CHINESE GEOGRAPHICAL SCIENCE
Volume 2, Number 3, pp.284–292, 1992
Science Press, Beijing, China

TEXTUAL RESEARCH ON THE MAIN SOURCE OF THE CHANGJIANG RIVER

Sun Guangyou (孙广友) Deng Wei (邓 伟)
Shao Qingchun (邵庆春) Hua Runkui (华润葵)
(Changchun Institute of Geography, Academia Sinica, Changchun 130021, PRC)

ABSTRACT: The Chinese people began to research the main source of the Changjiang (Yangtze) River 2,400 years ago. Limited by the scientific level, they did not discover it.

The Tuotuo River was determined as the main source of the Changjiang River in the 1970s. However, this was not correct, because when comparing the length of the Tuotuo River with the Dam River, the glacier length at the headwaters was added to the Tuotuo River, resulting in that the Tuotuo River is 1 km longer than the Dam River, keeping in mind that the glacier can not be regarded as part of the river.

In the summer of 1986, we investigated the source of the Changjiang River, we accurately measured the length of both the Tuotuo and Dam rivers, we discovered that the Dam River was 353.1 km long, and the Tuotuo River was 346.3 km long, the Dam River thus being 6.8 km longer than the Tuotuo River. The discharge of the Dam River is 196.18 m^3/ sec., 2.6 times as large as that of the Tuotuo River, that of the Tuotuo River is 75.10 m^3/ sec. The drainage area of the Dam River is 1.8 times as larger as that of the Tuotuo River; the drainage area of the Dam River is 30,715.7 km^2, the Tuotuo River is 16,691.0 km^2.

Through synthetic analysis of the factors mentioned above, we came to the conclusion that the main source of the Changjiang River is the Dam River instead of the Tuotuo River.

KEY WORDS: the Changjiang River, main source of a river, headwater

I. INTRODUCTION

The Changjiang River, also commonly known as the Yangtze River, is the first in China and the third in the world. Much close attention has been paid to its main source because of its drainage basin being very large: the source area is being located in the center of the Qinghai–Xizhang Plateau and the environment of the source area having access. The

river main source has been a matter of dispute though the research history has extended over a period of 2,400 years.

The Project Office of the Changjiang River Valley organized the investigations on the source of the Changjiang River in 1976 and 1978. The information was collected on the source area, and the main source was determined to be the Tuotuo River originating from the Geladaindong Glacial Group. The glacial group belongs to the middle part of the Tanggula Mountain. The length of the Changjiang River was 6,300 km. These conclusions have been widely adopted in teaching and scientific research of this project.[1–4]

In 1985, Professor Huang Xiaowen, a Chinese American scholar, investigated the source region of the Changjiang River. He questioned whether or not the Tuotuo River was main source arguing that the Dam River should be recognized as the main source. But his article lacked enough calculated data to be a thorough argument.[5]

In the summer of 1986, we participated in the drift exploration of the Changjiang River and made an on–the–spot investigation in the source region using remote sensing technique for making accurate measurements. There we discovered that the Dam River was longer than the Tuotuo River and possessed obvious superiority in discharge; as well as the area of the drainage basin and the water system developing, etc. From this, we concluded that the main source of the Changjiang River was the Dam River, not the Tuotuo River as previously supported.

II. THREE IMPORTANT SOURCES OF THE CHANGJIANG RIVER

The source area is a part of the Tongtian River drainage basin, located at 90° 30′ –95° 20′ E, and 32° 30′ –35° 50′ N. The south of the area starts from the limits of the Tanggula Mountain; the north reaches the Kunlun Mountain; the Ulan Ul Mountain is on the west of the area; and the Bayan Har Mountain is on the east. The total area of the drainage basin is about 107,140.0 km^2. In the source area, the branches of the Tongtian River form a complicated river system (Fig.1). How many important sources of the Changjiang River are there? Which river is the main source among them? There are various opinions on these questions. The cruxes are whether the Chumaer River is to be considered as one of the important sources, and which is longer between the Dam River and the Tuotuo River.

The Qumar River originates from the Hoh Xil Mountain of the Kunlun Mountain ranges; its river head being composed of two branches, one from the west and the other from the north. The length of the Qumar River is shorter than that of the Dam River and the Toutou River, and ranks the third (Table 1). The discharge also ranks the third. But its drainage area is smaller than that of the Dam River, and larger than that of the Tuotuo River. From this evidence, it is clear that the Qumar River can not be the main source of the Changjiang River, but because it is the third important source and contributes to the

formation of the river system, it is an important one. It also helps to form the geographic space, the Qumar River covering a wide area at the south foot of the Kunlun Mountain. Therefore the Qumar River is indeed one of the important sources.

Table 1 Comparison of lengths of streams in the Changjiang River source

River	Length (km)	Position of starting and stopping measurement
Dam River	353.1	From Zhaxigejun to the river mouth of Dam River and the Tuotuo River
Tuotuo River	346.3	From the end of the source of the Garkyadeugang Glacier to the mouth of the Dam River and the Tuotuo River

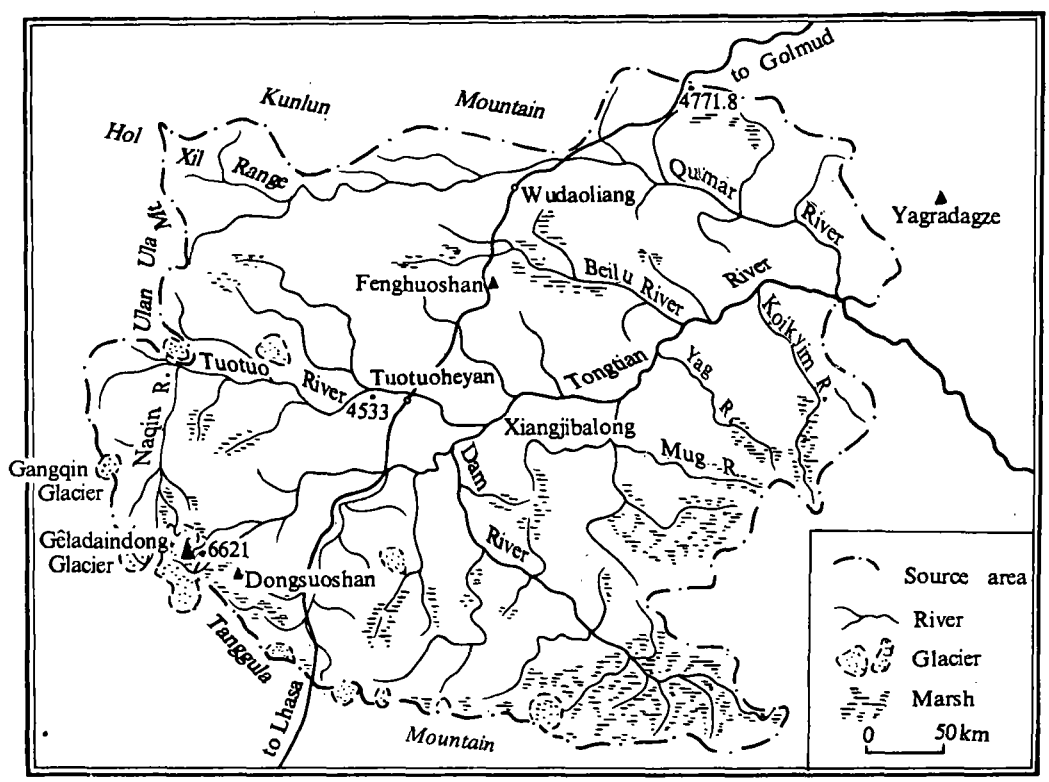

Fig.1 The system of the Changjiang River source

III. THE PRINCIPLE TO DETERMINE THE MAIN SOURCE OF THE RIVER

At present, there are not generally accepted principles to determine the main source,

when a river has several riverheads. The Chinese professor Mao Faxin has proposed the following ten criteria of determination[6]:

The principle most widely accepted by the most scientists is the principle that the river farthest from the river mouth is the main source.

1. Length of the river. The principle most widely accepted by the most scientists is the principle that the river farthest from the river mouth is the main source.[7-9] The main source of the Changjiang River was determined by this rule (some geographers regarded that this principle could be used to determine the head of the Amazon). Professor Shi Mingding regarded the Tuotuo River as the main source of the Changjiang River using this rule.[10]

2. Discharge of the river. The river with the largest discharge is regarded as the main source.

3. Length and discharge of the river. The river which is longest and has the largest discharge will be regarded as the main source.

4. Discharge and drainage area. The river with the biggest discharge and the largest drainage area will be regarded as the main source of a river.[11]

5. Historical factor. To comply with traditional thought (the source is mistaken but not corrected yet).

6. Arrangement of the river system. It is the main source if source stream flows in the same direction as the trunk stream.

7. Form of the river valley. The early wide development of the valley determines the main source.

8. Landform of the river head. To take the river which has the highest elevation and biggest falls as the main source.

9. Comprehensive marks. To consider all sorts of factors, such as the length, discharge, drainage area, the form of valley, and the historical factors etc., rather than depending on one of these factors alone, the main source of the Huanghe (Yellow) River was determined according this rule.[12]

10. Other factors. In our view point, the length of the river should be the main criterion; yet at the same time considering other factors also. It is specially necessary when the length of two rivers are almost identical. The discharge and drainage area are very important factors too, not excluding the length of the river, and other features such as the history, the arrangement system, form of the valley, etc. All of these factors appear in the situation of the Changjiang River. Especially the fact that the Tuotuo River is almost as long as the Dam River, caused us to analyse the other criteria to get the objective conclusion.

IV. TO DETERMINE THE MAIN SOURCE OF THE CHANGJIANG RIVER

1. Comparison of the River Length

By comparing the river lengths by the data from the reference, according to the data provided by Shi Mingding, the Tuotuo River is longer than the Dam River, the Tuotuo River being 358.1 km, the Dam River being 357.1 km, the Tuotuo River is determined as the main source of the Changjiang River.

First, it is point out that the length difference is only 1 km between the two rivers, this being allowed as an error of measurement. Therefor, in this case the superiority of river length factor by itself is not enough. Second, the length of the Tuotuo River including 12.6 km of the Jianggendiru Glacier. Many reference documents widely regard the glacier is only in the feeding area of the river, thus technically it can not be regarded as a part of the river itself, not a real river anyway.[8-9,13-14] Thus, the end of glacier tongue can be considered the true source of the river.

According to these ideas, we made corrections to the source positions of the Tuotuo River and the Dam River, and discovered that the main course of Tuotuo River was not at the end of the Garkyagdeugang Glacier (Fig.2). This was also quite distinct on the Landsat

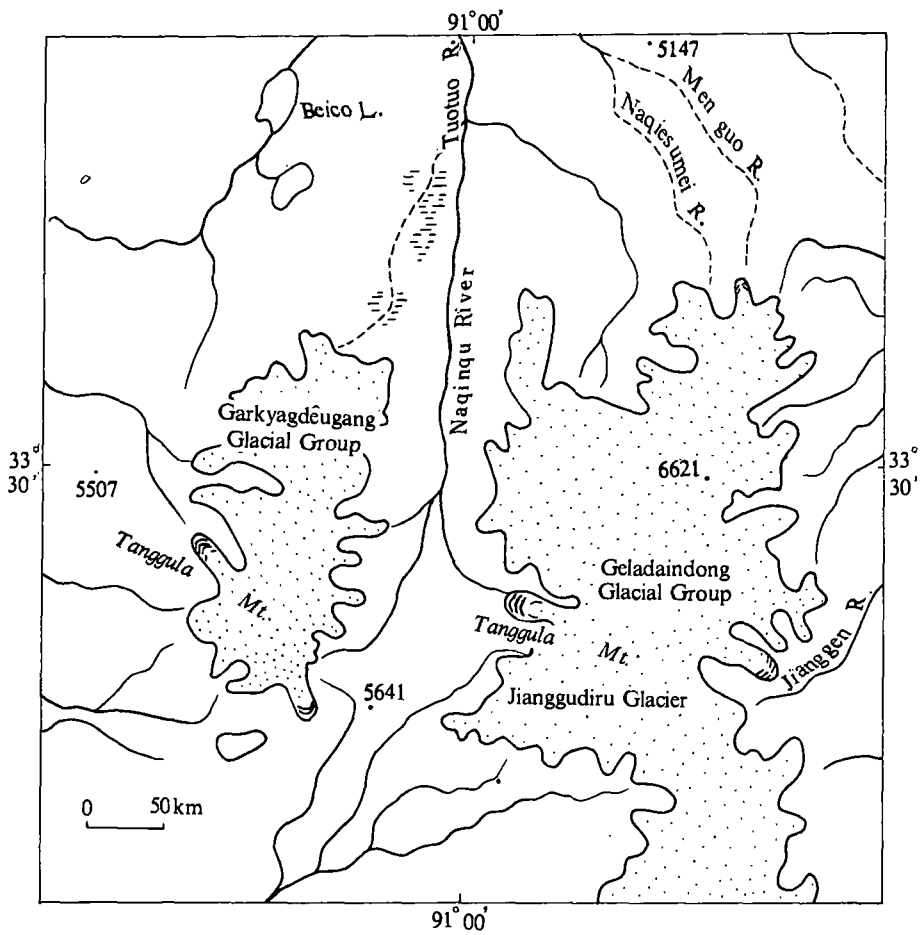

Fig.2 The system of the Tuotuo River source

images. The Dam River's main source is on a hilly plateau, and is not in the Xiasheriaba Mountain.[15] The Landsat images show that originally the spring water converge into a small lake, and form the original water of the Dam River that being the source of the Dam River (Fig.3).

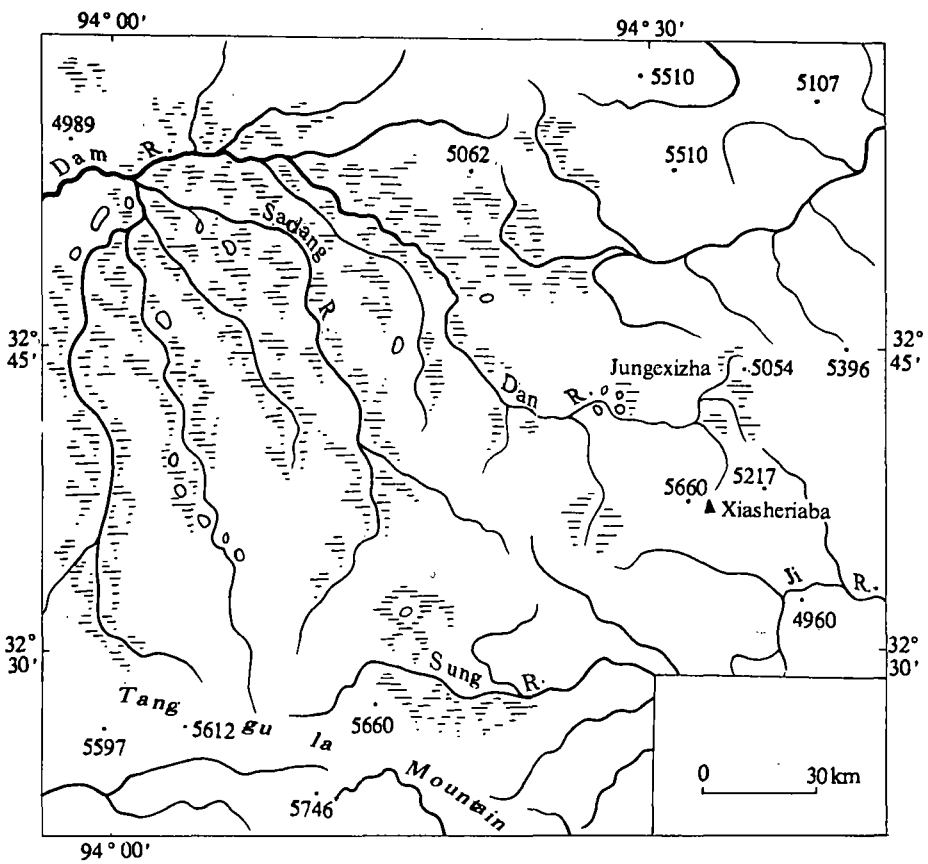

Fig.3 The system of the Dam River source

After determining the source of the Tuotuo River and the Dam River, we were able to measure their lengths, the results are in Table 1.

In Table 1, the Dam River is 6.8 km longer than the Tuotuo River. By the rule of length of river, the Dam River should be considered as the main source of the Changjiang River.

2. Comparison of the Discharge

Table 2 gives the hydrological values of streams of the Changjiang River headwater. Because there is no hydrological station on the Dam River, there is no data listed in

Table 2. The Gar River and the Bi River are two tributary streams of the Dam River (Fig.1), therefore we can make this comparison. The mean discharge of the Gar River and the Bi River is 49.30 m^3/ s, that is, 1.68 times that of the Tuotuo River.

In order to make up the deficiency of data, we made an on-the-spot measurement of the discharges of the Dam River and the Tuotuo River at the river mouth of the two rivers, the results are shown in Table 3.

Table 2 Hydrological value of streams of the Changjiang River

River	Station	Drainage area (km^2)	Discharge (m^3/ s)	max. discharge (m^3/ s)	min. discharge (m^3/ s)	annual discharge 100 mil.(m^3/ s)
Tuotuo R.	Tuotuoheyan	15,092	29.4	750	0.104	9.27
Gar R.	Tongtianheyan	4,123	24.20	319	0.00	7.6
Bi R.	Yanshi ping	4,570	25.10	507	1.34	7.94
Qumar R.	Qumarheyan	9,184	8.37	293	0.00	2.64

Table 3 Discharge measured in the Dam River and the Tuotuo River

River	Place of section	Date	Section area (m^2)	Discharge (m^3/ s)	Average flow velocity (m/ s)	Width of water (m)	Max. flow velocity (m/ s)	Mean depth of water (m)	Max. depth of water (m)
Dam River	6km to mouth	June 20	163.35	196.18	1.11	120.0	1.50	1.42	3.00
Tuotuo River	12km to mouth	June 25	35.51	29.90	0.62	117.00	1.28	0.34	0.65
Tuotuo River	By Tuotuo R.	June 20	83.70	75.10	0.90	112.50	1.23	0.74	1.90
Tuotuo River	By Tuotuo R.	June 25	48.87	42.18	0.60	118.00	1.54	0.45	1.22

In Table 3. We can see that the daily change of the Tuotuo River is big, the discharge on June 20 is 31% bigger than June 25, and its discharge near the mouth is smaller than Tuotuoheyan. Because the climate is dry in this section of the river; no branches come into the river, and the wide river bed consists of the sand, therefore, the river water is lost.

The discharge measured near the mouth of the Dam River is 6.56 times as big as the Tuotuo River. If comparing the data on the same day (June 20), the Dam River is 3.8 times as big as the Tuotuo River in consideration of 31% of discharge loss of the Tuotuo river mouth section. Even if comparing the data of June 20 from Tuotuoheyan, June 20, the discharge of the Dam River is still 2.6 times as big as the Tuotuo River. Therefore the result of the discharge showed that the Dam River is superior than the Tuotuo River being the main source.

3. Comparison of the Drainage Area.

In the determination of the main source of the river, the drainage area is an important mark next to the length and discharge of the river. It is in correlation with the discharge so much, at the same time the area of drainage basin can show the scale of a river in the geographical space.

The drainage area of each main river source measured and calculated can be seen in Table 4.

Table 4 Drainage area of streams of the Changjiang River source

River	Drainage area (km^2)	Note
Dam River	30715.7	The Dam River is biggest on drainage area, It is 1.8 times of the Tuotuo River.
Tuotuo River	16691.0	The Qumar River is between the Dam River and the Tuotuo River.
Qumar River	20831.8	

It is very reasonable, that the Dam River is considered as the main source judging from the area of drainage basin.

4. Comparison of the Shape of River System and Other Aspects

The Tuotuo River flows straight to north from the Garkyadeugang and the Geladaindong glaciers groups, then it turns to east in 90° , after flowing through the Jurhen Ul Mountain then it meets with the Dam River in Nangjibalong. But the Dam River flows first to northwest then turns to northeast. To compare the both of them, the direction of the Tuotuo River is more similar to the main stream of the Changjiang River, but it should be pointed out that the development of the river system of the Dam River is more perfect than that of the Tuotuo River, it shows a typical fan-shape. The flowing direction of the Gar River which rises in the east side of the Geladaindong snow mountain is the

most similar to the main stream of the Changjiang River among all of river sources, but it is the tributary of the Dam River. Therefore, the Tuotuo River only has a little superiority in the shape of the river system.

In addition, the Dam River rises in the wide hilly plateau where there is a bigger confluence basin, then it reaches the river mouth (see Fig.3) after passing wide mire; from the relief of the river source, it can be seen that the Tuotuo River rises magnificent glacier where the elevation is more than 6000 m (see Fig.2).

The time of forming river valley is difficult to define before the development history of the river source system has not been cleared.

To sum up, the Dam River as main source of the Changjiang River, has not only superiority in the leading mark of the river length, but also superiority in both of the discharge and basin area, only the trend of river and altitude of topography of the river source are minor to the Tuotuo River. Therefore, the main source of the Changjiang River is the Dam River instead of the Tuotuo River.

The length of the Changjiang River should be calculated again according to the Dam River as the main source. The Dam River is 353.1 km in length, the length from the Tungtan River downward still use original data (the Tongtian River is 813 km long, the Jinsha River is 2,308 km long, from Yibin City to the river mouth is 2,806 km long), the Changjiang River is 6,280 km in total length, budgetary estimate is 6,300 km, it is also in the third position in the world.

REFERENCES

[1] 雍万里.中国自然地理.上海：上海教育出版社，1985.

[2] 地理学词典编辑委员会.地理学词典.上海：上海辞书出版社，1983.

[3] 郑度等.中国的青藏高原.北京：科学出版社，1985.

[4] 中国科学院《中国自然地理》编委会.中国自然地理（地表水）.北京：科学出版社，1981.

[5] 黄效文.江源考.地理知识.1986 (1).

[6] 切波达列夫 A N.陆地水文学.北京：水利出版社，1958.

[7] 施成熙，梁瑞驹.陆地水文学.北京：中国工业出版社，1964.

[8] 成都水力发电学校.陆地水文学.北京：水利电力出版社，1979.

[9] 石铭鼎.关于长江正源的确定问题.地理研究 1983，2 (1).

[10] 黄盛璋.黄河上的历史地理问题与测绘的地图新考.见：黄河源头考察文集.西宁：青海人民出版社，1982.

[11] 祁明荣.扎陵、鄂陵两湖名称和黄河河源问题科学讨论会纪要.见：黄河源头考察文集.西宁：青海人民出版社，1982.

[12] Огиевский A B，天津大学水利系水文教研组译.陆地水文学.北京：人民教育出版社，1959.

[13] 上海市泸湾区教师进修学院.地理名词解释.上海：上海教育出版社，1977.

[14] 夏鹏章.长江江源水文概况.见：中国地理学会陆地水文学学术会议论文集.北京：科学出版社，1981.