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Flood Disasters and Social Responses in the Gaoyao Region during Historical Periods

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Abstract: *By reviewing historical records of climate-related disasters in the Gaoyao region, analyzing the data, and classifying these records by severity, combined with qualitative research and quantitative analysis methods, this study examines the characteristics, impacts, and societal responses to climate-related disasters in the Gaoyao region during historical periods from multiple perspectives. The study found that climate-related disasters in the Gaoyao region during the historical period were primarily floods. The intensity of these floods and their socioeconomic impact showed a gradual increase, exhibiting cyclical and seasonal patterns, while the occurrence of floods was also characterized by instability and complexity.*

Keywords: *Climate Change; Flood Disaster; Social Responses*

1. Introduction

Climate change poses a major challenge to sustainable human development. As early as 1988, the United Nations Environment Programme and the World Meteorological Organization established the Intergovernmental Panel on Climate Change, and it has since become a consensus among most countries worldwide that humanity must work together to address climate change. Of course, climate fluctuations have always been a part of the history of the Earth and humankind. Studying climate change throughout history—particularly the history of how people have responded to climate-related disasters and the lessons learned from those experiences—holds significant value for our current efforts to address climate change. The impacts of climate change on humanity and societal responses have long been a focal point of academic research[1]; however, existing studies primarily focus on macro-spatial scales such as the global or national levels, while research examining societal responses to climate change at the county level remains relatively scarce. Historically, the Gaoyao region was frequently struck by various climate-related disasters, the most common of which were floods and droughts. Floods and droughts have a significant impact on people's livelihoods and daily lives, not only adversely affecting crop yields but also seriously threatening social stability and the safety of people's lives and property. This paper focuses on the Gaoyao region during historical periods and, by combining qualitative research with quantitative analysis, examines the characteristics, impacts, and societal responses to floods from multiple perspectives, with the aim of providing insights for our current efforts to address climate-related disasters.

2. Data Sources and Methods

To conduct an in-depth study and gain a better understanding of historical climate-related disasters in the Gaoyao region, the author has compiled several important disaster datasets, including Historical Records of Natural Disasters in Guangdong Province, Compendium of Three Thousand Years of Meteorological Records in China, Chronicle of Water Conservancy in Gaoyao County, and the Chronicle of Gaoyao County[2-5]. By integrating these sources, it is possible to reconstruct a relatively detailed sequence of climate-related disasters in the Gaoyao region during historical periods.

By carefully reviewing records related to floods, a chronological table of floods was compiled. The table includes attributes such as the year of the disaster, the time of the disaster, the disaster situation, and the disaster severity level. The "disaster year" refers to the year in which the disaster occurred; "disaster time" refers to temporal information such as the month and season of the disaster; "disaster circumstances" provide a specific description of the disaster conditions for that year; and "disaster severity level" is a rating assigned based on the extent of the disaster's impact. The classification of

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disasters by severity level is a fundamental approach in quantitative disaster research and holds significant value for deepening the study of disaster history; some scholars have even pointed out that "classifying historical disaster data by severity level is not only of great significance but also an urgent necessity."[6] The semantic information regarding disaster conditions reflects the basic circumstances of disasters in different years and serves as the primary basis for determining disaster severity levels. By comprehensively considering semantic information such as the duration of the disaster, its destructive power, and the extent of its social impact, disasters in the Gaoyao region during the historical period were classified into three severity levels: mild, moderate, and severe.

Disasters are the result of the combined effects of disaster-causing factors, the affected area, and the environment conducive to disasters; therefore, determining the severity of a disaster requires comprehensive consideration of multiple factors. For example, if the disaster report does not indicate consequences such as property damage or loss of life caused by flooding, it is generally classified as a minor flood, such as the "heavy rains" of 996. However, if the affected area is particularly extensive, it is classified as a moderate flood; for example, the 1842 disaster was described as "flooding everywhere downstream of Wuzhou," indicating a vast affected area. If the event results in significant property damage and loss of life, it is classified as a moderate flood; examples include the 1480 "flood that breached the Gaoyao embankment" and the 1536 "flood that damaged crops, with a bushel of rice costing 100 cash"; If the disaster caused relatively severe property damage, resulted in loss of life, or triggered serious social consequences such as famine, it was classified as a severe flood. Examples include the 1481 event described as "a major flood caused the levee to collapse, completely submerging the crops, leading to famine in June," and the 1535 event described as "a major flood destroyed the crops, leaving the people starving."

3. Floods in the Gaoyao Region Throughout History

Floods have been the most common and most devastating meteorological disasters in the Gaoyao region throughout history; ancient people already lamented, "We suffer from the rising waters of the West."[7] Historical records of floods are extremely detailed. By sifting through historical materials, we have compiled records of floods in the Gaoyao region spanning 144 years.

There are records of six floods prior to the Ming Dynasty, all of which occurred during the Song and Yuan periods. Of these, four took place during the fall and winter months—the ninth and tenth months of the lunar calendar—while only two occurred during the spring and summer. Although floods were more frequent in the fall and winter, they were generally mild and had little impact on local society. In contrast, while floods were less frequent in the spring and summer, they were all severe and had a significant impact. The flood of 1325 caused a certain degree of widespread famine, while the flood of 1350 was even more dangerous, featuring "river overflow" that caused significant natural and social disruption; famine became more widespread, and many people suffered from starvation. It is worth noting that, in order to withstand floods and safeguard agricultural production, the construction of levees in the Gaoyao region began to flourish after the second year of the Zhidào era of the Song Dynasty (996).[8] That year, Gaoyao constructed the Lanjiang, Jinxi, Luo'an, and Hengtong embankments, among others.[9] The construction of these embankments enhanced the people of Gaoyao's ability to withstand floods, while also having a profound impact on regional socioeconomic development and changes in the ecological environment.

There are records of 138 flood years in the Gaoyao region during the Ming, Qing, and Republic of China periods. Of these, 49 were recorded during the Ming Dynasty, 59 during the Qing Dynasty, and 30 during the Republic of China period. The frequency of floods in the Gaoyao region during the Ming Dynasty was 18%, during the Qing Dynasty it was 22%, and during the Republic of China period it was 79%. To further analyze the intensity characteristics of floods in the Gaoyao region during this period, the floods were classified into three levels—mild, moderate, and severe—based on the semantic characteristics of the disaster conditions. According to statistics, among the 138 flood-affected years from the Ming Dynasty to the Republic of China period, there were 32 years of mild flooding, accounting for 23.2% of the total; 60 years of moderate flooding, accounting for 43.5%; and 46 years of severe flooding, accounting for 33.3%. It is evident that floods in the Gaoyao region from the Ming Dynasty to the Republic of China period were predominantly moderate and severe.

Looking specifically at different dynasties, of the 49 years of flooding during the Ming Dynasty, 18 were classified as mild, 17 as moderate, and 14 as severe. Mild floods accounted for 36.7% of the total number of flood years, moderate floods for 34.7%, and severe floods for 28.6%; Of the 59 flood-affected

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years during the Qing Dynasty, 14 were classified as mild floods, 25 as moderate floods, and 20 as severe floods. Mild floods accounted for 23.7% of the total, moderate floods for 42.4%, and severe floods for 33.9%; Of the 30 flood years during the Republic of China period, there were 0 instances of mild flooding, 18 instances of moderate flooding, and 12 instances of severe flooding; moderate flooding accounted for 60% of the total number of flood years, while severe flooding accounted for 40%. It can thus be seen that from the Ming Dynasty to the Republic of China period, the proportion of mild floods gradually decreased, while the proportions of moderate and severe floods both showed an upward trend. This indicates that in the Gaoyao region, from the Ming Dynasty to the Republic of China period, the intensity of floods and their socio-economic impact gradually increased.

To analyze long-term trends in flooding in the Gaoyao region, index values of 1, 2, and 3 were assigned to mild, moderate, and severe flooding, respectively. Cumulative statistics were compiled in 10-year intervals to illustrate the trends in the flooding index in the Gaoyao region from the Ming Dynasty through the Republic of China period. From the perspective of overall trends, from the early 15th century to the first half of the 20th century, flood incidence in the Gaoyao region generally showed an upward trend. Although accompanied by fluctuations during this period, the upward trend in the flood index remained significant. Of course, fluctuations in flood conditions were very frequent during this historical period, with almost every decade exhibiting fluctuations of varying degrees, reflecting the instability and complexity of flood occurrence in the Gaoyao region throughout this historical period.

Based on flood trends and fluctuations, the occurrence of floods in the Gaoyao region from the Ming Dynasty to the Republic of China period is divided into four phases: the gradual increase phase (1400s–1480s), the phase of intensified fluctuations (1490s–1700s), the steady rise phase (1710s–1900s), and the phase of severe flooding (1910s–1940s). (1) During the 90-year period from the 1400s to the 1480s, there were 11 disaster years, with a flood occurrence rate of 12.2%, a cumulative flood index of 21, and an average flood index of 2.3 per decade; (2) During the 200-year period from the 1490s to the 1700s, there were 49 disaster years, with a flood occurrence rate of 24.5%, a cumulative flood index of 95, and an average flood index of 4.75 per decade; (3) During the 200-year period from the 1710s to the 1900s, there were 47 disaster years, with a flood occurrence rate of 23.5%, a cumulative flood index of 100, and an average flood index of 5 per decade; (4) During the 40-year period from the 1910s to the 1940s, there were 31 disaster years, with a flood occurrence rate of 77.5%, a cumulative flood index of 74, and an average flood index of 18.5 per decade.

Floods in the Gaoyao region exhibit cyclical patterns. During the Ming Dynasty, floods occurred approximately once every 5.6 years; during the Qing Dynasty, approximately once every 4.5 years; and during the Republic of China period, approximately once every 1.3 years. The flood cycle has become progressively shorter, and the frequency of floods has shown an increasing trend, with floods occurring more frequently. Floods in the Gaoyao region also exhibit seasonal patterns. From the Ming Dynasty through the Republic of China period, there were 126 years for which flood data included specific information on the season or month of occurrence—44 in the Ming Dynasty, 54 in the Qing Dynasty, and 28 during the Republic of China period. The data show that most disaster years included such timing information, providing strong support for our analysis of the seasonal characteristics of floods in the Gaoyao region during this period. Of these 126 disaster years, 1 occurred in spring, 1 occurred during the spring and summer, 103 occurred in summer, 4 occurred during the summer and fall, 15 occurred in fall, and 2 occurred in winter. Summer floods accounted for 82% of the total, while fall floods accounted for 12%. It can thus be seen that, historically, floods in the Gaoyao region were primarily concentrated in the summer and fall seasons, with summer floods being the most common, while floods in the spring and winter seasons were rare.

4. The Dangers of Floods and Societal Responses

Throughout history, the Gaoyao region has experienced frequent and severe floods, which have caused significant harm to society; the widespread occurrence of disaster chains has further exacerbated the complexity of disasters in the region.

First, floods disrupt the normal growth of crops and can even damage them. China is a major agricultural nation; people in most parts of the country rely primarily on agriculture for their livelihood. Agriculture is the main source of livelihood, and crops are the primary fruits of people's labor; crop losses can place severe economic strain on the population. In 1586, rainfall persisted from spring through summer. That year, more than 90 breaches occurred in the embankments, resulting in severe flooding that destroyed 8,652 qing of young crops. The flood of 1611 was even more severe: 3,080 hectares of

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farmland were submerged and rendered unproductive; some fields were buried by mudslides, and in some areas, both early and late rice crops rotted due to the flooding, forcing people to flee their homes. As crops were damaged, prices for grain and other commodities were significantly affected. Often, due to disasters causing crop damage and grain shortages, rice prices would experience sharp fluctuations. In 1848, excessive rainfall damaged crops, causing rice prices to soar.

Second, floods damage infrastructure such as levees, as well as various types of buildings. Generally, floods cause significant damage to levees. The flood of 1547 caused a breach of more than twenty zhang in the city's protective embankment; the flood of 1586 caused breaches in more than ninety sections of the embankment; in 1614, the embankment east of the city breached; in 1647, the embankments along the river completely collapsed; in 1784, the city's protective embankment breached over several zhang; in 1817, as many as eleven breaches occurred; in 1832, all the embankments breached; in 1833, twenty-one breaches occurred; in 1860, a breach flooded twenty-five wei of farmland; and in 1915, all the embankments in Gaoyao County collapsed.

Floods caused significant damage to buildings such as houses. Once a dike breached, damage to structures within the enclosed area was inevitable. The most common type of damage was to houses. The flood of 1506 caused "residences to collapse," while the flood of 1586 resulted in damage to as many as 21,759 homes. The great flood of 1611 caused "all civilian dwellings to be completely submerged," forcing people to flee their homes and seek shelter in the mountains. The flood of 1614 "swept away tens of thousands of farmsteads and dwellings." In 1630, floodwaters breached the city walls: "Water entered the city through the West Gate, destroying countless government and civilian dwellings." In 1668, "only one or two out of ten civilian dwellings remained standing." In 1701, "more than 26,600 dwellings were destroyed"; in 1784, "hundreds of thousands of government and civilian dwellings within the county collapsed"; in 1794, a major flood "destroyed 4,199 civilian dwellings"; in 1833, 10,000 civilian dwellings were destroyed; and in 1914, 3,000 to 4,000 houses collapsed in the Dawanwei area alone.

Third, floods can easily trigger famines, leading to severe social unrest and even loss of life and property. Disasters are the result of the combined effects of disaster-causing factors, disaster-prone environments, and disaster-affected entities. Traditional agricultural livelihoods are significantly affected by meteorological disasters and are relatively vulnerable; moreover, social security systems are not sufficiently robust. Consequently, if disasters are mismanaged or are particularly severe, they can easily lead to social crises. In 1325, 1350, 1480, 1481, 1506, 1521, 1553, 1769, 1779, and 1788, floods caused famines. In 1545, alternating floods and droughts, coupled with inadequate government relief efforts, led to the deaths of a large number of people; in 1586, floods caused 31 people to drown; and in 1915, the entire region suffered from flooding, which occurred at night, resulting in numerous drownings. Extreme meteorological disasters have severely disrupted social order.

Floods pose a tremendous threat to the livelihoods, daily lives, and even the lives of people in the Gaoyao region; throughout history, the region has also developed a number of proactive measures to cope with these disasters.

First, the extensive construction of dikes. There is a complex interplay between dike construction and changes in the regional environment. On the one hand, dikes help protect against flooding; on the other hand, as dikes expand, low-lying areas that could have served as water storage and regulation basins are reclaimed for farmland, causing river channels to become increasingly constricted, which in turn further exacerbates flooding. The construction of dikes in the Gaoyao region is closely linked to changes in the Pearl River Delta's hydrological environment. After the Tang and Song dynasties, as the alluvial plain in the lower reaches of the Pearl River Delta gradually expanded outward, the mouth of the Pearl River shifted further downstream. At the same time, the tributaries and channels of the Xi River gradually silted up and became blocked, leading to progressively higher floodwater levels in the Xi River and a corresponding expansion of its floodplain. To prevent flood damage, the Gaoyao region began constructing embankments as early as the Song Dynasty. By the end of the Yuan Dynasty, there were six completed embankments with a total length of 68.21 kilometers, protecting 121,100 shi mu of enclosed farmland; during the Ming Dynasty, the embankment system expanded further, and by the end of the Ming Dynasty, 21 embankments had been completed, with a total length of 187.9 kilometers, protecting 312,830 shi mu of farmland; by the end of the Qing Dynasty, 38 embankments of various sizes had been built, with a total length of 221.6 kilometers, protecting an area of approximately 352,700 shi mu of enclosed farmland; by the end of the Republic of China period, there were a total of 68 embankments of various sizes, with a total length of 282.76 kilometers, protecting 445,400 shi mu of enclosed farmland.[8]

Second, improving the city's drainage system. After the Zhaoqing prefectural city was rebuilt with brick walls during the Song Dynasty, it developed an inner and outer moat system designed for flood

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control and drainage.[10] Following renovations carried out by Prefect Huang Yu during the Tianshun era of the Ming Dynasty, a relatively comprehensive moat system consisting of the outer moat, inner moat, and western moat was established. The outer moat ran northward from outside the West Gate, encircling the city, then turned eastward across the North Gate Bridge, and finally headed south to the area outside the East Gate. The West Moat was located to the west of the city: "The water channel that draws river water from Shizui near the West Gate is called the West Moat; it served as a shelter for government vessels." [7] Since the West Gate was relatively close to the prefectural office, the West Moat was chosen as the mooring site for government vessels. Both the Outer Moat and the West Moat were located on the outer side of the city walls, while the Inner Moat was situated on the inner side. The Inner Moat was further divided into the Upper Moat and the Lower Moat. Starting from inside the West Gate, a small stream flows through a channel across South Gate Street and widens behind the Qing Military Guesthouse; this is called the Upper Moat. It then flows through a channel past Tangjitou Street and empties into the lower moat, where its width is considerably reduced; this is known as the Lower Moat. The Lower Moat also flows through a channel out of the city, connects to the Outer Moat, and reaches the Yangtze River. Tangjitou Street marks the dividing line between the Upper Moat and the Lower Moat.

The key to the Hao Dao's ability to control water lay in its use of water gates to regulate the water cycle—taking into account the topography and characteristics of the aquatic environment—thereby protecting the city from flooding. There were two water outlets: the East Outlet, located near the southeast corner of the city wall, connected the Lower Moat—part of the Inner Moat—to the Outer Moat; the North Outlet was situated near the west side of the North City Gate. The East Outlet was situated at a lower elevation, while the North Outlet was situated at a higher elevation. Under normal circumstances, water from the Inner Moat was primarily discharged into the Outer Moat through the East Outlet. However, during floods, the Eastern Outlet would experience backflow; therefore, it was necessary to "block the Eastern Outlet to prevent the intrusion of external water." As water levels in the Inner Moat and Tang'ao gradually rose, the water would flow northward through the northern channel of the Inner Moat, discharge through the Northern Outlet, and either flow into Shangnie Pond north of the city or be discharged via the Outer Moat. Should the Jingfu Enclosure's embankment breach, the only option would be to simultaneously seal off both the East and North Outlets, allowing the city walls to serve as a temporary levee to block the floodwaters and protect the city from inundation.[7] In 1614, when the moat embankment collapsed, the four gates of the prefectural city were closed to temporarily protect the area inside the city walls from flooding.

Third, government disaster relief and assistance. Once a disaster strikes, the government's capacity to respond to it will have a significant impact on the disaster's aftermath. Generally speaking, the government mitigates the aftermath of disasters primarily through emergency response and rescue operations, tax exemptions, and relief for disaster victims.

First, emergency relief efforts were promptly organized. In 1547, severe flooding in Gaoyao caused a crack more than twenty zhang long in the city's protective embankment, resulting in a breach. The situation was extremely critical, but Prefect Hu Chun promptly mobilized laborers and personally supervised the conscripted workers in plugging the breach, successfully averting the crisis. In 1563, heavy flooding caused several dams to burst, and the Caowan embankment surrounding the city was on the verge of collapse, threatening the safety of the prefectural capital. Prefect Zou Guangzu stood on the embankment and managed to stop the breach.[11]

Second, depending on the extent of the damage, taxes were either waived or deferred. In 1506, to address the decline in grain production caused by flooding, the government exempted the affected areas of Gaoyao from grain taxes. In 1529, due to alternating floods and droughts in Gaoyao, half of the taxes were waived. In 1694, taxes corresponding to the flood-affected areas were waived. In 1714, the collection of overdue taxes was deferred due to severe flooding. In 1725, an imperial edict ordered the remission of taxes and grain levies in the disaster-stricken areas.

Third, he actively provided relief to disaster victims. In 1535, severe flooding triggered a famine; Dai Jing, the Chief Censor, organized relief efforts that saved the lives of a large number of people. In 1545, due to consecutive years of floods and droughts, grain prices soared to 150 qian per dou; the government's relief efforts were inadequate, and many common people starved to death. It was not until Censor Chen Chuxiu ordered the release of grain from the granaries for relief that the crisis was gradually resolved. In 1553, a flood triggered a famine, with the price of rice reaching 140 qian per dou, and "all counties provided relief." In 1616, numerous levees in the Gaoyao region burst. Governor-General Zhou Jia-mo and Circuit Censor Tian Sheng-jin submitted a memorial requesting the remission of taxes; they also donated 10,000 taels from public funds to repair the breached levees, thereby alleviating the burden on the affected populace.

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During the late Qing Dynasty, social relief efforts—such as disaster relief—began to specialize, leading to the emergence of dedicated institutions like charity halls. In the 12th year of the Guangxu reign, the Guangshan Hall was established in the Gaoyao area, located on Dongmen Street outside the city walls. In the 24th year of the Guangxu reign, the Ren'ai Charity Hall was founded on Dongmen Street; it was later merged into the Guangshan Hall. During the Guangxu era, Guangli Market also had a Tongshan Hall, founded with donations from local merchants. Each year, local dignitaries were invited to reside at the hall to deliver lectures; the hall also provided free medical care and coffins. In times of famine or crop failure, the hall would call on the community to donate funds to organize grain distribution at stable prices.[12]

Fourth, promote the development of storage facilities. Disasters arise from the combined effects of disaster-causing factors, a disaster-prone environment, and the affected entity. If the affected entity possesses strong disaster management and control capabilities, the impact of disasters on society can be significantly mitigated. The effective development of storage facilities is a key means of enhancing the affected entity's resilience against the effects of disasters. As early as the Song Dynasty, the renowned statesman Bao Zheng established the Fengji Granary on Rice Granary Alley; during the Ming Dynasty, Prefect Bu Congxin relocated it to the east side of the prefectural seat. To enhance resilience against famine, the government in the early Ming Dynasty required local authorities to construct granaries: "In the early years of the Hongwu era, an edict was issued ordering all counties nationwide to each establish four reserve granaries, where officials would purchase and store grain to prepare for relief efforts. Local elders of proven integrity were selected to manage them."[13] During the Ming Dynasty, six Changping Granaries were built in the Gaoyao region: "One was located west of the prefectural office, on the site of the former Dongyue Temple, built by Prefect Huang Yu during the Chenghua era; one was in Ying'en Lane east of the city, built by County Magistrate Li Jin in the fifth year of the Zhengtong era, later abandoned, and rebuilt by County Magistrate Sun Zhen in the seventh year of the Chenghua era; one in Lulu Village, Liantang District; one on Chayuan Gang, Hengcha District; and one on Qingyu Gang, Shangcangbu—all built by Sun Zhen in the seventh year of the Chenghua era; one was east of Songtai Academy, on the site of the former postal relay station, built by Deputy Prefect Ma Xiang in the ninth year of the Chenghua era and later merged with the granary to the right of the City God Temple." However, by the end of the Ming dynasty, all the granaries had fallen into a state of severe disrepair. It was only through the financial contributions of Lingxi Circuit Commissioner Wang Daoyuan, Prefect Lu Ao, and Deputy Prefect Shi Yanxu—who donated their salaries to fund the project—that they were rebuilt and restored.

The Qing Dynasty's grain storage system was even more sophisticated. In addition to continuing the use of the Fengji Granaries and Changping Granaries from previous dynasties, new storage facilities such as the Zhaofeng Granary, county granaries, and village granaries were also established. The Zhaofeng Granary was located slightly east of the main gate of the prefectural office; originally a prefectural granary, it was transferred to county administration in the seventh year of the Jiaqing reign. The county granaries were located within the county government compound and consisted of three sites: the East Granary, the West Granary, and the Granary Tower behind the compound. The East Granary had one bay, the West Granary had two bays, and the Granary Tower had six bays. The number of Changping granaries increased during the Qing Dynasty. In addition to retaining the 13 granaries originally established during the Ming Dynasty, seven more were gradually added. In the twenty-first year of the Jiaqing reign, County Magistrate Chen Wenbing constructed six granaries—Zhengde, Liyong, and Shousheng—to the east of the county office, as well as one Zeng-character granary and one granary pavilion to the west, along with a passageway connecting the east and west granary gates. There were three community granaries: one was located in the prefectural city and was converted from a disused deputy magistrate's office in the twenty-first year of the Qianlong reign; the other two were situated next to the Hengcha Office.[13]

Management of grain storage became even stricter during the Qing Dynasty. In the third year of the Yongzheng reign, "it was approved that in Guangdong, prefectures, counties, and towns with large amounts of grain stored in public granaries should open their granaries to sell grain at a fixed price, and immediately use the proceeds to purchase grain from counties and towns with insufficient stocks for storage; any shortfalls were to be strictly investigated and made up." This regulation helped regulate grain prices across different regions and replenish the grain reserves of counties and towns with insufficient supplies. In the twenty-fifth year of the Qianlong reign, it was stipulated: "Grain in the community granaries of Eastern Guangdong shall continue to follow the old practice of being borrowed in the spring and repaid in the fall. Beginning in the twenty-fifth year of the Qianlong reign, an interest of one dou per shi shall be added. After verifying the proportion of grain collected, exemptions shall be granted accordingly; furthermore, expenses such as grain losses due to natural wear and tear and losses from inventory checks shall all be drawn from the interest grain. The remaining interest grain shall be

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verified against the county's grain donation quota; if the quota is 5,000 shi or more, it shall be sold and remitted for storage in accordance with the practice in Western Guangdong, to be used for local relief efforts. If the original quota falls short of 5,000 shi, the remaining interest shall be incorporated into the quota grain to supplement reserves. "By lending grain at interest, the Village granaries not only helped grassroots communities weather economic hardships by borrowing grain at low prices but also ensured the granaries' continued operation. If substantial interest revenue was generated, it could further serve as a reserve for local relief efforts. The village granaries were managed by the village head and deputy head; if they failed to manage them properly, They would be held liable for compensation. In the 49th year of the Qianlong reign, the village granary under the jurisdiction of the Hengcha Bureau was flooded. The village head and deputy village head were required to compensate at a rate of eight qian and six fen per shi; the total amount was 834 taels and 7 fen, 2 li. Of this, 510 taels and 3 fen, 6 li were remitted to the prefectural treasury for transfer to the Provincial Administration Bureau, while 324 taels and 3 fen, 6 li were retained in the prefectural treasury.

5. Conclusions

Throughout history, climate-related disasters in the Gaoyao region have primarily taken the form of floods, though the impacts of droughts, windstorms, insect infestations, and hailstorms triggered by abnormal weather conditions cannot be overlooked. Specifically, the severity of floods and their socioeconomic impact have shown a gradual increase, exhibiting cyclical and seasonal patterns; the occurrence of floods is also characterized by unpredictability and complexity. Climate-related disasters affected crop yields, damaged infrastructure, and triggered famines, thereby disrupting social order. In response, county-level societies took proactive measures such as constructing water conservancy projects, improving urban drainage systems, building storage facilities, and providing disaster relief.

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