

“PEOPLE SAID THAT  
EXTINCTION WAS NOT  
POSSIBLE”:

THE ECOLOGICAL CONSEQUENCES  
OF LAND CLEARANCE

Opening the hills of Lingnan to cultivation by peasant families was made possible not simply by state policies favoring the development of “scattered plots,” but also by New World foods that thrived in dry, hilly land and, where feasible, by irrigation techniques mastered over the centuries. Then, encouraged by the state and armed with new crops and tried-and-true irrigation technologies, settlers headed for the far corners of Lingnan. Peasant-farmers had long tilled the river valleys in northern and northeastern Guangdong, but the record of new dams and reservoirs in the second half of the eighteenth century (to be discussed later) chart additional penetration there,<sup>1</sup> while in Guangxi an official stated in 1751 that in the western highlands under his jurisdiction (Sicheng, Zhen’an and Si’en prefectures along the Zuo River), “all the river valleys have received irrigation and all the hills planted with dry rice.”<sup>2</sup> And in 1752, Guangdong Governor Suchang noted that “the poor in the hills of eastern Guangdong all plant sweet potatoes and miscellaneous crops (*za liang*).”<sup>3</sup>

*New World Crops*

As Governor Suchang makes clear, by the middle of the eighteenth century New World food crops had become an important part of the peasant-farmer’s basket of crops. In addition to sweet potatoes, peanuts, maize, and tobacco, all had been brought to China in the sixteenth century by the New World traders who sought silks and porcelains for the European market. And the record is clear that peasant-farmers quickly introduced these new crops into their rotation. In the early sixteenth century, peasant-farmers in the Jiangnan region were planting peanuts, and by the last quarter of that century, peasants

<sup>1</sup> The history of waterworks will be taken up in more detail later in this chapter.

<sup>2</sup> Memorial dated QL16.11.3, in QLCZZ 1: 836.

<sup>3</sup> Memorial dated QL17.11.8, in QLCZZ 4: 251-53.

Clearly, much land had to have been deforested in the process, as we will see in the next chapter. One can only wonder whether the outcome would have been different had the policies of the Yongzheng emperor been followed instead.

As it was, with the population continuing to grow in the nineteenth century and the limits of cultivable land in Guangdong reached by 1850, a critical point had been reached. How much more intensely could the land be farmed to sustain a growing population? Without modern inputs, in particular of chemical fertilizers and insecticides, how much more could yields be raised? With the technologies then available, how many more people could the land sustain?

To people living on ever-smaller plots of land, though, those were not the questions. For them, with the extent of cultivable land in Guangdong reached by midcentury, with farming techniques as developed as possible, and with yields stagnating, the question became one of obtaining more land at the expense of one’s neighbors. Thus, fights between neighbors over land, water, and hills with trees became endemic in Lingnan<sup>97</sup> by the middle of the nineteenth century, contributing to the lineage conflicts and feuds that so distinguished the region,<sup>98</sup> to the conflict between Hakka and Punti (*kejia* and *bendi*, “guests” and “natives”), including the rise of the Taipings in Guangxi province,<sup>99</sup> to the rise of secret societies and sworn brotherhoods,<sup>100</sup> and to the mass uprisings in the 1850s.<sup>101</sup> Given the importance of Lingnan in China’s modern (i.e., post-Opium War, ca. 1850) history, I think that the connections between the emerging ecological crisis and the various social movements that originated there are more than coincidental, but making that case is beyond the scope of this book. Suffice it to say here that with population densities in Guangdong increasing from about 60 to 105 persons per square kilometer over the century from 1750 to 1850, many people began developing survival strategies that did not include just farming the land. But the hunger for land affected not merely human relations with other humans. For the clearance of land in the eighteenth and nineteenth centuries precipitated crises for other species as well.

<sup>97</sup> For examples in eastern Guangdong, see Marks, *Rural Revolution in South China*, 60-75.

<sup>98</sup> See Harry Lamley, “Hsieh-tou: The Pathology of Violence in Southeastern China,” *Ch’ing shih wen-l’i* 3 (1977): 1-39.

<sup>99</sup> See Jen Yu-wen, *The Taiping Revolutionary Movement* (New Haven: Yale University Press, 1973).

<sup>100</sup> See Robert Antony, *Pirates, Bandits, and Brotherhoods: A Study of Crime and Law in Kwangtung Province, 1796-1839* (University of Hawaii, Ph.D. dissertation, 1988).

<sup>101</sup> See especially Frederic Wakeman Jr., *Strangers at the Gate: Social Disorder in South China, 1839-1861* (Berkeley and Los Angeles: University of California Press, 1966).

planted maize in Yunnan and Henan, about the same time that sweet potatoes were being planted in Fujian and Guangdong.<sup>4</sup>

The earliest record of sweet potatoes in Lingnan comes from an entry in the Dongguan county gazetteer in 1580, when one Chen Wen brought back some sweet potatoes from Annam (present-day Vietnam). Another source dates the introduction of sweet potatoes in Chaozhou prefecture to 1584. Whatever the exact date was, it clearly was in the late sixteenth century; within a very short period of time thereafter, sweet potatoes were planted throughout Guangdong province. By the late seventeenth century it was reported, "Sweet potatoes are planted everywhere."<sup>5</sup> In contrast, maize, according to Qu Dajun "is not eaten much in Lingnan."<sup>6</sup>

Given the importance of the cultivation of maize both to patterns of migration and environmental change in the hills south of the Yangzi River,<sup>7</sup> its absence in Lingnan is curious. Several observers have offered their explanations, mostly extolling the virtues of sweet potatoes. According to Qu Dajun writing around the turn of the eighteenth century, "The sweet potato has recently been introduced from Luzon. It is very easy to grow, the leaves can be used to fatten pigs, the roots can be fermented into liquor, and they can be dried and stored. In Zidanchengjia (?) where there are many people over 100 years old, they do not eat the five grains but only sweet potatoes."<sup>8</sup> The sweet potato grew rapidly, and in times of harvest failure, according to Xu Guangqi, the author of the late-seventeenth-century *Nong zheng chuan shu*, it "can be used for famine relief."<sup>9</sup> Finally, the sweet potato was a high-yielding crop, producing as much as 10 *shi* per *mu*, a yield exceeding nearly all other crops: "A family with one *mu* can be sustained with one harvest of sweet potatoes."<sup>10</sup> According to Guo Songyi, a modern historian, the reason for the differential acceptance of maize and the sweet potato in Lingnan was threefold: the sweet potato had many uses, it was easy to plant, and it had a high yield.<sup>11</sup> All of these could also be said about maize, so perhaps American corn simply was more unpalatable to the south Chinese than even the sweet potato.

Besides, planting sweet potatoes required "no fertilizer" and "little labor" and they could be planted in hilly, sandy, and dry soil that had little or no other use.<sup>12</sup> In the sugarcane-growing and silk districts, this attribute of the sweet

<sup>4</sup> The classic article on the subject is Ping-ti Ho, "The Introduction of American Food Plants into China," *American Anthropologist* 57 (1955): 191-201.

<sup>5</sup> Sources cited in Chen Shuping, "Yumi he fanshu zai Zhongguo juanfan qingkuang yanjiu," *Zhongguo shehui kexue* 3 (1980): 193-95.

<sup>6</sup> Qu, *Guangdong xin yu*, juan 14.

<sup>7</sup> See Anne Osbourne, "The Local Politics of Land Reclamation in the Lower Yangzi Highlands," *Late Imperial China* 15, no. 1 (June 1994): 1-46.

<sup>8</sup> Quoted in Guo Songyi, "Yumi, fanshu zai Zhongguo juanfan zhong de yi xie wenti," *Qingdai luncong* 7 (1986): 96.

<sup>9</sup> Quoted in *ibid.*, 97. <sup>10</sup> Quoted in *ibid.*, 102.

<sup>11</sup> *Ibid.*, 96. <sup>12</sup> Quoted in *ibid.*, 102.

potato was especially noteworthy, for it meant that it did not compete with other crops for land. With increasing demand for sugar, fruits, or silk, peasant-farmers could convert rice paddy to those purposes and simultaneously plant sweet potatoes on previously marginal land, as was the case around the town of Shilong, a fruit and sugar center.<sup>13</sup>

Where sweet potatoes supplemented the diet of the relatively poor, peanuts were a cash crop, sold in the market to pressers for their oils. The peanut shells were then fed to pigs, dumped into fish ponds, or spread as fertilizer on the sugarcane fields. And also unlike sweet potatoes, peanuts actually improved the fertility of marginal soils by fixing nitrogen in the soil.

Tobacco was different from all of the other New World crops. Not only was it a purely commercial crop that could not be eaten; its nutrient demands exhausted the soils. And also unlike sweet potatoes and peanuts, which peasant-farmers in the late sixteenth century clearly had adopted, tobacco was slow to spread in Lingnan, becoming significant only in the eighteenth century. Because of its high market value, tobacco was eminently suited for the scattered plots opened under the Qianlong emperor's land reclamation policy of the 1750s. According to the 1819 edition of the Nanxiong gazetteer, tobacco began to be planted "40 or 50 years ago . . . The profit obtained is much greater than rice. But the tobacco is all planted on the hill tops. As soon as the land is opened, the soil deteriorates and erodes. Any heavy rain silts the rivers and there is fear of imminent flooding. But because of the large profit it is tolerated. The locals [now] are forbidden to open any new land so as to correct the situation."<sup>14</sup>

### *Ecological Consequences of Land Clearance*

The brief entry in the Nanxiong gazetteer highlights two of the most significant ecological impacts of opening hill lands for cultivation: deforestation followed by increased erosion, and siltation of riverbeds. From the northernmost edge of the Lingnan drainage system, silt from newly opened land planted with tobacco or sweet potatoes flowed downstream, past the Sang Yuan Wei levee at the beginning of the Pearl River delta. And just as the Yuan- and Ming-era pioneers in the delta captured the silt to create the *shatan* fields, so too in the eighteenth century did the silt provide the raw material for adding more *shatan* to the delta. This time, though, the new *shatan* did not just extend the cultivated land area, but began to obstruct the flow of water through the delta, increasing the danger of flooding.

Records of serious floods in 1694 and 1743 showed that while *shatan* existed then, they had not impeded the river.<sup>15</sup> But in 1751, when the governor of

<sup>13</sup> Qu Dajun, quoted in Chen, "Yumi he fanshu," 202.

<sup>14</sup> *Nanxiong zhouzhi*, 1819 ed., juan 9: 35a. <sup>15</sup> Peng, *Qing dai tudi kaiken shi*, 168.

Guangdong province, Suchang, investigated the condition of water flow in the Pearl River delta channels, he concluded that half of the 38 *shatan* dikes in Nanhai, Panyu, and Shunde counties so obstructed the river that he ordered them destroyed. Despite the probable destruction of the offending *shatan*,<sup>16</sup> construction of new ones continued. Finally, in 1765, a year after serious flooding destroyed embankments throughout the delta but especially in Nanhai county, the governor prohibited new construction of *shatan*, prompting greater vigilance of the dikes in the years afterwards. In early 1769, the governor memorialized that "the three prefectures of Guangzhou, Zhaoqing, and Chaozhou all have diked fields (*wei tian*). In the summer and fall, flood waters are held in check by the *wei tian* dikes. During the agricultural slack season, I have ordered district officials to lead owners and tenants in cooperative efforts to strengthen and raise the level of the dikes."<sup>17</sup> Despite concern about flooding, the ban was rescinded three years later on the condition that new *shatan* not obstruct the river,<sup>18</sup> but the condition was not met. By the early nineteenth century, so much *shatan* had been created on both sides of the channel in an area called Wan Ding Sha separating Dongguan from Xiangshan county that gentry leaders from each side fought over which county the *shatan* belonged to, each hoping to secure the rents. Officials split the land between the two counties, awarding 67,000 *mu* to Dongguan.<sup>19</sup>

### Water Control and Irrigation

As will be recalled from Chapters 2 and 3, the construction of waterworks in Lingnan had begun in Tang and Song times and continued in the Ming. In the Qing, most of the earlier waterworks were maintained, while the eighteenth-century expansion of population and cultivated land area saw a new building spurt. The construction of the new waterworks did not merely accompany the development of the new land brought into cultivation during the eighteenth century, but in many cases was a condition for transforming land from "waste" into agricultural uses. The Pearl River delta *shatan*, of course, simply would not have existed without embankments; but fields elsewhere in Lingnan too required waterworks either to protect them from flooding or to provide the regular source of water required for wet-rice cultivation. Still other places needed reservoirs to enable peasant-farmers to

<sup>16</sup> Given the wealth and power of the *shatan* owners, Suchang's actions no doubt caused significant turmoil, but because most state memorials from the first 17 years of the Qianlong reign have been lost, the story cannot be told.

<sup>17</sup> Memorial dated QL33.11.14, in QLCZZ 32: 486.

<sup>18</sup> *Nanhai xianzhi*, 1835 ed., juan 16.

<sup>19</sup> Wang, "Qing ji Zhujiang sanjiaozhou de nongtian shuili," 583. The Dongguan gentry had wanted the rents from all the lands to support their academies.

grow more than one crop per year. Water control in Lingnan thus was not of a single type, but of several kinds designed to accomplish different ends.

From the several score of different names given to the waterworks listed in provincial gazetteers, five or six different types can be identified. The first type was designed for flood control and existed mostly to protect urban populations in prefectural or county cities. Called *yu an* or *ti* dikes, these projects were first constructed in Song times and in much of Guangdong had reached their peak numbers by the mid-sixteenth century. Increases in the numbers of *yu an* or *ti* from the Ming through the Qing can be identified only in Panyu county in Guangzhou (no doubt designed to protect the city of Guangzhou), in Chenghai county in Chaozhou prefecture (in the Han River delta where the city of Shantou was developing), and on Hainan Island. In Guangxi, though, several new dikes were constructed in the eighteenth century, especially in Pingle (along the Li River), Wuzhou (along the West River), and Xunzhou (along the Yu and West Rivers).

Related to flood control dikes were the "enclosures" (*ji wei* or *wei tian*) primarily designed to regulate water in *shatan* fields bordering the river channels in the Pearl River delta. The great dikes built at the beginning of the Pearl River delta in the Song – the Sang Yuan Wei, for instance – not only provided flood control, but also made draining the swamps in Sanshui and Nanhai counties possible. Often translated as "polder," the *ji wei* did not keep out tides, but rather freshwater. Where the 1561 edition of the Guangdong provincial gazetteer lists *ji wei* enclosures in Xinhui and Sanshui, the category was dropped in the 1731 edition but returned in the 1822 edition. Between 1561 and 1822, the number of *ji wei* in Xinhui and Sanshui remained constant, but additional ones were built in Nanhai, Shunde, and Xinning counties. Interestingly, in the 1561 gazetteer, *shatan* were distinguished from *ji wei*, but were not listed as a category of waterworks in later editions of the gazetteer.

To make dikes and enclosed fields useful, irrigation structures required openings of various kinds and sophistication, called passages (*guan*), gates (*men*), or sluice gates (*zha*). *Guan* may have been simply depressions in earthen banks that could be filled in with dirt to close off the water flow, while *men* probably were wooden structures that could be lifted to allow water in. The most elaborate were the *zha*, constructed of stone with wooden gates that could be opened and closed depending on the need for water.

A second major category of waterworks included reservoirs called *pi*, *ti*, *tang*, or *keng*. Since each of these had a different name, presumably they were somewhat different. "That which catches overflow waters is called a *tang*," according to a brief definition in the 1731 Guangdong provincial gazetteer, while "that which stores water is called a *keng*."<sup>20</sup> *Pi* and *ti*, on the other hand, were semi-damlike structures in streams or rivers designed to back up the water into pools,

<sup>20</sup> *Guangdong tongzhi*, 1731 ed., juan 15.

from which the calmed water could be lifted by hand or waterwheel to the fields. The *pi* dam and *tang* reservoir were the most numerous type of waterworks listed in the provincial gazetteers.

A third type of waterwork consisted of dams (*ba*) and weirs (*yan*). Unlike *pi* or *ti*, which were only partially built into a stream, these structures spanned the watercourse. Dams were designed to block the water more or less completely, while weirs might be seen as low dams over the top of which water continued to flow, while enough backed up behind it to be useful for irrigation purposes. Dams might have been useful directly for irrigation, but it seems that they might have been the anchor of larger, more complex sets of waterworks that included ditches (*gou*), sluices (*han*), or canals (*qu*), all of which comprise a fourth type of waterwork. In Huizhou prefecture, for example, the inhabitants of Changle and Yong'an counties all "relied on canals to direct the water into the fields rather than build *pi* or *tang*."<sup>21</sup>

The fifth type of waterwork consisted of streams, rivers, springs, and wells, all more or less natural phenomena from which water could be lifted, carried, or directed onto fields. In Guixian along the Yu River in Guangxi, for instance, the 1801 edition of the Guangxi provincial gazetteer explicitly noted that "the whole county is along the river so it is easy to irrigate the fields with little else."<sup>22</sup> Also in Shaozhou, Nanning, and Wuzhou prefectures, specific note was made that the inhabitants used waterwheels (*shui che*) to lift the water from the rivers into the fields. Waterwheels moved by human labor, while *niu yun* waterwheels were turned by water buffalo. Where rivers flowed in directions not convenient for farmers, sometimes (or at least once), they were moved. In Hepu county (in the southwestern littoral), where a river flowed in a direction not useful for irrigation, a local official dammed it up and sent it in another direction closer to arable land.<sup>23</sup>

While different kinds of waterworks were fitted to different needs and locations in Lingnan, none represented a new technology. Rather, the story of irrigation and water control in Lingnan mostly is one of the extension of known techniques more broadly throughout the region. In very broad historical terms, the development of water control efforts in Lingnan began in the Song dynasty with flood control in the core regions around the provincial capitals of Guangzhou and Guilin, developed in the Ming into irrigation works in the same areas, and then in the eighteenth century spread into peripheral areas. Using successive generations of provincial gazetteers it is possible to reconstruct a more detailed history of the temporal and spatial development of irrigation works in Lingnan, but the data must be used with care. Like all data in gazetteers, the lists of waterworks may or may not be complete. Second, only a few listings include the length of the structure or amount of land irrigated, so

<sup>21</sup> Ibid. <sup>22</sup> *Guangxi tongzhi*, 1801 ed., juan 24.

<sup>23</sup> Listing for Hepu in the section on Lianzhoufu, *Guangdong tongzhi*, 1864 ed., juan 115-19.

it is not necessarily possible to equate a *pi* dam in Shaozhou with one in Zhaoqing. A third consideration in comparing the lists from successive gazetteers is that it is not clear that the meaning of the terms remained the same from one edition to the next; *shatan* appeared in the 1561 edition, but not later ones, while 63 *ji wei* enclosures appear in the 1822 edition that had not been mentioned in the 1731 edition. Furthermore, over time gaps between nearby *ti* and *wei* might have been connected, reducing the number listed from two to one, when actually there was an increase in the length of the embankment.

These caveats notwithstanding, I think the lists of waterworks in successive provincial gazetteers are both consistent with what else we know about Lingnan and help tell the story. As mentioned earlier, dikes for flood control were mostly all in place by the mid-sixteenth century, with little new construction afterwards. In Guangzhou prefecture, the increases in number of *ti*, *tang*, and *wei* from 1731 to 1822 all occur in those counties where *shatan* emerged: in Nanhai, Shunde, and Sanshui. The greatest increase in the number of reservoirs was in the most peripheral areas. Described in the early eighteenth century as places "where hill land (*shan tian*) constitute the majority of fields,"<sup>24</sup> prefectures such as Nanxiong and Lianzhou in northern Guangdong tripled and doubled the number of irrigation works from 24 in 1733 and to 73 in 1822 and from 36 to 71, respectively. Did this increase mean that irrigated fields came to outnumber dry upland fields by the end of the eighteenth century? Maybe. Smaller but still substantial increases also occurred in Zhaoqing, Gaozhou, Leizhou, and Lianzhoufu prefectures.

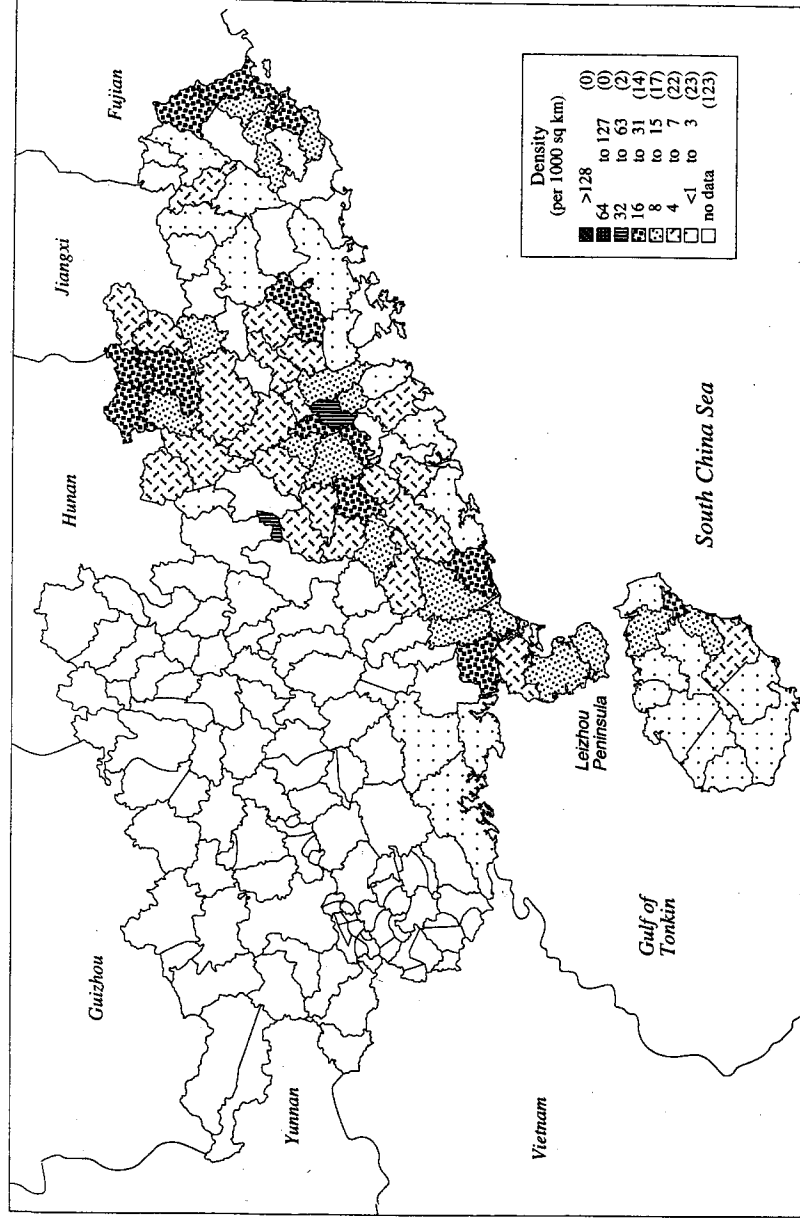
In Guangxi in the early eighteenth century there were so few waterworks that the 1733 edition of the provincial gazetteer did not even contain a section on waterworks (*shui li*); what irrigation did exist then was listed in the "mountains and streams" (*shan chuan*) section. Just a few *ti* and *tang* could be identified in 1733: 3 in Lingui, 2 each in Yangchun, Pingle, Xuanhua, Liucheng, and Yishan counties. By 1801, there were 26 in Lingui, 25 in Xuanhua, and 11 in Yishan, not to mention dozens elsewhere. The marvelous Ling Qu canal also had been repaired three times, in 1714, 1731, and 1754.<sup>25</sup>

How much land did these new works irrigate? In the preceding chapter I estimated that in the century from 1753 to 1853 an additional 25,000 square kilometers of land was cleared for agriculture in Lingnan, most of which was in the hill regions where the number of irrigation works likewise increased the most. Unfortunately, we still have little idea of the amount of land irrigated.<sup>26</sup> The best that can be done with the available data, for both the new and older agricultural lands, is to get a rough sense of the density of the

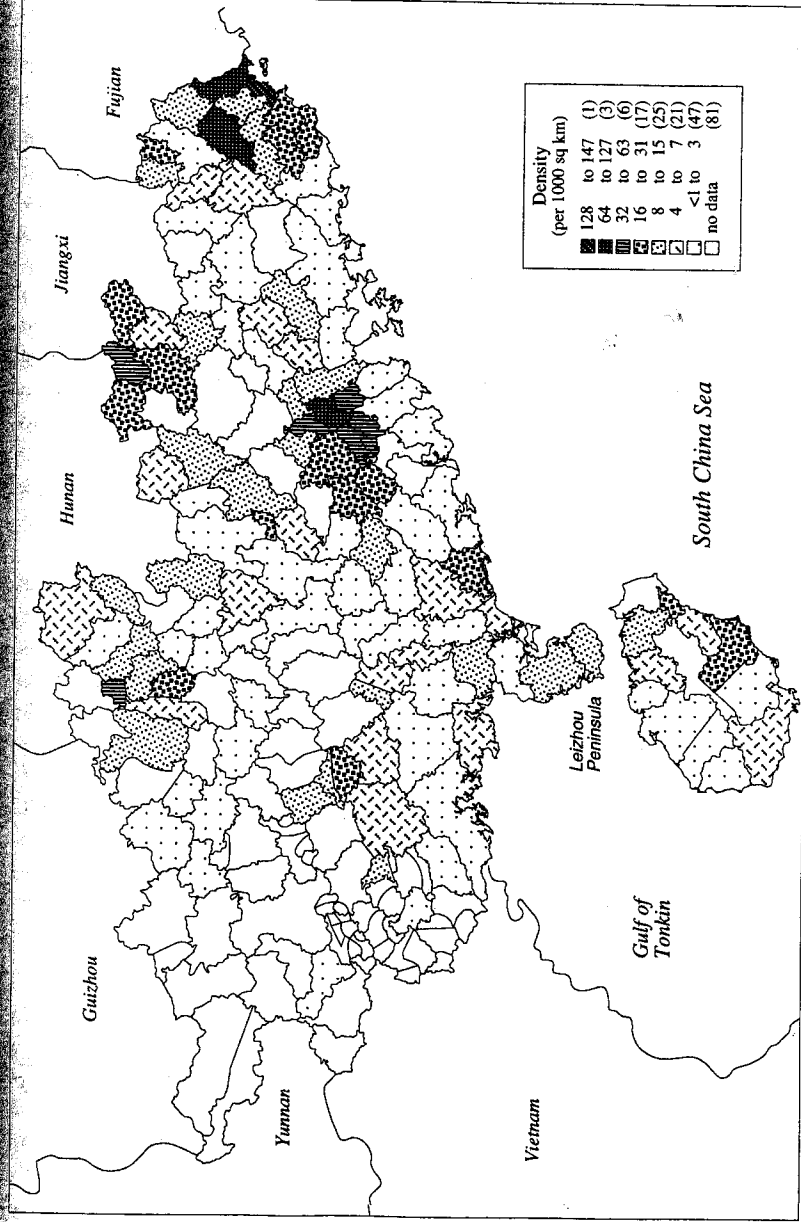
<sup>24</sup> Memorial dated YZ6.9.11, in YZCZZ 11: 331-32.

<sup>25</sup> *Guangxi tongzhi*, 1801 ed., juan 24.

<sup>26</sup> In Nanhai, 6,500 of 12,000 *qing* were irrigated; in Shunde 4,300 of 9,000. See Wang, "Qing jz Zhujiang sanjiaozhou de nongtian shuli," 571, 574.



Map 10.1a. Density of waterworks, ca. 1731.



Map 10.1b. Density of waterworks, ca. 1820.

waterworks as measured in terms of total area in a county or the amount of cultivated land. These measures are obviously limited – the vast number of projects in Shaozhou prefecture, for instance, no doubt were very small compared with those in Dongguan – but they do provide a rough sense of the proportion of irrigation works to total and cultivated land area (see Maps 10.1a and b).

Around 1820, the counties with the densest network of waterworks (as measured by the number of waterworks per 1,000 square kilometers) were in the Pearl River delta – Nanhai heads the list (at 80 per 100 square kilometers), followed by Sanshui and Shunde (with about 50). But counties to the north – Renhua, Lechang, and Qujiang in Shaozhou prefecture – also appeared high in the rankings (with 30–40 per 1,000 square kilometers). Below that, the rest of the counties in Lingnan each had 10 or fewer recorded waterworks per 1,000 square kilometers in 1820. Part of what this measurement tells is not unexpected – the counties in the Pearl River delta had the highest density of irrigation and water control works, while the river valleys of Guangxi as well as the hill regions of both Guangdong and Guangxi were less densely irrigated.

When the number of waterworks are measured against the amount of cultivated land, a different picture emerges, with peripheral counties in western and northern Guangxi province having the most (more than one per 1,000 *mu*); Nanhai and Shunde counties, by contrast, had less than one waterwork per 10,000 *mu*. But this measurement also shows that not all of the peripheral areas were undeveloped in terms of water control; Taiping prefecture in western Guangxi appears to have been the most advanced of the relatively undeveloped areas of Lingnan. What this measurement also shows, of course, is that peripheral areas had a larger number of smaller irrigation and water control works, and, conversely, that the waterworks in the Pearl River delta were large and complex, serving more than one village.<sup>27</sup>

<sup>27</sup> The investments of labor and capital necessary to create and then maintain these waterworks were substantial and certainly beyond the reach of individual peasant families. In discussing the *shatan* we have already seen that only the largest and wealthiest of delta lineages had the wherewithal to invest in creating the new lands. Not all of the waterworks were built with private funds; the state invested too. A few of the waterworks listed in the gazetteers were listed as “state-owned” (*guan you*), while the rest presumably were privately owned. Sometimes the state entered into a partnership, as in Qingyuan prefecture when the governor of Guangxi proposed lending 2,400 taels to a local gentry leader to begin construction of a dam, several sluice gates, and seven *ti* for the express purpose of opening new land for cultivation. See the memorial dated QL19.1.11, in QLCZZ 7: 371–72. After being constructed with capital provided by large landowners, tenants were responsible for providing the labor necessary for upkeep. As an example, see memorial dated QL33.11.14, in QLCZZ 32: 486.

### Deforestation

The evidence reviewed so far – the growth of the population, the changes in land reclamation policies favoring opening scattered plots in the hills, the spread of New World food crops, and the expansion of water control and irrigation works into previously unirrigated areas – all point to the substantial clearance of land in Lingnan in the eighteenth and nineteenth centuries. The obverse of the story of land clearance is one of deforestation, but since eighteenth- and even nineteenth-century sources do not speak directly to the issue, that story can be pieced together only using later evidence. By the early twentieth century, though, the results were plain to those who began to look. In the hills of northern Guangdong, the forestry expert G. Fenzel observed “vast stretches of flat, barren hills, [with] wild grass growth.”<sup>28</sup> Shaw, writing in 1912, found forests in Lingnan only in the upper reaches of the North River in Guangdong and in westernmost Guangxi, on the border with Guizhou province. And in the 1930s, Communists hiding from enemy forces found dense forests on the border with Jiangxi to be virtually impenetrable.<sup>29</sup>

If evidence both from earlier periods and from the twentieth century can be used to illuminate eighteenth-century land clearance practices, fire probably had been used to remove the forest cover and to ready the hillside for planting: “In this process fire is amply used as a pioneer, till, soon, the whole surface of the mountains bordering the valley lies barren from top to bottom.”<sup>30</sup> The non-Han Chinese were especially adept at the use of fire:

The Yao cause tongue-like inlets to be burnt into the forests where he cultivates on the rich soil – still more improved by the ashes – his barley, maize, or sweet potato for two or three years. After this period of crude and transitory cultivation, he . . . moves to another spot for the cultivation of his cereal and potatoes . . . When the soils are clear in this way, a special sort of rice, which grows on the steep slopes without terracing and artificial irrigation, or maize or sweet potatoes are grown.<sup>31</sup>

Land clearance for agriculture was not, of course, the only cause of deforestation. In earlier chapters I have mentioned the logging that was done to provide raw materials for the furniture, building, and shipping industries. And while it is clear that these industries could exhaust the supply of particular kinds of trees (such as the iron wood used in shipbuilding), they did not by themselves clear the land of forest. For that, agriculture clearly played the

<sup>28</sup> Fenzel, “On the Natural Conditions Affecting the Introduction of Forestry,” 81.

<sup>29</sup> Norman Shaw, *China's Forest Trees and Timber Supply* (London: T. Fisher Unwin, 1912), 81–95. Gregor Benton, *Mountain Fires: The Red Army's Three-Year War in South China, 1934–38* (Berkeley and Los Angeles: University of California Press, 1992), 93, 103.

<sup>30</sup> Fenzel, “On the Natural Conditions Affecting the Introduction of Forestry,” 93.

<sup>31</sup> *Ibid.*, 92.

greatest role. But there is more. Wood from forests also had been the major source of fuel for cooking and heating. How much impact this demand for energy contributed to deforestation is not easily estimated, but there is clear evidence from the early nineteenth century that wood was no longer available for use as a fuel, at least in some parts of Lingnan.

According to Captain J. Ross, who traveled overland from Hainan Island to Guangzhou in 1819 following the wreck of his ship, "This part of China is badly supplied with firewood, and the people are obliged to substitute straw, hay, and cow-dung." It was not that there were no trees, but that there were so few: "The country . . . was well cultivated, though hilly, with a few groves of small pines." The reason for the scarcity of forest, of course, is that peasant-farmers had cleared and planted the land, which Ross described as "hilly and poorly cultivated, producing chiefly sweet potatoes, with a sprinkling of other vegetables."<sup>32</sup>

By the early nineteenth century, then, people in Gaozhou prefecture no longer used wood for fuel, but burned straw and dung instead. Certainly this picture has all the earmarks of an energy crisis, with people using for fuel – for cooking, heating, and lighting – the very organic material that had gone into fertilizing the fields.<sup>33</sup> One wonders how widespread this condition was. The population density of Gaozhou in 1820 was 150 people per square kilometer, about the same as Zhaoqing, Chaozhou, and Jiaying and but half of the density of Guangzhou (see Table 9.2). If we assume that areas with about the same population density experienced similar fuel shortages, then the problem was widespread indeed, and it was present as early as 1800.<sup>34</sup>

The vast, treeless grasslands observed in the early twentieth century thus had emerged as a result of a historical process of burning off the forest, planting a crop for 2 or 3 years, and then moving on to another location without replanting trees. By the twentieth century, the Yao tribesmen who Fenzel observed had taken to replanting trees after they moved on; but the Chinese did not do so then and probably had not in earlier times either. After abandoning a cleared hillside, "the land is often invaded so seriously by weeds that

<sup>32</sup> Ross, "Journal of a Trip Overland from Hainan to Canton in 1819," 247.

<sup>33</sup> For an overview, see Adshad, "An Energy Crisis in Early Modern China," 20–28.

<sup>34</sup> Today, of course, the shortage of fuel in the rural areas of China is a critical issue, impinging not just upon economic development, but also on environmental degradation. When I visited the Meiling Pass in early 1994, village women were combing through the hills cutting ferns for cooking the evening meal. By late afternoon, the whole valley was filled with choking smoke from the thousands of stoves. Simply to survive, then, peasant-farmers in this northernmost, mountainous region of Lingnan, which once was heavily forested, remove biomass from the hillsides in order to cook. For conditions in early-twentieth-century Shandong, see Pomeranz, *The Making of a Hinterland*, ch. 3. For contemporary China, see Smil, *China's Environmental Crisis*, 101ff.

further cropping is impossible," according to Robert Pendleton, a botanist who had studied similar processes in the Philippines.<sup>35</sup> After 5 or 10 years, scrub brush might grow and the soil regain some fertility, making it possible to burn it off again. "If, however, the weeds and the brush growing up in the abandoned clearings are removed by annual burning, tree growth has little chance to develop."<sup>36</sup>

And in Lingnan, at least in the twentieth century, peasants habitually burned off the hills every year or two, not only rendering the hills unfit for replanting, but also preventing trees from growing. In Guangxi, Stewart observed that the peasant-farmers "habitually fire most the burnable slopes in the vicinity of the homes during the dry season each year. The continuation of this practice tends to destroy the majority of the species of woody plants and change the aspect of a once richly forested country to that of a hilly or mountainous grassland."<sup>37</sup> In Guangdong too, according to Fenzel, Chinese farmers "annually burn down the grass covering the mountains."<sup>38</sup>

Given the fuel shortage noted earlier, the practice of burning off the hillsides appears somewhat curious, since it would appear to waste a valuable resource. At this point, I do not have any easy answers that would reconcile the two kinds of conflicting evidence. But certainly, those peasant-farmers who burned the grass off the hillsides would have had an alternative fuel source, while those who didn't would have cut the grass from the hills for fuel. Whatever the case may have been, the results were basically the same: removal of forest and the creation of conditions making the regrowth of forest cover unlikely or impossible.

Besides eliminating forests, land clearance by burning, followed by periodic reburning, had an impact on the ability of the watershed to retain rainfall and prevent erosion. On the one hand, the rapid growth of the tough grasses following cultivation retarded soil erosion.<sup>39</sup> Unlike other parts of China where deforestation and shifting cultivation was not followed by the rapid invasion of grasses but by deep soil erosion and the silting of rivers, in Lingnan the grasslands may have prevented extensive soil damage during the summer monsoon. On the other hand, some soil erosion did occur, taking off the thin layer of humus-rich material on the forest floor. When that happened, the ability of the soil to retain water decreased. According to Stewart, the effects upon rivers in Guangxi were clear:

<sup>35</sup> Robert Pendleton, "Cogonals and Reforestation with *Leucaena Glauca*," *Lingnan Science Journal*, 12 no. 3 (Oct. 1933): 555.

<sup>36</sup> *Ibid.*, 556.

<sup>37</sup> Albert N. Stewart, "The Burning of Vegetation on Mountain Land, and Slope Cultivation in Ling Yun Hsien, Kwangsi Province, China," *Lingnan Science Journal* 13, no. 1 (Jan. 1934): 1.

<sup>38</sup> Fenzel, "On the Natural Conditions Affecting the Introduction of Forestry," 42.

<sup>39</sup> Pendleton, "Cogonals and Reforestation," 559.

In Ling Yuin Hsien we found steadily flowing streams in the undisturbed areas of forest at the height of the dry season. At the same time the stream beds in the nearby cultivated and burned-over area were mostly dry. We believe that the preservation or replacement of woody vegetation cover on these slopes would so materially affect the moisture available during the dry season as to be of real economic benefit to the people because it would enable them to grow winter and spring crops, sometimes with the help of irrigation, which it is now impossible to produce on account of the dryness of the soil and the lack of precipitation at that season of the year.<sup>40</sup>

Conversely, of course, with less water retained to seep out and keep the streams flowing in the dry season, more rainfall simply ran off during the summer monsoon, increasing the flow of streams and rivers and, hence, the incidence of flooding.

The immediate question, of course, is whether or not eighteenth-century peasant-farmers too annually burned off the hills after they had cleared them of forest the first time or whether forest might have reestablished itself. Unfortunately, there is little direct evidence, and the little there is, is ambiguous. For instance, when in 1793 Staunton gazed down into Lingnan from the Meiling Pass, he observed "towards the southerly point of the compass . . . a tract of waste and barren ground. The hills scattered over the plain appeared, comparatively to the vast eminence from whence they were viewed, like so many hay-ricks; as is, indeed, the distant appearance of many other Chinese hills."<sup>41</sup> Clearly, Staunton saw at least one scar in the hills, and maybe all of the other hills, having the shape if not the color of "hay-ricks," were covered not with green forest but with grassland.

In the twentieth century, peasant-farmers gave several reasons why they burned off the hills. One was that "after burning off hills the grass ashes wash down the slopes serving as a source of fertilizing material for the lower agricultural land." Pendleton thought this unlikely, since "there are frequently dug contour ditches which carry away the water and eroded material from the hills to prevent flooding of the rice of other low lands."<sup>42</sup> When Fenzel asked "the farmer why he annually burns down the grass covering the mountains . . . [the farmer] stereotypically replies that it is to deprive the robbers, tigers, and snakes of their dens."<sup>43</sup> This answer deserves to be taken seriously and can provide some clues as to when the practice began of annually burning off the hills to prevent the regrowth of forest cover.

*Bandits.* Banditry certainly was a problem in the eighteenth century and probably had continued unabated for decades. The mid-seventeenth-

<sup>40</sup> Steward, "The Burning of Vegetation," 2-3.

<sup>41</sup> Staunton, *An Authentic Account*, vol. 2: 213-14.

<sup>42</sup> Pendleton, "Cogonals and Reforestation," 557.

<sup>43</sup> Fenzel, "On the Natural Conditions Affecting the Introduction of Forestry," 42.

century crisis had spawned a vast number of groups the state had labeled "bandits," and even E-mi-da had justified his land development policies in part to alleviate banditry. But compared with the endemic bandit problem of the 1920s and 1930s, the eighteenth century probably appeared calm. In principle, of course, it is possible to chart the presence of bandits from the numerous entries in the local gazetteers and thereby obtain a rough comparison with the twentieth century. But that exercise might not tell us anything about the peasant-farmer's practice of burning off the hills, since, as adaptable sorts, while they preferred forests, bandits could exist in almost any kind of habitat. But not so tigers. Tigers required a particular habitat - forests - and did not inhabit grasslands.

*Tigers.* Indeed, along with notations on natural disasters, rebellions, and dragon sightings, the chronicles of local gazetteers are filled with reports of tiger attacks on villages. In 1680, for example, "in Xin'an county, many tigers injured people; [the tigers] were extremely numerous; the attacks stopped by the end of the year."<sup>44</sup> Three years earlier, "hundreds of people" had been injured by tiger attacks in Lianping county.<sup>45</sup> In the southwest littoral, tigers in 1723 attacked so many people and animals in Maoming that 37 people died.<sup>46</sup> In Guangxi province too, tigers entered villages and attacked people and animals, as in Huaiji county in 1752<sup>47</sup> and in Liucheng county in 1696.<sup>48</sup> Villagers thus had reason to fear tigers, and tigers may well have been more threatening to peasant-farmers than bandits.

The relevant and interesting thing about the south China tiger (*P. tigris amoyensis*), though, is its habitat. Unlike lions, which prefer grasslands or savanna, tigers stalk their prey from the cover and the shadows provided by forests.<sup>49</sup> The relationship is pretty simple: no forests, no tigers. The converse also held: where there were tigers, there were forests in Lingnan. And the forest had to have been quite large: recent studies have shown that a single adult tiger requires between 20 and 100 square kilometers of forested habitat to sustain itself, depending on the availability of large game.

<sup>44</sup> *Guangzhou fuzhi*, 1879 ed., juan 80-81, *Da shi ji* entry for KX19.

<sup>45</sup> *Huizhou fuzhi*, 1877 ed., juan 17-18, *Da shi ji* entry for KX16.

<sup>46</sup> *Zhaoqing fuzhi*, 1833 ed., juan 49, *Da shi ji* entry for YZ1.

<sup>47</sup> *Wuzhou fuzhi*, 1770 ed., *Da shi ji* entry for QL17.

<sup>48</sup> *Liuzhou fuzhi*, 1764 ed., major events entry for KX35.

<sup>49</sup> Edward O. Wilson has made the interesting point that while tigers and lions in captivity have been crossbred ("The offspring are called tiglon when the father is a tiger and ligers when the father is a lion"), in the wild, the two species do not "hybridize." Besides radically different behavior (lions are social, while tigers are solitary), "they liked different habitats. Lions stayed mostly in open savanna and grasslands and tigers in forests." Wilson, *The Diversity of Life*, 39. Had lions been anywhere near Lingnan when the burning off of the hills began, lions might have replaced tigers, and the peasant-farmers would have been faced with that old choice: Which do you prefer, the lion or the tiger?



If Chinese peasant-farmers and literate chroniclers paid no attention to forests and failed to comment on the deforestation of the hills, thereby leaving us with no written records from which to reconstruct the story of deforestation, they did note tigers, especially tigers which attacked villages. Since tigers are indicators of forests, reports of tiger attacks in the chronicles of Chinese gazetteers can serve as proxies for forests. Charting the time and place of the tiger attacks thus should produce a picture, however fuzzy, of where the forests were and where they were not. For from the point of view of the Chinese agriculturalists, land reclamation, the clearance of hills, and the annual burning over of the grasslands may have been activities that assured the human population its food supply, but from the point of view of tigers, the same actions constituted the destruction of their habitat. The destruction of tiger habitat by burning off the forest cover reduced the tigers' food supply and contributed both to their willingness to enter villages searching for food and to their willingness to attack and eat people.

The prevalence of "man-eating tigers," according to Charles McDougal (and the appellation, "man-eating," is his), is highest under certain circumstances. Where the incidence of man-eating tigers is low, natural prey (in the case of tigers in Lingnan, primarily deer) is adequate and the encroachment of humans into the environment is gradual. "In some areas tiger habitat has been completely destroyed without man-eating becoming a problem . . . In such cases the tigers were killed off at approximately the same rate that their habitat was removed." But where human encroachment on tiger habitat occurred and where, in addition, there was a reserve of good tiger habitat, tigers "were forced to occupy marginal habitat . . . Tigers forced to occupy areas where their normal food was in short supply supplemented the latter with livestock and also humans."<sup>50</sup> The record of tiger attacks in Lingnan, then, indicated not merely the destruction of tiger habitat, but also the existence of a forest reservoir from which more tigers emerged.

Tiger attacks thus are meaningful indicators simultaneously of forests and of the encroachment of humans into tiger habitat. What does the historical record for Lingnan show? Let us begin by working backwards. Today, just a few tigers survive in the mountains on the border of northern Guangdong and Guangxi, not surprising in light of the extensive deforestation clearly documentable in the twentieth century.<sup>51</sup> In earlier centuries, the distribution of tigers was more general throughout Lingnan. Around 1700, according to Qu Dajun, "There are many tigers in Gaozhou, Leizhou, and Lianzhoufu. Mer-

<sup>50</sup> Charles McDougal, "The Man-Eating Tiger in Geographic and Historical Perspective," in Tilson and Seal, eds., *Tigers of the World*, 445-46.

<sup>51</sup> Lu Huoji, "Habitat Availability and Prospects for Tigers in China," in Tilson and Seal, eds., *Tigers of the World*, 71-74. Lu estimates that 4,000 tigers inhabited the area in 1949, 150-200 in 1981, and 50-80 in the mid-1980s.

chants encounter them." Qu also noted that "in the wilds of Leizhou, there are many deer."<sup>52</sup> For the rest of Lingnan we lack the sweeping generalizations provided by Qu Dajun, but the record of tiger attacks can tell the story. In Guangzhou prefecture, most of the tiger attack records are in the Ming dynasty, with a few in the early Qing. Of interest in the Qing records are those in the first decade of the Kangxi reign when the coastal population was relocated inland. The abandoned fields apparently rapidly reverted to scrub if not actual forest, and with the return of cover came the tigers.<sup>53</sup> Significantly, in Guangzhou prefecture the last tiger attack on record is for 1690. After that, the record of tiger attacks ends, presumably coincident with the destruction of tiger habitat and the elimination of tigers. A similar story can be told about Chaozhou prefecture, where the last recorded tiger attack was in 1708. The last tiger attack in Gaozhou prefecture (which, it may be remembered from the preceding chapter, was second only to Guangzhou in population density in 1820) was recorded in 1723. In Huizhou, though, the records of tiger attacks continue through the eighteenth century, and in Shaozhou prefecture and in Nanxiong (to the north in the Nanling Mountains) the last records are in 1813 and 1815, respectively. Records are more sparse in Guangxi, but in Wuzhou and Xunzhou, the last attacks were scattered from 1752 to 1777.

The records from which to reconstruct tiger attacks in Lingnan no doubt are incomplete – some prefectural gazetteers, such as for Lianzhoufu and Leizhou do not include annual chronicles, and certainly some tiger attacks escaped official notice. Furthermore, tigers lived in areas that did not record any attacks, such as Conghua county, which Qu Dajun said "has many tigers in the hills"<sup>54</sup> and which in the early twentieth century still may have harbored tigers.<sup>55</sup> Nonetheless, I think the story that the record of tiger attacks in Lingnan tells is quite clear. During the mid-seventeenth-century crisis when the human population decreased substantially and forest returned to much of Lingnan, the range of the tigers expanded, even into relatively densely populated areas like Guangzhou prefecture in the Pearl River delta. As population there (and elsewhere) began to recover and forests were cleared for agriculture, tigers and people came into contact. By 1700, tiger habitat probably had been destroyed in and around Guangzhou, while the hills in Guangdong and Guangxi remained forested, as did much of the southwestern littoral. As people moved into the hills and burned off forests, tiger attacks spread outwards, ending in the early nineteenth century in northernmost Guangdong.

<sup>52</sup> Qu, *Guangdong xin yu*, 531, 532.

<sup>53</sup> *Huizhou fuzhi*, 1877 ed., juan 18, *Da shi ji* entry for KX6.

<sup>54</sup> Qu, *Guangdong xin yu*, p. 531.

<sup>55</sup> Shaw writes that tigers could be found 20 miles from Guangzhou in the early twentieth century; if so, the only places that had forest remnants were either surrounding the Buddhist temples at Lofu Mountain east of Guangzhou and at Dinghu Mountain west of Guangzhou, or to the north in Conghua county. Shaw, *China's Forest Trees*, 90.

The record of tiger attacks followed the destruction of their habitat, and the end of tiger attacks in the early nineteenth century dates the nearly complete destruction of tiger habitat in Guangdong by then.

The willingness of Chinese peasant-farmers to destroy tiger habitat may have been due in part to cultural beliefs. In the symbolism of the forces of nature, the tiger and the dragon represented the *yin* and the *yang* of weather: the dragon represented life-giving rain, springtime, and the east, the direction from which the rains came; the tiger symbolized drought, autumn, and the west, the direction from which dry, cold winds came. The rains came, Chinese peasant-farmers believed, when the sleeping dragon arose from the depths of the water and ascended into the heavens, while drought was explained by the unwillingness or inability of the dragon to emerge from the water. In these instances, it was necessary to rouse the dragon, and so a tiger skull was dragged through pools in an attempt to arouse the dragon and bring the rains.<sup>56</sup> It is tempting to think that Chinese peasants, believing that tigers were a baleful influence on the rains, would not have objected to their wholesale destruction. Even if these beliefs did not cause Chinese peasant-farmers to burn off the hills, neither did they provide any restraint.<sup>57</sup> Besides, tigers were dangerous.

The accumulated evidence thus indicates the progressive deforestation of Lingnan in the eighteenth century, coincident with the population and cultivated land areas surpassing previous peaks in the Song and Ming, and with official state policy after 1740 encouraging the clearance of the hill country and the periodic – if not annual – burning of grass off the hills. If, as Ling Daxie has estimated, forests in 1700 had covered about half of the land area of Lingnan, decreasing to 5–10 percent by 1937,<sup>58</sup> then most of that deforestation and loss of habitat occurred during the eighteenth century.

This is not to say that all of Lingnan had been cleared of forest, for that clearly was not the case. Certainly much of the western half of Guangxi remained forested in 1850, and there was sufficient timber in northernmost Guangdong, perhaps as far south as Yingde county (about half-way from

<sup>56</sup> For descriptions of the drought prevention ceremonies, see de Visser, *The Dragon in China and Japan*, 119–20.

<sup>57</sup> The persistence of Chinese attitudes about tigers to the present day can be found, most amazingly, in a 1994 Chinese text: "Large carnivorous animals (including the wolf, tiger, and leopard) and many kinds of poisonous snakes have done great harm to humans and livestock since ancient times. With the gradual clearing of lush forest and swamp vegetation and the rapid increase in population and settlements, harm from carnivorous animals and poisonous snakes has gradually been lessened. Some harmful animals, such as the tiger, have now even become endangered species and have been preserved in natural reserves. Wolves, however, still inflict havoc on human life and livestock in the extensive pastoral areas of China." Zhao, *Geography of China*, 162. Pity the wolf.

<sup>58</sup> Ling, "Wo guo senlin ziyuan de bianqian," 34–35.

Guangzhou to the Nanling Mountains in the north),<sup>59</sup> to sustain a lumber industry into the twentieth century. Traveling north from Guangzhou in 1861, Samuel Bonnerly "anchored for the night alongside Timber [*sic*] rafts" in the Pearl River delta, and in Lechang county (in the far north) he noted "groves of dark green firs on the left [bank of the river] – hills in the rear, on both sides, jungly."<sup>60</sup> Traveling south into Guangdong over the Zheling Pass from Hunan province in 1925, Harry Franck commented on the surprise of finding northernmost Guangdong "so mountainous and wooded . . . Evergreen forests gave great quantities of logs, of telegraph-pole size, a hole chopped laboriously in the end of each by which it was dragged down the river and tied into a raft . . . The dull boom of small rafts dropping down the boiling rocky river broke every now and again the stillness, and in the narrow river valley the woodsmen obstructed the public trail . . . with piles of logs." Lest Franck convey the wrong picture of a forested Guangdong, he hastened to add that "even here [i.e., two days' walk from the summit] the old Chinese tendency to destroy forest growths was showing its hand, and great patches of the steep mountain sides had been denuded."<sup>61</sup>

The deforestation of Lingnan thus was not complete by the middle of the nineteenth century, but the process had gone so far as to leave little forest in any areas inhabited by people. Moreover, the forest in the northern Guangdong hills that was left had been cleared in places, rendering an appearance somewhat like swiss cheese, making it possible for some tigers to hang on even into the late twentieth century. But certainly, the rapid growth of the Chinese population from 1700 on and the consequent push to reclaim land for cultivation in the eighteenth and early nineteenth century had seriously altered the environment.

### *Environmental Change*

Besides deforestation, the destruction of habitat, and the extinction of species, land clearance for agriculture in the eighteenth and early nineteenth centuries precipitated other environmental changes as well. Twentieth-century ecologists have shown that the large-scale clearance of tropical and subtropical forests triggers both increased flooding and drought, and they have hypothesized that such deforestation might even affect broader climatic patterns. Without the canopy of the forest to stop the rain, drops hit the uncovered soil with greater force, both eroding the soil and running off rather than slowly percolating in.

<sup>59</sup> See the observations of Sir John F. Davis, who wrote an account of the Amherst Mission to Beijing in 1840 and its return to Guangzhou (via the same route as Staunton in 1793), in *Sketches of China* (London: C. Knight, 1841), 155–56.

<sup>60</sup> Samuel Bonnerly, *Canton to Hankow, Overland* (Canton: Friend of China, 1861), 2, 16.

<sup>61</sup> Harry A. Franck, *Roving through South China* (New York: Century, 1925), 642–43.

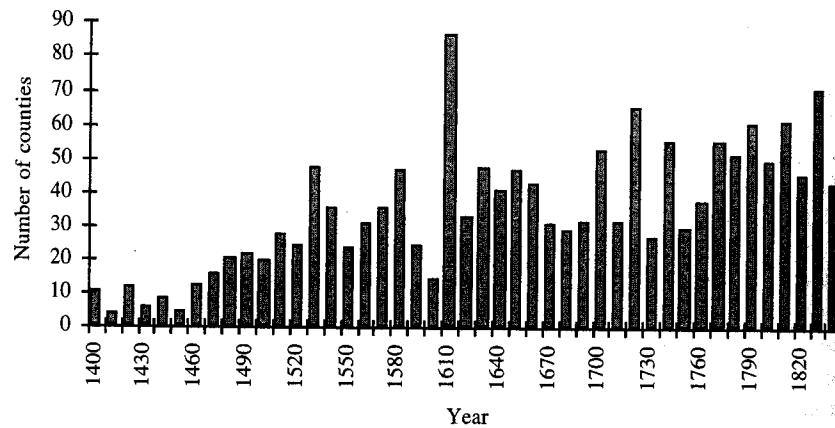


Figure 10.1. Counties afflicted with floods, 1400–1850. Source: Compiled from *Guangdong sheng ziran zaihai shiliao* (Guangzhou: Guangdong sheng wenshi yanjiu guan, 1961), 1–61.

Trees also absorb the sun's energy and release water vapor into the air, so that their removal both increases the temperature on the ground and decreases the amount of water vapor recycled back into the atmosphere.<sup>62</sup>

If the eighteenth- and nineteenth-century land clearance and deforestation in Lingnan had these local effects, they should have been observable in the increased incidence of floods and droughts. Drawing upon the compilation of gazetteer citations of climatic events in Guangdong province, we can chart the number of counties reporting floods and droughts from 1400 to 1850 to see whether or not there are any noticeable changes. Aggregating the data by decade (see Figures 10.1 and 10.2), we can see that the total number of both floods and droughts indeed did tend to increase in this period.<sup>63</sup>

For floods, the increased frequency and scope is more obvious than for droughts and exhibits a pattern that does correlate with what we know about the history of land clearance in Lingnan, increasing by steps from the Ming through the Qing dynasty. From 1460 through 1600, the number of counties reporting drought fluctuated around 20 per decade; after declining during the early Qing, the number increases in the mid-eighteenth century to around 25

<sup>62</sup> Bruenig et al., *Ecological-Socioeconomic System Analysis and Simulation*, 29–30.

<sup>63</sup> Statistical analysis of these data also confirms the upward trend. For floods, the equation for the linear trend has a slope of .106 with an  $R^2$  of .533, and for droughts the slope is .075 with an  $R^2$  of .362. In other words, the incidence of floods and droughts over the entire period tended to impact one additional county each decade.

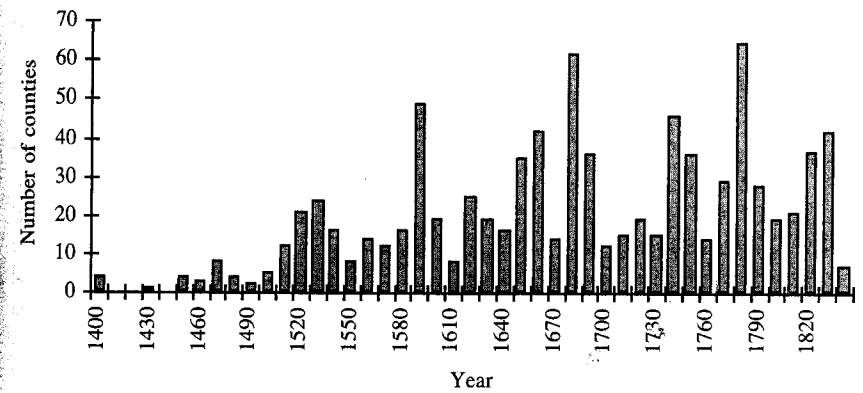


Figure 10.2. Counties afflicted with droughts, 1400–1850. Source: Compiled from *Guangdong sheng ziran zaihai shiliao* (Guangzhou: Guangdong sheng wenshi yanjiu guan, 1961), 62–92.

per decade; and finally, from the 1760s on, the number fluctuates around 40 per decade.

Clearly, the reports of flooding increase in steps that correspond to the history of land clearance. But is there a causal link between the land clearance and increased reports of floods? Certainly that is one possibility, but there are two others as well. In the first instance, it may have been that the incidence of floods did not increase, but merely the reporting of them. It may well be the case that the records for the early fifteenth century are incomplete and that the increase from 1400 to 1480 is a function of more conscientious reporting. By 1500, though, the gazetteer records seem to be quite detailed, so I think that from that time on we can assume that reporting is not a crucial variable in accounting for the number of floods. Second, it may be argued that the increased incidence of flooding may have been associated with climatic changes bringing more rain into Lingnan. But, it may be recalled from Chapter 6, the last decades of the eighteenth century tended to be drier than earlier years; a wetter climate thus cannot account for the increased incidence of flooding. Rather, I think the available evidence points to eighteenth-century deforestation as the primary cause of the increase in flooding.<sup>64</sup>

<sup>64</sup> The amount of rainfall and the extent of land clearance are but two factors that must be taken into account to understand why rain does not get absorbed into the ground but instead runs off into streams and rivers, sometimes overflowing their banks. For an example of the complexity, see Shen Ts'an-hsin, "Non-Hortunian Runoff Generation in the Humid Regions of South China," in Laurence J. C. Ma and Allen G. Noble, eds., *The Environment: Chinese and American Views* (New York: Methuen, 1981), 143–69.

Not only did the incidence of flooding increase, but so too did its severity. The best examples are the 1784 and 1794 floods that breached the Sang Yuan Wei and other levees in the lower reaches of the West and North Rivers. Those levees, it will be recalled, had checked flood waters for centuries. But in 1784, perhaps in part because the river channels had risen with increased silt deposits and perhaps in part because of increased runoff in the upper reaches of the drainage basin, floodwaters overflowed the levees, inundating counties along the West River and in the Pearl River delta. A decade later, floodwaters again breached the levees. In one measure of the extent of the 1794 flooding, relief operations provided for 20,000 families displaced by the floodwaters. As a result of the 1794 floods, local leaders recognized the seriousness of the problem and began to repair and raise the height of the levees.<sup>65</sup>

If the changes in land use increased the incidence of flooding locally in Lingnan, the progressive deforestation may have had a much broader impact on the climate of the rest of China. Ecologists have hypothesized that the elimination of forest in Lingnan likely resulted in lesser humidity reaching north into the interior of China.<sup>66</sup> Until recently, this has remained an interesting hypothesis. But a team of researchers led by Zhang Peiyuan has collected and analyzed an immense amount of historical data on the incidence of drought in China and has concluded that China has indeed become increasingly arid since the thirteenth century.<sup>67</sup>

#### *In Lieu of a Conclusion to This Chapter: Extinction*

In terms of the reciprocal relationship between environment and economy in Lingnan, the eighteenth century represented a turning point. Until then, the population and cultivated land area peaks reached twice earlier around 1200 and 1600 had not been surpassed. These earlier maxima probably had left about half of the land area covered with original rain forest. And when populations and cultivated land areas retreated by as much as one-third in the fourteenth and seventeenth centuries, the forest "reclaimed" – if I am allowed to invert the meaning of a key word used in the preceding chapter – land.

By 1800, both the population and the cultivated land area of Lingnan had reached levels twice as high as at any previous time, and by 1853 the limits of cultivable land had been reached in Guangdong. The destruction of forest that accompanied those gains, though, progressed not arithmetically and proportionally, but geometrically. In Guangdong, the 1850 cultivated land area approached the levels reached in the twentieth century when just 10 percent

<sup>65</sup> *Sang Yuan Wei zong zhi*, Ming Zhigang, comp. (TZ9 1870), juan 1: 8a–9a.

<sup>66</sup> Bruenig et al., *Ecological-Socioeconomic System Analysis and Simulation*, 31.

<sup>67</sup> Zhang, "Climate Change and Its Impact on Capital Shift during the Last 2,000 Years in China."

of the land area was left covered with forest. And in Guangxi, while the cultivated land area still had room to expand in the nineteenth and twentieth centuries, there too the forest cover had diminished toward the twentieth-century low of 5 percent. The reason the forest disappeared faster than the population growth was because of the practice of repeatedly burning off the hills. Even on the hills that were cleared and had been planted just once, Chinese peasant-farmers continued the practice of burning the hills to deprive "bandits, tigers, and snakes" of their habitat. This had its effect, at least with respect to tigers, for the final, early-nineteenth-century records of tiger attacks on villagers place tigers only in remote sections of northern Guangdong in the Nanling Mountains, where they have managed to hang on as an endangered species in the remaining pockets of forest cover.

In contrast to the elephant, the other star species that disappeared from Lingnan, the progressive elimination of the tiger population followed a different route. As Edward O. Wilson has recently observed, "For species on the brink, from birds to fungi, the end can come in two ways. Many, like the Morrean tree snails, are taken out by the metaphorical equivalent of a rifle shot – they are erased but the ecosystem from which they are removed is left intact. Others are destroyed by a holocaust, in which the entire ecosystem perishes."<sup>68</sup> As we saw at the beginning of this book, the elephant had been taken out with the "rifle shot," hunted and killed by humans for their tusks and the delicacy of consuming their trunks; otherwise, the environment was left more or less intact. Tigers, on the other hand, were taken out in a "holocaust" with the clearance of forest from Lingnan.

If land clearance destroyed the habitat of the tiger, pushing it to the edge of extinction, the same fate awaited other wildlife too. And while no one seemed concerned about the fate of the tiger, by the early nineteenth century at least one Chinese observer, the compiler of the 1811 edition of the Leizhou gazetteer, Deng Bi'an, had become conscious of the loss of other species in Lingnan. Whether his consciousness was new and had formed because the rate of the loss of habitat and species had become palpable in his time is not readily apparent. But however his ideas formed, he lamented the passing of various species:

Because local products come from the land [and because there are changes in the land], the local products too change over time. Of the common ones mentioned in the ancient texts, just 80–90 percent exist today; of the rare ones, just 20–30 percent survive. [Today], there is no land that has not changed, so the times are no longer the same either. Northerners record that Leizhou produced teeth and ivory from black elephants, and noted that in Xuwen there were *bao niu* (a kind of buffalo?). The *Records of Jiaozhou* [probably a fourth-century CE text] say that Xuwen had the giant cen-

<sup>68</sup> Wilson, *The Diversity of Life*, 258.

tipe de . . . The provincial gazetteer records that in the wilds of Leizhou deer were plentiful, and that the "fragrant navel of the civet" could substitute for musk-deer . . . Today these [species] are all extinct. The reason these extinctions were not recorded before is that people then said that extinction was not possible . . . Today it is my task to record for posterity these extinctions in the appendix [to the local products section], [in the hope that my records will be of use] for later research.<sup>69</sup>

Record for posterity only? If so, how lonely is Deng Bi'nan's voice. Was there no one else with whom he could share his sense of loss? Did he feel so alone in his concern that all he could do was record extinctions for posterity? Was he a pioneer who no one else followed? Where did he get his faith that a later researcher — someone like me — would resurrect his lament? And has he recorded those extinctions only for posterity? Or can something yet be done?

<sup>69</sup> *Leizhou fuzhi*, 1811 ed., juan 2: 67a-b.

## CONCLUSION

The middle of the nineteenth century has long been seen as a turning point in Chinese history. The Opium War (1839–42) and the Taiping Rebellion (1850–65) are commonly taken to mark the beginning of China's modern history, a history in which the themes of economic development, state formation, and revolution (among others) in the context of a European-dominated capitalist world take center stage in the problematic through which historians interpret Chinese history. But 1850 (or thereabouts) also marks a significant change in terms of the story about Lingnan's environment and economy that I have told here.

By 1850, Lingnan had passed an important divide. As we saw in Chapter 9, the limits of cultivable land were reached by then, and yet the population continued to increase. A colder climate in the first half of the nineteenth century had decreased the already stretched food supplies of the region, and the pressure of people on the land had led to deforestation, the destruction of habitat and ecosystems, and the extinction of an unknown number of species. To be sure, some officials may have become aware of the fate of the wildlife of Lingnan, perhaps presaging an attempt by the state to take corrective action. But China's defeat by Britain in the Opium War began the slow process of switching the presuppositions of the role of the state, from Confucian statecraft concerns for the maintenance of the empire, to "self-strengthening" and competing in the new world of aggressive nation-states,<sup>1</sup> while the Taiping Rebellion focused elites' attention on reconstructing the social bases for their continued dominance of Chinese society. To these social, political, and intellectual crises that wracked China in the second half of the nineteenth century and helped to define what modern China was to become, I think we must now add an environmental crisis. Thus, to understand modern China, we need to understand not just the historical origins of the social and political crises, but also the history of the environment and the making of the environmental crisis.

<sup>1</sup> See Pomeranz, *The Making of a Hinterland*.