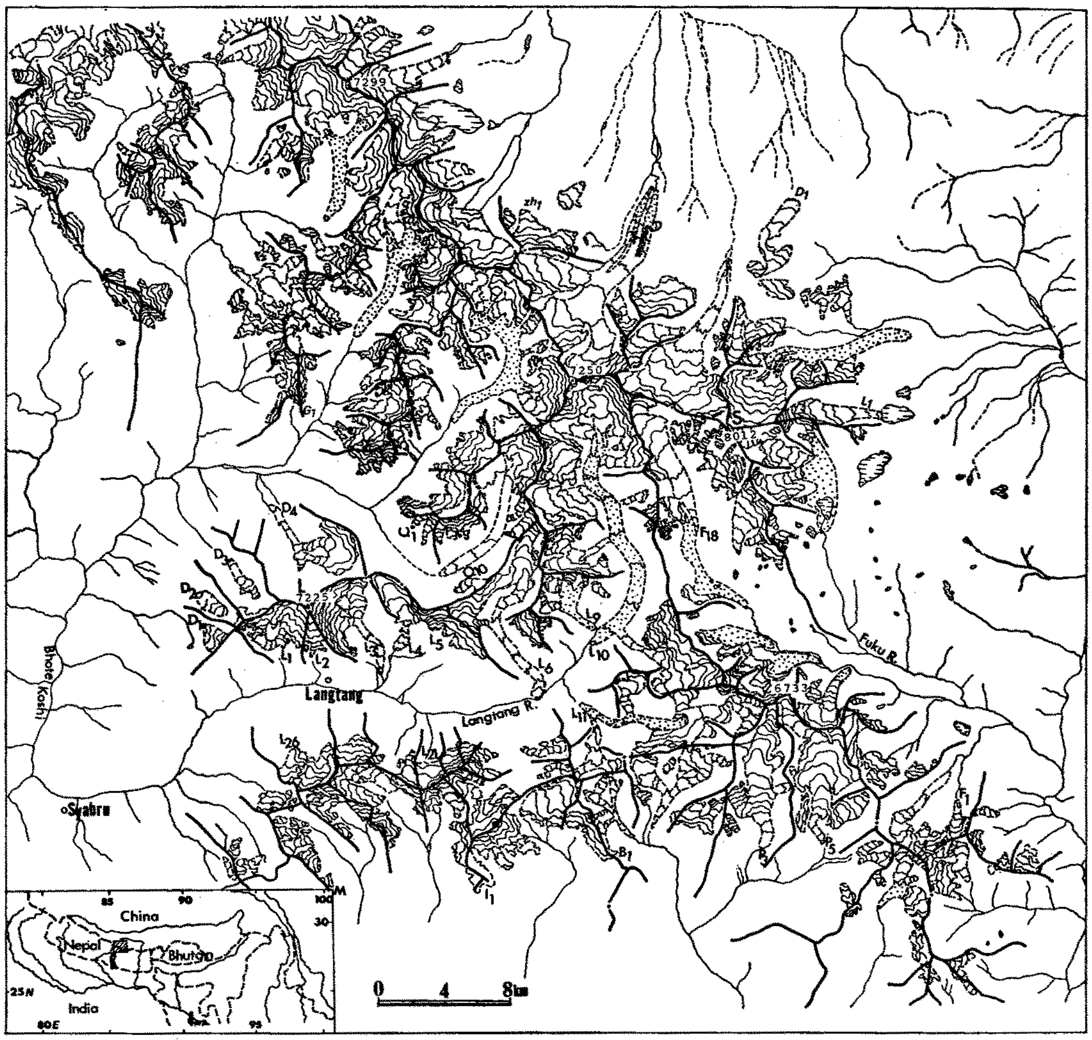

Fig. 1. Distribution Map of glaciers in Langtang Himal region.
L_1, L_2..., M_1, B_1 and so on are the glacier number
L_{7225}: Mt. Langtang Lirung, 7225 m a.s.l.
S_{8012}: Mt. Shisha Pangma, 8012 m a.s.l.

avalanches. It brings much debris to the glacier surface. The debris covered area extends nearly to the back wall of the firn basin.

Kimshun Glacier (also called East Glacier) is a special form of valley glacier with a wide tail. Its upper source is a shallow depression 1 km wide and 4 km long formed by the erosion of ancient high planation, so the high peaks on both sides are relatively gentle and covered with snow. Its glacial tongue faces the south with a steep slope at about 30° forming an ice fall. A short and small glacier tongue is found on its western flank without surface moraine, so the glacier surface is very clean and the glacial terminus is fan-shaped with marginal ice cliff. Ice blocks often occurred during the course of the investigation.

Yala Glacier is a well studied glacier in the northeast of Base House and developed on the altiplanation of Langtang Himal at 5000–5200 m a.s.l. Its width is southward 1 km wide and is 4.5 km long from northwest to southeast. The height of the glacial terminus and that of the firn line are 700–1000 m and 800–900 m lower than those of the ice cap on the northern slope of Mt. Shishapangma respectively. The thickness of Yala Glacier is 57.8 m at 5400 m. Its ice core shows firn within the depth of 10 m and meltwater below it. In addition, there is a layer composed of firn-ice and ice lens over 7 m thick, which is similar to the snow-layer structure of the firn basin of the Rougo Glacier in the south-eastern part of Xizang (Li Jijun and Zheng Benxing, 1981). It should belong to the warm infiltration ice.

2. Several Features of Glaciers

1) The glacial morphological types are directly influenced by geomorphology of landscape. Generally, the source of large valley glacier is without a wide and large firn basin, but the glacial surface is covered by much debris. The area of buried ice in glacial tongue area of the Langtang Glacier and that of the Lirung Glacier are about 12.42 km^2 and 4 km^2, or 21.11 % and 37.91 % of the total area, respectively.

2) The subglacial river is very well developed, and supraglacial lakes and moraine hills are all around. There is much meltwater from firn layer in the accumulation area of Yala Glacier, reflecting the high temperature of glacier. However, only deep-cut supraglacial rivers are found in the glaciers on the northern slope of the Mt. Shishapangma where the

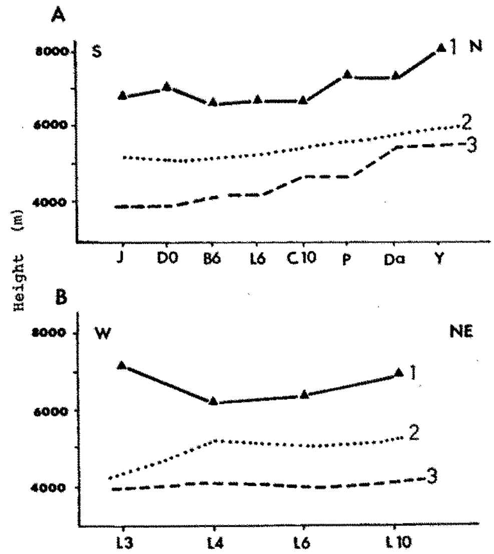

Fig. 2. Relative location of upper limit (1), firn-line (2) and terminus height (3) of glaciers.
(A) From south to north
(B) From west to northeast along Langtang valley
1: Upper limit of glaciers; 2: Firn line; 3: Glacial terminus; Da: Daqu Glacier; D0: Dorje Lakpa Glacier; L3: Lirung Glacier; L6: Shalbachum Glacier; B6: Balephi Glacier; J: Jogol Glacier
P: Purepu Glacier; Y: Yebokangjal Glacier; C10: Qusongdo Glacier; L4: Kimshun Glacier; L10: Langtang Glacier

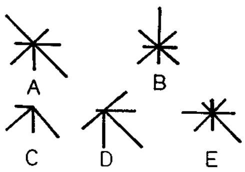

Fig. 3. Frequency of orientation of glaciers in Langtang Himal region.
(A) Frequency of orientation of valley glaciers
(B) Frequency of orientation of glaciers in Langtang River
(C) Frequency of orientation of glaciers in Qusongdo River
(D) Frequency of orientation of glaciers in Indrawati Khola
(E) Frequency of orientation of glaciers in Balephi Khola

glacial temperature was about −9°C near the snow line (6000 m) at a depth of 5 m in early May, 1964 (Huang Maohuan, 1982).

3) The glaciers on the southern slope are bigger and longer than those on the northern slope, because the rivers of the southern slope are deeper; the annual precipitation is also greater on the southern side. For example, much precipitation occurs along the south side of Mahabharat ranges (3000–4000 mm/yr; see Fushimi, 1981), near the Kathmandu Region (1500–2000 mm/yr.), and in the frontal zone of the great Himalaya (3000 mm/yr.). Near the great Himalaya there is lower precipitation at only 614.7 mm/yr. (1916–1975) at Nyalam (3810 m), and northward to Dingri (4300 m) with its 236.1 mm/yr. Water vapour also rises upstream along the valley. During the expedition to the Langtang River area, clouds and fog were encountered upstream along the valley every afternoon, so the firn line and glacier terminus near Mt. Langtang Lirung are lower than at the source (Fig. 2).

4) Most of the valley glaciers face the southeast or southwest for the same reason mentioned in item 3 (Fig. 3).

5) Although high mountains and deep valleys are prevailing here, the peneplane of Pliocene is still restricted on the top of the mountains. A special type of flat-topped glacier is formed, reflecting the relatively new aspect of the Himalaya.

6) There are two glacial types in Chinghai-Xizang Plateau, they are monsoon maritime glaciers and continental glaciers (Li Jijun and Zheng Benxing, 1981). However, a complex type glacier located at a special place with high firn basin and lower glacial terminus, also has characteristics both of continental glacier and maritime glacier, for example the Batura Glacier in Karakoram mountains (Shi Yafeng and Li Jijun, 1981). From research on glaciers in the Nepal Himalaya (Higuchi, 1981) and the glacial characteristics and natural environment of the Langtang Himal Region, glaciers in the high mountainous zone on the northern part may be distinguished as those of the complex type and those of the Kangjala Himal-Jugal Himal snow mountains (i.e., mostly of the Langtang River) belong to the maritime type.

3. Variations in Existing Glaciers

The series of end moraines in the front of glaciers suggest that there are large glacial advancing stages and several small waves advancing after the hypsithermal period. These three advancing stages have been correlated to the three advancing stages of the Neoglacial age on the Chinghai-Xizang Plateau (Zheng Benxing and Shi Yafeng, 1982). During the first great advance of Neoglaciation in the Langtang River region, many glaciers of the tributaries flow into the main valley stretching downward 1–2 km from the termini of existing glaciers.

An alluvial terrace is located at about 2 km in the front of Langtang Glacier about 4 m above the bed of the Langtang River. The spore-pollen analyses of the blue paleosoil in the upper part of the section of the terrace reveal the presence of many spore and pollen of coniferous and broad-leaved forests, but now only mountain shrubs grow there, showing that the paleoclimate was warmer than today. This period was about 8000–3000 B.P. and is called a hypsithermal period in Middle Holocene. Then the climate became cold, and the glaciers generally advanced again.

The yellow moraine hill near the Langtang Glacier terminus is older than the modern moraine, perhaps representing the end moraine of Neoglaciation. There are also a series of moraines about 2 km in front of the Shalbachum Glacier, which may be in three groups; distant from to existing glacial terminus are about 2.2 km, 1.5 km and 0.5 km, respectively. An end moraine with much well-rounded gravel near the stone house at Nubama indicates that the Shalbachum Glacier incorporated same in the course of its advance (Zheng Benxing, 1982). Therefore, this glacial advance is called Nubama Neoglaciation. In the third stage of Neoglaciation (i.e., 17–19th Little Ice Age), the Shalbachum Glacier extended into the bed of the Langtang River and a very high end moraine was formed.

During Neoglaciation, the maximum advance of the Lirung Glacier reached nearly to the main flow of the Langtang River. Since the 17–19th Little Ice Age, the glacier has had three waves of advance forming three lateral moraines about 40 m above the glacial surface. After that, this glacier retreated quickly, its meltwater flowing out through the lakes or bogs from the large glacial cave in front of it.

Judging from the ice fall from the ice cliff of the glacial terminus and the extension of a

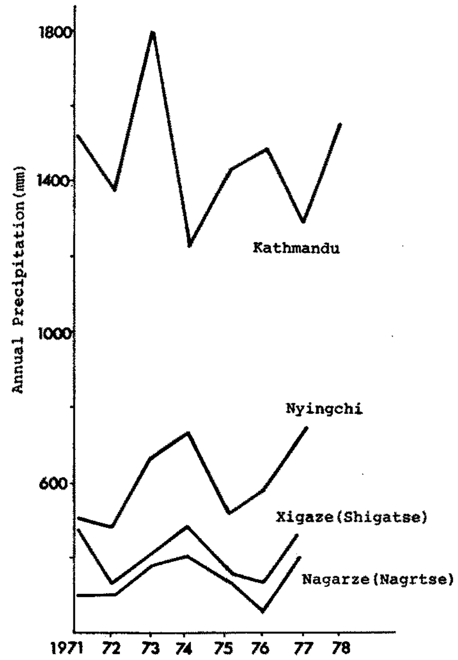

Fig. 4. Curve of variation of annual precipitation in Kathmandu, Xigaze etc. in the middle of 1970's.

short glacial tongue from the western side of the Kimshun valley Glacier, it advanced in the late 1970s, reflecting possibly increased precipitation since the mid-70s (Fig. 4).

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