

Dear anonymous referee,

Thank you very much for your valuable comments and constructive suggestions. Having carefully reviewed your feedback, we have gained significant insights and benefited greatly. We believe that revising according to your suggestions will greatly enhance the quality of our study.

For instance, following your advice, we consulted additional historical sources and found quantitative evidence for assessing the effectiveness of disaster relief measures. For example, in memorials to the throne, prefectural and county gazetteers, and other local documents from the Qing Dynasty, we discovered that in response to the 1759 disaster and to increase grain production, local communities expanded the area of reclaimed land, bringing some previously uncultivated wasteland into agricultural use. A memorial records that in the Hexi Corridor of Gansu Province, newly reclaimed land produced 82,346 dan of grain in 1760, enough to feed 41,173 adult males for one year. A local gazetteer records that on the Ningxia Plain, the Tanglai Canal and Hanyan Canal irrigation systems were dredged, expanding the irrigated area by 21,970 mu in 1760, which increased grain production by 26,364 dan, enough to feed 13,182 adult males for one year. Adding this evidence undoubtedly makes our study more complete and presents readers with more robust and scientifically grounded findings and conclusions.

Regarding the three valuable comments you raised below, we will add one paragraph in the manuscript to address each of them, in order to supplement the deficiencies of the original version. However, because the journal requires review by two external referees, and we have just received the comments from the second referee, a large number of figures and substantial portions of the text need to be redrawn and revised. Therefore, the full revision of the manuscript is still ongoing.

Anonymous referee, 12 Sep 2024

First, the manuscript should include more records to show the responses by government. In particular, the effect of these measures should be supported by these records. So far, the effect of these measures are evaluated indirectly. If there are some records directly show the effectiveness of these measures, it will be more persuasive.

A: Comment accepted. By consulting historical documents and local chronicles, we have identified several quantitative accounts that directly describe societal adaptive capacity to disasters, which help address the previous lack of direct and quantitative evidence:

1. For example, in a memorial to the throne from 1760, we found that grain production from newly reclaimed land in the Hexi Corridor of Gansu Province in 1759–1760 reached as high as 82,346 dan. According to information from the same memorial system, each soldier-farmer consumed 3 dan of grain per year (1 dan \approx 60 kg, so 3 dan \approx 180 kg; another memorial from 1777 records that in the agricultural colonies in Urumqi, each adult received 0.5 kg of flour per day, while children received half that amount. Based on this, each adult consumed approximately 0.5 kg of grain per day, or 182.5 kg per year, roughly equivalent to 3 dan. This represents the consumption level of an adult male engaged in intensive labor in a military colony. For basic survival alone, the annual consumption would be about 2 dan). Therefore, 82,346 dan of grain could sustain the basic survival of 41,173 adult males for one year.

2. On the Ningxia Plain, the construction and dredging of irrigation canals in 1759–1760

expanded the irrigated area. Compared with 1759, the irrigated area increased by 21,970 mu in 1760, and the resulting increase in grain production could sustain the basic survival of 13,182 adult males for one year.

Furthermore, the study area (Gansu and Shaanxi Provinces) served as the main rear base for the Qing Dynasty's military operations in Xinjiang, continuously supplying grain and manpower to support the stationed troops and immigrant land reclamation. We therefore collected data on the annual grain shipments from Gansu and Shaanxi to Xinjiang in the years prior to 1759. In 1759, due to the drought, these grain shipments were suspended, thereby alleviating the grain pressure in Gansu and Shaanxi themselves. Thus, the grain shipment data from previous years can indirectly reflect the extent to which grain pressure was reduced in Gansu and Shaanxi in 1759.

This work is still ongoing, and we are continuing to consult relevant memorials to the throne and local chronicles, striving to rigorously reconstruct the specific amount of grain production increase achieved through human efforts during 1759–1760.

Second, the study may consider the demographic pressure and conditions. After the drought occurrence, how about the migration conducted by local communities? The migration out of town may reduce the vulnerable groups under disaster which lead to less loss.

A: Comment accepted. Thank you for pointing out this flaw. We collected data on the number of people dispatched from Shaanxi and Gansu Provinces to Xinjiang for land reclamation in 1759 and 1760. These people were distributed across multiple Xinjiang oasis areas, including Hami, Barkol, Pichan, Urumqi, Ili, Yarkand, and Kashgar. The specific numbers are currently being verified and calculated based on the area of newly reclaimed land in each of these regions during these two years.

This type of land reclamation was divided into military colonies and civilian colonies. For the military colonies, the number of reclamation soldiers and the area of reclaimed land were both recorded in detail. By subtracting the area reclaimed by military colonies in 1759–1760 from the total newly reclaimed area, we can obtain the area newly reclaimed by civilian colonies during the same period. Then, based on the number of households corresponding to that reclaimed area, we can calculate the number of migrants from Shaanxi and Gansu to Xinjiang in 1759–1760. Our basis is a memorial to the throne from 1770, which reported on newly reclaimed land in the Barkol area of Xinjiang as follows: "A detailed inspection found that 30 civilian households had reclaimed land in the Dadun area, totaling 3,000 mu." This historical record indicates that each reclamation migrant household in the Barkol area reclaimed 100 mu of land. Given that the reclamation policies in 1770 were likely unchanged from those in 1759–1760, we can accordingly use the planned target area of newly reclaimed land in various regions of Xinjiang in 1760 to back-calculate the number of migrant households from Shaanxi and Gansu to Xinjiang in 1759–1760.

Meanwhile, land reclamation was also ongoing in the oasis areas of Gansu Province. As mentioned in our response to your first comment, the newly reclaimed land in the Hexi Corridor of Gansu Province achieved grain production increases in 1760. Based on the grain production of 82,346 dan from the newly reclaimed land in 1759–1760, and combined with the average grain yield per mu at the time, we can back-calculate the number of migrants required to reclaim this land.

However, two issues need to be addressed. First, we are currently determining the average yield per mu by consulting memorials to the throne, tax records, and other historical sources. In particular, newly reclaimed land that was still in the tax-exemption period may have incomplete records due to the tax exemption, requiring more detailed examination of historical sources. Second, because the policy at the time granted a three-year tax exemption for newly reclaimed dry land and a five- to six-year tax exemption for paddy fields, it is necessary to identify and exclude land that had been reclaimed before 1759 when estimating the newly reclaimed land in Gansu Province.

Because other reviewers have raised comments regarding the delineation of the study area, we are currently adjusting the description of the study area and the corresponding scope of historical material collection. At the same time, the above-mentioned work of identification, clarification, statistical analysis, and organization is ongoing, in order to present readers with the most rigorous and scientifically sound estimate of the number of migrants.

Third, in addition to government measures, how about the measure at the civil level? I think it would be better to include some discussions on this point from a bottom-up mode.

A: Comment accepted. Thank you for this suggestion. Because the historical sources previously used in this study are mainly official histories, which contain relatively few records at the civil level, the previous manuscript did not sufficiently demonstrate the disaster response behaviors of local communities.

In a collection of historical disaster records entitled Qing Dynasty Drought Archive Materials, we found that in the summer of 1759, in areas of northern Shaanxi such as Yulin and Yan'an, where crops had already died due to drought, farmers removed the dead crops and replanted with new autumn-harvest crops.

In the Lingzhou and Guyuan areas of Gansu Province, where wells had dried up due to drought, herders abandoned their high-altitude summer pastures—where water was difficult to obtain from dried-up wells—and moved to lower-altitude areas along riverbanks, even though summer was the season for grazing in the high mountains. Although this move resulted in some loss of livestock, it saved the herders' lives.

It is worth noting that at the civil level, drought directly threatened people's lives. However, in a traditional agricultural society, the means available to ordinary people for responding to drought were limited. As a result, their efforts after a drought tended to lean toward religious, sacrificial, and ritualistic practices such as praying. While consulting Qing Dynasty local chronicles of Ningxia in the library of present-day Yinchuan City (which was under the jurisdiction of Gansu Province at that time), we found that in 1760, farmers in the suburbs of Ningxia Prefectural City (present-day Yinchuan) built several river temples dedicated to the Yellow River. Ancient people believed that the Dragon King in the river could bring rainfall to the areas along the river; therefore, river temples were often used for rain-seeking rituals—prayers for humid climate conditions and bumper harvests. We are currently continuing to collect and organize similar information.