THE DISTRIBUTION OF GLACIERS AND SNOW COVER IN THE YARLUNG ZANGBO-BRAHMAPUTRA RIVER BASINS

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The Yarlung Zangbo River flows from west to east, originating in the glaciers on the northern slope of the Mariyangzong Kangri mountains (30°00'N, 82°01'E) in Tibet, China, with its main stream valley along the east-west fault zone. The Himalayan mountains are located in the southern part of the basin, while the Gangdise, Nyaingentanglha, and Baxoila mountains surround the basin on the northern and the northeastern sides. There are some main tributaries in the basin, such as the Nyang, Lhasa, Parlung Zangbo, etc.

The Yarlung Zangbo river turns sharply to the south around the Nangagbarwa Peak (7,782masl, 29° 30'N, 95° 10'E), passing through the Himalayas and then turning southwest after flowing across the border nearby the Paxikar of China where it meets other tributaries, such as the Xibaxa, Kamen, Sankosh, Tista, etc, that originate in the south slope of the Himalayas. It takes the name of Brahmaputra in India. The total length of the Yarlung Zangbo-Brahmaputra-Jamuna is 2,806.0km of which 1,940km is within China, and the basin area is about 5,19,570.0 km^2 of which the 3,37,230.0km^2 is within China, accounting for 64.9% of the total basin area (Fig. 1).

The Yarlung Zangbo-Brahmaputra is located in an the area of low latitudes, with big changes in the elevation of the basin and an extremly remarkable difference of natural zone from the tropical zone and the aiphyllum of subtropical zone to the alpine frigorideserta. The warm and humid southwestern monsoon air in the Bay of Bengal travels along the river valley, along the terrain of the Himalayas, and results in abundant precipitation, reaching maximum values of 4,000mm per year. According to

statistical data, precipitation in the basin decreases from the southeast to the northwest, by 4,496mm/year in Parikar, 1,000mm/year around Tangmai, and 634mm/year in Nyingchi.

In the middle and upper reaches of the river valley, the precipitation decreases sharply, leaving the area with less annual precipitation; for example, 434mm/year in Xigaze because the southwestern monsoon is affected by the protective screen of the Himalayas.

The glaciers and snow cover are widely distributed in the alpine area of this basin. The primary investigation shows that the glacial area in the whole basin is 16593.6km^2, which is about 82.5%, of which 13682.6km^2 is on China's side. The annual runoff volume of glacial meltwater can only reach up to 173.19x10^{8}m^3 in China, equalling 14.8% of the annual runoff volume at the border where theYarlung Zangbo flows to India. The snow-covered area in the whole basin is about 57477.0km^2, drawn from NOAA/AVHRR image of March 25, 1988. The distribution condition of glaciers and snow in each mountain system, and main branching streams in the basin, have been analysed (Table 1 and 2). Due to the impact of the global change, the temperature has risen and precipitation has decreased in the Yarlung Zangbo River basin. Hence the glacial annual mass balance is negative, about 300-700mm/year, and most of the glaciers in this basin have retreated recently.

Table 1. The Statistics of Glaciers and Snow Cover in the Basin of Yarlung Zangbo-Brahmaputra River

Name of Mountain	Glacial Area (km^2)	Percentage of Glacial Area in Total Basin area	Elevation of Glacial Snow Line (m)	Snow Area (km^2)	Pecentage of Snow Area in Total Area Basin
North slope of Himalaya Mts.	7407.8	44.7	4500-6000	15246.0	26.5
South slope of Himalaya Mts.	4274.2	25.8	4400-5500	26469.0	46.1
South slope of Nainyentanglha Mts.	3797.6	22.8	4400-5300	9756.0	17.0
South slope of Gangdise Mts.	813.3	4.9	5600-6000	1965.0	3.4
South slope of Hengduan Mts.	300.7	1.8	4500-5000	4050.0	7.3
Total	16593.6	100.0		57477.0	100.0

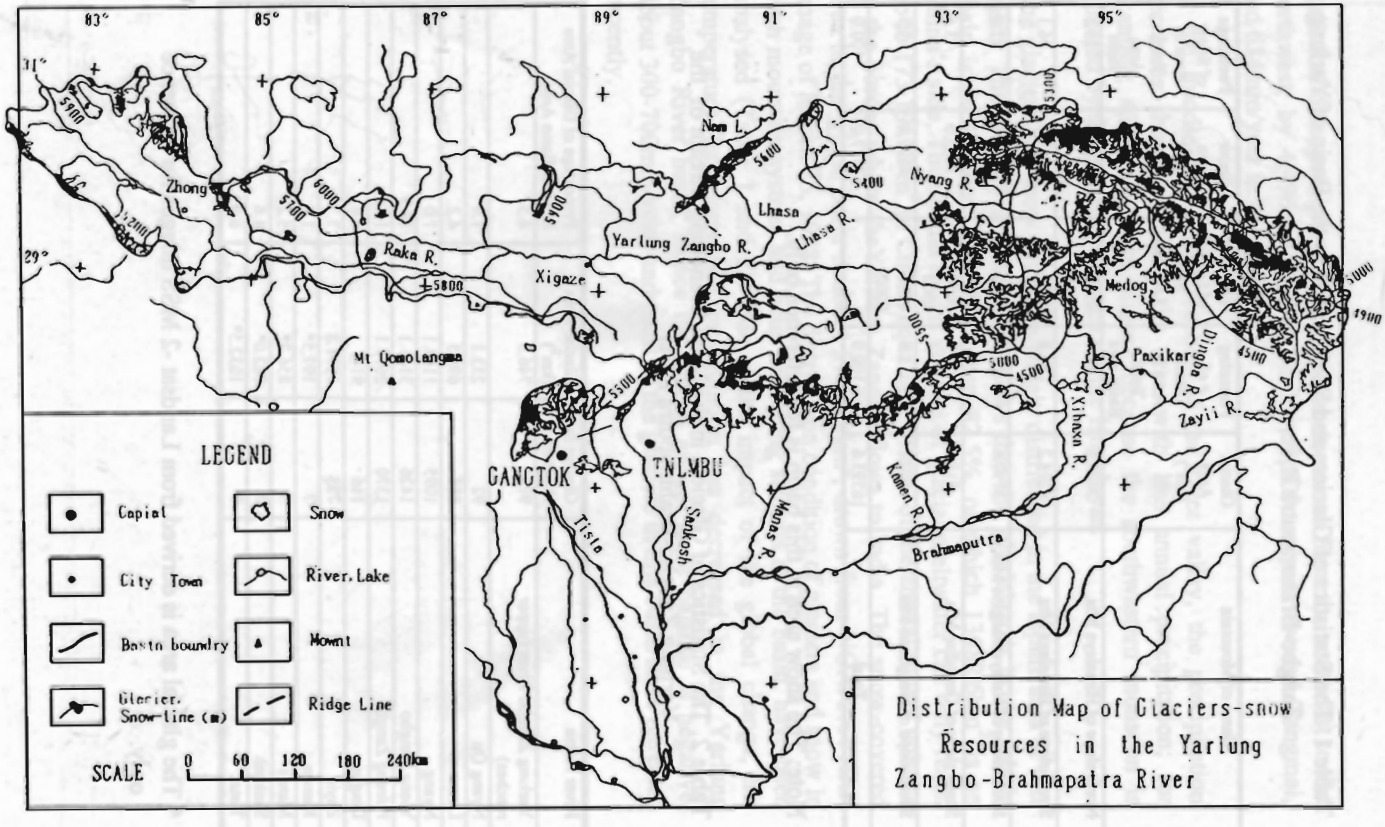
Note: The snow area in this basin is for reference only.

Table 2. The Statistics of Glaciers in the Main Branching Stream of the Yarlung Zangbo-Brahmaputra River

River Name	Glacers in Numbers	Glacial Area (km^2)	Percentage of Glacial Area in Total Basin Area
Yarlung Zangbo River (upper reaches)	912	746.3	4.5
Nyang Qu	92	233.1	1.4
Lhasa	885	690.5	4.2
Nyang	1095	1164.1	7.0
Yiong Zangbo	1426	3141.1	18.9
Palrung Zangbo	1370	2699.1	16.2
Dingba	116	91.8	0.6
Zayii	785	1271.8	7.7
Kamen	?	197.5*	1.2
Manas	?	856.7*	5.2
Sankosh	?	762.0*	4.6
Tista	?	1032.5*	6.2

* The glacial area is derived from Landsat -2 MSS images for reference only.

Figure 1.


83°
85°
87°
89°
91°
93°
95°
31°
29°
Zhongba
Raka R.
Xigaze
Yarlung Zangbo R.
Lhasa
Lhasa R.
Nam L.
Nyang R.
Medog
Paxikar
Dingbo R.
Zayii R.
Xiaxu R.
Mt Qomolangma
CANGTOK
THLMBU
Tista
Sankosh
Manas R.
Konen R.
Brahmaputra
LEGEND
Capital
City Town
Basin boundry
Glacier, Snow-line (m)
Snow
River, Lake
Mount
Ridge Line
SCALE
0 60 120 180 240km
Distribution Map of Glaciers-snow Resources in the Yarlung Zangbo-Brahmapatra River