Further Investigations of The Famine in Yunnan Province, China, from 1815 to 1817: Factors Other Than Climatic Issues

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1. Introduction and state of art

The 1815 Mount Tambora eruption in Indonesia led to low temperatures and snow disasters in many provinces of China, including Yunnan, Guangxi, Guangdong, Fujian, Shanxi, Jiangxi, Shandong, Hebei, and Jilin. However, Yang et al., Cao et al., and Gao et al. have indicated that Yunnan suffered from the most severe harvest failures and famines from 1815 to 1817.[3]

The REACHES database created by Wang et al. provides data on social events due to weather shocks in China from *A Compendium of Chinese Meteorological Records of the Last 3000 Years*. It provides evidence of the number of harvest failures recorded in local chronicles in Taiwan and China in 1815–1816. Specifically, the dark purple area of Figure 2 demonstrates that 49 harvest failures were recorded in Yunnan Province in 1815–1816 (Figures 2).[4]

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[3] Yang, Y-D, Man, Z-M, Zheng, J-Y, 'A Serious Famine in Yunnan (1815-1817) and the Eruption of Tambora Volcano,' *Fudan Journal (Social Sciences)* **1** (2005): 79-85. Trigo, R., Vaquero, J., Alcoforado, J. et al., 'Iberia in 1816, The Year Without A Summer,' *International Journal of Climatology* **29** (2009): 99-115. Kozak, J. and Cermak, V. *The Illustrated History of Natural Disasters* (Berlin: Springer Nature, 2010), pp.103-105. Cao, S-J, Li, Y-S, Yang, B. 'Mt. Tambora, Climatic Changes, and Chin's Decline in the Nineteenth Century,' *Journal of World History* **23** (3) (2012): 587-607. C. Washington, 'Review of *Tambora: The Eruption that Changed the World*, by Gillen DArcy Wood,' *Studies in Romanticism* **54** (1) (2015): 127-131. Gao, C., Gao, Y., Zhang, Q. and Shi, C-M 'Climatic Aftermath of the 1815 Tambora Eruption in China,' *Journal of Meteorological Research* **31** (1) (2017): 28-38.

[4] Zhang, D-E. *A Compendium of Chinese Meteorological Records of the Last 3000 Years*. (Nanjing: Phoenix Publishing House, 2004). Wang, P-K, Lin, K-H. E., Liao, Y-C et al, 'Construction of The

Figure 1. The locations of Yunnan, Guangdong, and Fujian provinces of China and Taiwan.[5]

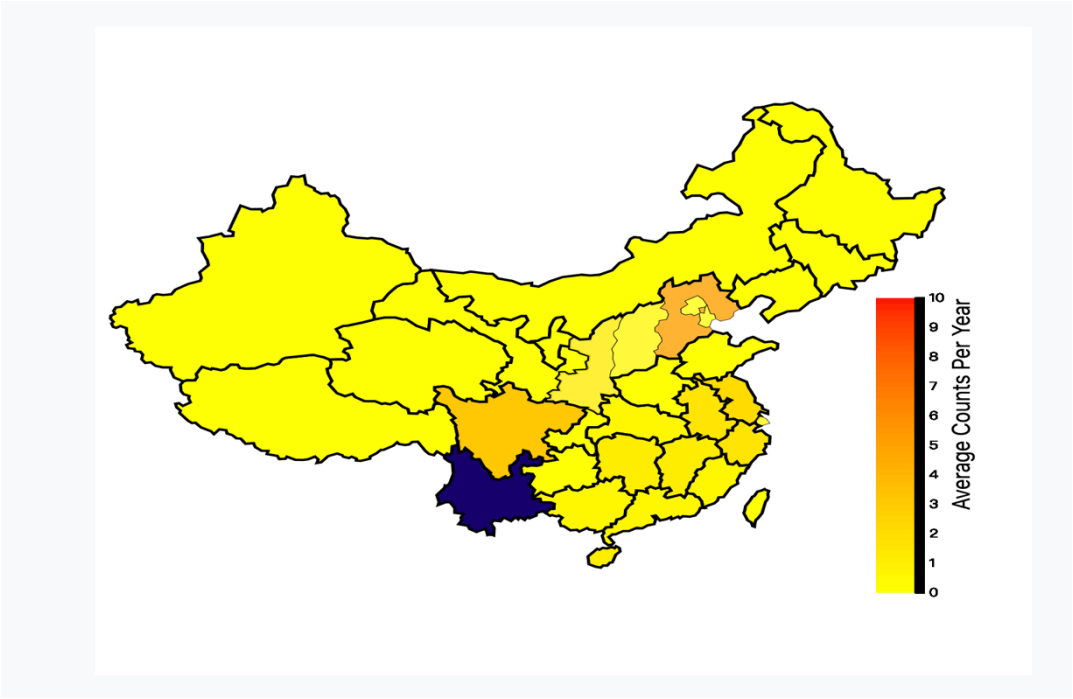

Figure 2. Number of primary sources recording famine in 1815–1816 in China and

REACHES Climate Database Based on Historical Documents of China,' *Scientific Data* **5** (2018): 180288..

[5]https://www.google.com/maps/place/China/@27.9647575,99.8489576,4.95z/data=!4m6!3m5!1s0x31508e64e5c642c1:0x951daa7c349f366f!8m2!3d35.86166!4d104.195397!16zL20vMGQwNXcz?hl=en&entry=ttu&g_ep=EgoyMDI1MDgxOS4wIKXMDSoASAFQAw%3D%3D

Taiwan.[6]

Second, past literature, including case studies in Europe from the fifteenth to the eighteenth centuries, has proven that low temperatures and high precipitation negatively impact agricultural production. However, adaptation measures like the development of grain varieties resilient to low temperatures can sustain the harvest conditions. In addition, factor endowments, including labor, land, capital, and institutional frameworks are causal to the area's agricultural production with long-term economic development; for instance, because China was a labor-abundant country, its economic development heavily relied on labor-intensive agricultural production before the twentieth century.[7]

Hence, this study investigates factors other than climatic issues that led to adverse harvest failures and famine in China's Yunnan Province from 1815 to 1817.

2. Methodology

The research used first-hand accounts derived from the local chronicles sorted by

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[6] Zhang, *A Compendium of Chinese Meteorological Records of the Last 3000 years*. Wang, Lin, Liao et al., 'Construction of the REACHES climate database based on historical documents of China,' 180288.

[7] Rybczynski, T.M., 'Factor Endowment and Relative Commodity Prices,' *Economica* **22** (88) (1955): 336-341. Leamer, E.E. *Sources of International Comparative Advantage: Theory and Evidence* (Cambridge, MA: MIT Press, 1984). Ohlin, B. *Interregional and International Trade* (Cambridge, MA: Harvard University Press,1933). Helpman, E., 'The Structure of Foreign Trade,' *Journal of Economic Perspectives* **13** (1999): 121–144. Grigg, D. *The Dynamics of Agricultural Change: The Historical Experience*. (Routledge: London, 1982). Gallup, J., Sachs, J., and Mellinger, A.,'Geography and Economic Development,' *International Regional Science Review* **22** (1999): 179–232. Acemoglu, D., Johnson S. and Robinson, J.A., 'The Colonial Origins of Comparative Development: An Empirical Investigation,' *American Economic Review* **91 (**5) (2001): 1369–1401. Engerman, S. and Sokoloff, K. 'Factor Endowments, Inequality, and Paths of Development among New World Economics,' *National Bureau of Economic Research, Inc, NBER Working Papers* **3** (2004). Karlen, S., Andrews, S.S., and Wienhold, B.J., 'Soil Quality, Fertility and Health– Historical Context, Status and Perspectives,' *Managing Soil Quality: Challenges in Modern Agriculture* (2004): 17–33. Mehlum, H., Moene, K.and Torvik, R.,'Institutions and The Resource Curse,' *The Economic Journal* **116** (508) (2006): 1-20. Deng, K. *China's Political Economy in Modern Times: Changes and Economic Consequences, 1800-2000* (Routledge: London, 2012). Ashraf, Q. and Michalopoulos, S.,'Climatic Fluctuations and The Diffusion of Agriculture,' *The Review of Economics and Statistics* **97** (3) (2015): 589–609. Barbier, E.B. *Scarcity, Frontiers and The Resource Curse: A Historical Perspective. In Natural Resources and Economic Growth*. (Routledge: London, 2015), pp. 54-76. Sofo, A., Zanella, A., and Ponge, J-F., 'Soil Quality and Fertility in Sustainable Agriculture, with A Contribution to The Biological Classification of Agricultural Soils'. *Soil Use and Management* **38** (2) (2021): 1085–1112. Waldinger, M., 'The Economic Effects of Long-Term Climate Change: Evidence from the Little Ice Age.' *Journal of Political Economy* **130** (9) (2022).

Yang et al.—namely the *Chuxiong Xian Zhi, Dengchuan Xian Zhi, Yaozhou Zhi, Yunnan Tong Zhi, Dayao Xian Zhi,* and *Dinyuan Xian Zhi*. These chronicles recorded weather anomalies with the resulting harvest failures and famine among residents from 1815 to 1817. They also recorded the institutional operation and factor endowments of the agricultural sector.[8]

3. Analysis

The descriptive data on crop yields and prices, along with famine information in Yunnan from 1815–1816, were largely inaccessible. Only limited results could be obtained based on records of soaring grain prices.[9] Therefore, the severity of the famine remains inconclusive.

Moreover, a significant limitation was encountered when attempting to acquire data regarding casualties and labor productivity following the harvest failures and famine in Yunnan in 1815–1816. No relevant records were found in the local chronicles. Although Wirakusumah and Rachmat stated that "thousands of people died" because of this event, they failed to indicate their sources.[10]

Possible explanations are as follows: First, the authors of the local chronicles collected socioeconomic records from local communities and published them in the chronicles. The period usually ranged from decades to hundreds of years, leading to the inadvertence of the crop yield data, specifically from 1815 to 1817. In addition, as derived from *Dayao Zian Zhi* and *Yaozhou Zhi*, Yunnan's location is in the southwest

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[8] Su, M-H *Chuxiong Xian Zhi* (楚雄縣志), 1818. Hou, Y-C and Shen, C-E *Dengchuan Xian Zhi* (鄧川縣志), 1851. Lu, Z-Z. *Yaozhou Zhi* (姚州志) 1885. Chen, T. and Chen Y-I. *Yunnan Tong Zhi* (雲南通志) 1895. Liu, R-F and Xun L. *Dayao Xian Zhi* (大姚縣志) 1904. Wang, Y., Fan Y-Y, and Jiang, Y-F. *Dinyuan Xian Zhi* (定遠縣志). Yang, Man, Zheng, 'A Serious Famine in Yunnan (1815–1817) and the Eruption of Tambora Volcano,' 79–85.

[9] 斗米一千八百文，民有食僅土者，多由之死。嘉慶楚雄縣志，卷一。風批無收，斗米數千錢，民餓死者眾。 光緒姚州志，卷十一。嘉慶二十一年，大飢，斗米三兩。飢者食草根、樹皮、土粉，疫死者多。大姚縣志，卷四。

[10] Wirakusumah, A.D. and Rachmat, H., 'Impact of the 1815 Tambora Eruption on Global Climate Change,' *IOP Conference Series: Earth Environmental Science* **71** (2017), no. 012007.

of China, which features many mountains and cliffs; thus, government officers could not easily access quantitative information about the province's agricultural sector and relevant social issues.[11] A major limitation here is that the qualitative records in the chronicles were still abundant; hence, whether the aforementioned geographical barriers were the reasons for the lack of data requires further examination.

Nevertheless, primary sources and the evidence from REACHES indicated that the number of famines was the highest from 1815 to 1817. Thus, Yunnan was the area with the most severe agricultural losses and famine (Figure 2). In addition, the local chronicles analyzed in this study were published in the nineteenth century and, to a lesser extent, in the early twentieth century. The records regarding the famine and harvest failures in Yunnan from 1815 to 1817 were consistent.

The results suggest that institutional inefficiency could have existed in Yunnan. The local authorities had been granting proxy rights to military troops to collect taxes from farmers regardless of the harvest conditions. Those who could not afford the tax payments had no choice but to pawn their lands to the troops.[12]

Additional factors contributing to variations in agricultural production between Yunnan and other Chinese provinces in 1815–1816 included disadvantageous capital resources and reduced resilience of crops to low temperature anomalies. First, Yunnan's agricultural sector relied on an outdated irrigation system and required intensive labor participation. There was no record of the acceleration in capital accumulation after the climatic shocks. Second, despite the varieties of produce and

[11] 蜻蛉舊地，龍馬高峰，沙逶迤，伏莽無憂。王屏重開，金沙足恃，扼要西北，足當藩籬。煙羅森列，龍馬奔騰，儲書案山之英，納蜻蛉河之秀。蕞爾彈邑，明秀可稱。

[12] 按糧派兵，人民逃竄。光緒姚州志，卷三。籲天府從民便等事，案內仍照額征舊冊造報定案。其各里伍內之逃絕無主田地，責令里長招佃收租納糧。查納租納糧之數，多量少。而當日不令佃民納糧，而令里長收租者，因有久荒未墾、有糧無田、及朋納不敷、無著錢糧，責成里長完辦故也。光緒姚州志，卷三。各里各伍內，查有逃絕田地稍腴者，責令里長收租代納，某人充當里長，及以某人為納戶，以租息之餘，補額徵之不足。此亦權宜通融之法。其現戶錢糧，亦係里長包收代納，額外科派，不一而足。相沿日久，深為民累。

rice, no evidence suggests that the soil quality and grain varieties could have been resilient to low temperatures. Moreover, there was no evidence indicating the cultivation of substitute produce that could be grown during periods of low-temperature anomalies.[13]

4. Conclusion

These findings imply that modern governments should respond quickly to adverse weather by introducing policies to overcome and mitigate its influence on agricultural production. In addition, public finance budgets should be used to improve the capital resources of the agricultural sector when encountering climatic shocks. Finally, when the agricultural sector does not possess the features of resilience and adaptation utilizing the factor endowments to climatic shocks, along with the institutional inefficiency and lack of grain varieties sustaining the adverse weather, harvest failures and famine conditions can occur among the residents.

[13] 紅毛稻，白毛稻，光頭稻，長毛稻。大姚縣志，卷三。大麥，小麥，玉麥。大姚縣志，卷三。胡豆，黑豆，黃豆，蠶豆，飯豆，紅豆，碗豆。大姚縣志，卷三。蔬之屬，舊志十六種，芹，菁，韭，莧，芥……大姚縣志，卷三。