RICE CULTURE IN SOUTH CHINA, 1500-1900:

ADJUSTMENT AND LIMITATION IN HISTORICAL PERSPECTIVE*

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INTRODUCTION

Rice was a major food crop in south China and the origin of its cultivation could be traced back to around 5000 B.C. as demonstrated by some earliest relics of cultivated rice found in the lower Yangtze area in recent years.[1] Many ancient Chinese texts mentioned varieties of rice and methods of rice cultivation.[2] Before the T'ang dynasty (618-907), one crop of rice was produced every two years in the lower Yangtze area, but in the eighth century, annual cropping of rice and rice-wheat double cropping were developed in this area. This phenomenon of intensification was considered as a beginning of "agricultural revolution" in medieval China by some scholars.[3] Consequent developments in the Sung dynasty (960-1279), especially the important event of introducing early-ripening rice (Champa rice) in A.D. 1012 and its spreading afterwards, firmly established the predominance of rice production in China.[4] At the same time, the South had become economic gravity center in China and supported a majority of the population.[5] By the early seventeenth century, rice production shared about 70 percent of the total grain production that

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1. Yang Shih-ting 1982:64-77; CNK 1986:2-4; Yen Wen-ming 1989:51-54.
2. Amano Motonosuke 1962:180-209.
3. Li Po-chung 1986.2:1-11.
4. Ping-ti Ho 1956:200-218; Ping-ti Ho 1959:169-176; Amano 1962:216-220.
5. Mark Elvin 1973:204.

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nourished the Chinese people.[6] However, as food crops from the New World were introduced into China and widely planted to help feeding an increasing population in the eighteenth and nineteenth centuries, the share of rice declined and occupied only 36 percent of the total grain production in the 1930s.[7]

While the case of Sung China has been designated by scholars as "medieval economic revolution",[8] as "green revolution",[9] and as an outstanding case of "intensive growth" in the pre-modern world,[10] the case of Ming-Ch'ing China involved a significant issue of maintaining stable per capita productivity with an increasing population. This issue has been carefully studied by Perkins. The aggregated estimates demonstrated that between 1400 and 1957, the grain yields per unit of cultivated land increased steadily with only a slight decline during the later half of the nineteenth century. In general, Chinese agricultural production was able to keep pace with population growth during the past six centuries.[11]

With the above general view in mind, it seems to me that relevant discussion for our theme could be done here with local (regional) evidences related to rice production. This paper is thus attempted to review the rice culture in south China during the Ming (1368-1644) and Ch'ing (1644-1911) periods by focusing on four aspects: 1) technological improvements in rice cultivation, 2) adjustment and conflict between the production of rice and cash crops when the economy became more commercialized, 3) the attitude of work involved with rice culture and finally, the limitation of traditional Chinese rice culture.

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6. Sung Ying-hsing, *T'ien-kung K'ai-wu*, 1955:2.
7. Ping-ti Ho 1959:190-192.
8. Elvin 1973:113-199.
9. Francesca Bray 1984:597-603.
10. E. L. Jones 1988:73-84.
11. Dwright Perkins 1969:13-36.

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TECHNOLOGICAL IMPROVEMENTS IN RICE CULTIVATION

Modern scholars generally agree that Chinese agricultural technology, implements in particular, had not been changed very much after the Sung periods. However, they also agree that spreading and improvements of the existing technology should not be neglected in Ming-Ch'ing times when Chinese agriculture continued to expand.[12] Here, I should only try to discuss some of the most significant points related to rice cultivation.

The rice planting technology had been developed and fallen into a pattern by the Ming dynasty. This pattern involved a sequence of works which may be summarized briefly. In terms of seeding technology, this pattern involved certain indispensable steps: 1) dry the seed with sunshine and sterilize it with ice water, 2) select the seed either by the wind or by shifting, 3) soak the seed (usually around ch'ing-ming 清明, April 5) for hastening its sprout and the best time for seeding is right after buds appear. In terms of farming technology, this pattern involved the following major steps: 1) till the land deeply and carefully and apply enough initial fertilizer, 2) between hsiao-man 小滿 (May 21) and mang-chung 芒種 (June 6), transplant the sprouts by taking a reasonable close interspace of about 5-6 Chinese inches (15-18 cm.) for each small bundle of four or five sprouts, 3) weed two or three times during the growing period, 4) when the rice plants are shooting to some extent (usually around li-ch'iu 立秋, August 8, in the lower Yangtze area), drain out water from paddies and let the land surface fully dry in order to prevent ineffective shooting, and then irrigate the paddies again and finally, harvest at right time.[13]

The most notable improvement in Ming-Ch'ing times was related to the aspect of fertilizer.[14] Not only the varieties of fertilizer increased greatly but

12. Amano 1962:329, Perkins 1969:6-7; Evelyn Rawski 1972:38-39.
13. CNK 1986:10-23; Chen Wei-ming 1988.3:31-35
14. Amano 1962:329; CNY 1984:119-121, 159-162.

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the knowledge about using fertilizer also became more accurate. As for varieties of fertilizer, the famous late Ming scholar and agriculturist, Hsu Kuang-ch'i 徐光啓 (1562-1633), had recorded more than one hundred kinds of raw materials that could be used as fertilizer, organic and inorganic, in a manuscript specialized on the subject.[15] Green manures and by-products of oil processing consisted major sources of fertilizer in Ming times.[16]

Moreover, there were several methods of making compost mentioned in *Pao-ti ch'uan-nung-shu* 寶坻勸農書 (A book for encouraging agriculture in Pao-ti, Hopei). These methods included *t'a* 踏 (trampled by animals), *chiao* 窖 (stored in a cellar), *cheng* 蒸 (evaporated in a tight container), *niang* 釀 (fermented in a pool), *wei* 煨 (rosted) and *chu* 煮 (cooked in water with bone of ox). Among these methods, the first two, *t'a* and *chiao,* were more prevalent in the South and it was suggested that they should be imitated in the North. As for the last one, *chu,* it was regarded by the Ming author as a superb way of making fertilizer, but by modern scholars as an inferior one because the effect of fertilizer might be destroyed by cooking.[17] In addition, it is notable that a method of making high quality fertilizer (known as *fen-tan* 糞丹, literally, manure pill) was suggested in the manuscript of Hsu Kuang-ch'i. Essentially, this method mixed up organic manure (such as dung, beans and beancakes) with inorganic ingredient (such as arsenic, lime and sulphur). It was said that the effect of this "manure pill" could be one hundred times of that of night soil.[18]

In the Ch'ing period, with accumulation of experiences there was a further increase in the variety of fertilizer as one agriculturist had tried to classified them into ten categories: night soil, dung, putrid grass and leaves, earth and dust, mud, ashes, green manure, various kinds of oilcakes, black beans, and feathers and skin.[19]

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15. CNY 1984:120.
16. CNY 1984:121.
17. CNY 1984:121.
18. CNY 1984:121-122.
19. CNY 1984:159.

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Although it is rather difficult to ascertain that all these increases in the variety of fertilizer were applicable to rice cultivation, it has been pointed out that dung and all sorts of oilcakes became major sources of fertilizer for rice in the lower Yangtze area.[20] Estimates showed that the quantity of fertilizer used for producing one shih (about 100 liters) of rice in this area increased from 53 catties (1 catty = 0.6 kilogram) in late Ming to 112-118 catties in late Ch'ing.[21] The same study concluded that in this area the intensification of rice cultivation in Ming-Ch'ing times was achieved not by putting in more labor to one unit of land but by more fertilizer. The share of fertilizer in the total inputs of labor and fertilizer together increased from 27% to 50% during this period.[22]

As for knowledge of using fertilizer, a few points are notable. First of all, fertilizer was recognized as being the most important factor in determining the yields of crops as reflected in some proverbs, such as "Take care of manure as it is gold" and "It is better to have more manure than more land". Secondly, it was pointed out that fertilizer had effects in improving land quality and good for the growth of roots that in turn could help strengthening the plants to resist against wind, flood and drought. Thirdly, it was noted that different kind of fertilizer should be used to improve different kind of soil; for example, it was suggested that for improving tight soil (*chin-t'u* 緊土) burned earth and sand should be used; for cold soil (*han-t'u* 寒土) lime and straw ashes should be used. Fourthly, it was known that the strength of manure differed; for example, the effect of night soil was fast while that of cattle dung was durable. Fifthly, it was well understood that the effect of initial fertilizer was different from that of supplementary fertilizer and thus large amount of initial fertilizer should be applied during the time of tilling and plowing.[23]

An important principle of applying supplementary fertilizer in regard to rice was pointed out in *Shen-shih nung-shu* 沈氏農書 of the early seventeenth

20. Li Po-chung 1984.1:33; Li Po-chung 1986.3:10.
21. Li Po-chung 1984.1:35.
22. Li Po-chung 1984.1:31.
23. CNY 1984:119-120, 130.

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century. This principle stated that the supplementary fertilizer should be used only when rice shoots had turned yellow.[24] This principle of applying supplementary fertilizer by detecting the color of rice shoots was a rather reliable method and it implied that the agriculturist already recognized that improper application of supplementary fertilizer would retard ripening and affect the yield of rice.[25] Moreover, it was suggested in *T'ien-kung k'ai-wu* 天工開物, in the manuscript of Hsu Kuang-ch'i, and in *Fu-chun nung-ch'an k'ao-lueh* 撫郡農產考略[26] that roots of rice sprouts could be imbued with ashes of animal bones when they were transplanted if the nature of soil was cold. This practice could be identified as an application of phosphate fertilizer.[27]

In addition to fertilizer, knowledge and practice of interim cropping and consecutive cropping of rice were also notable. These two practices involved production of two crops of rice in one year and were usually referred to double cropping of rice. Another type of double cropping in south China was a system of one rice crop followed by one winter crop. The development of these double cropping systems were mostly related to the introduction of Champa rice and subsequent dissemination of early-ripening varieties.[28]

A method of interim cropping of rice in Fukien, Kwangtung and southern Chekiang was recorded in a fourteenth-century work, *Nung-t'ien-yu-hua* 農田餘話. Under this method, the late rice (*wan-tao* 晚稻) was planted as an interim crop of the early rice (*tsao-tao* 早稻). The early rice was seeded around ch'ing-ming (Aprial 5) and transplanted before mang-chung (June 6) with wide interspace in which the late rice could be transplanted after about ten days. When the early rice became ripe at li-ch'iu (August 8), it was harvested and then supplementary fertilizer should be applied to help ripening of the late rice.[29]

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24. Chang Lu-hsiang, 1871:49/7b.
25. CNY 1984:129.
26. Sung Ying-hsing 1955:5; Ho Kang-te 1907:A/23b, 30b, 31b.
27. CNY 1984:129.
28. Ping-ti Ho 1959:174-175.
29. Chen I 1974:A/1a (3640).

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This method of interim cropping was also mentioned in *Chiang-nan ts'ui-keng-k'e-tao pien* 江南催耕課稻篇 (To urge farming and teach rice cultivation in Chiang-nan) in the early nineteenth century for encouraging double-cropping of rice in the lower Yangtze area.[30] It is notable that the aforementioned early Ming text did not state clearly how large was the interspace set for planting late rice, but a text in late Ch'ing said that the interspace was 9 × 12 Chinese inches, and thus there was an interval of 5 Chinese inches for two crops of rice.[31] Moreover, it is notable that certain dry rice variety was used as the second crop involved in interim cropping at some places in the lower Yangtze area. This dry rice was seeded directly beneath the first crop ten days before the latter was harvested as *Ch'i-min ssu-shu* 齊民四術 recorded.[32] By this method, labor for breeding rice sprouts and for transplanting the second crop could be saved and the risk of loss during transplanting could be avoided.[33] This practice of interim cropping with dry rice was also applied to yellow beans which were seeded before the first crop of early rice ripening in the lunar eighth month.[34] These evidences seem to suggest that the technique of interim cropping had been spreaded and applied more widely in the Ming and Ch'ing periods.

As for consecutive cropping of rice, there were more records in the Ch'ing period. Among southern provinces, consecutive cropping of rice was found in Kwangsi, Kwangtung and southern Fukien; interim cropping was practiced in Fukien and Chekiang; both interim and consecutive croppings were found in Hunan, Kiangsi, and Kiangsu; even in Wu-ch'ang of Hupei as well as in T'ung-ch'eng and Shu-ch'eng of Anhwei consecutive cropping was also found.[35] Agriculturial historians have pointed out that double cropping systems adopted at various places were not only affected by natural geographical conditions but also related to factors such as varieties of seed, fertilizer, labor

30. Yang Huai-shen 1983:101; CNY 1984:168.

31. Ho Kang-te 1907:A/35b; CNY 1984:168.

32. Pao Shih-ch'en 1872:25A/3a.

33. CNY 1984:169.

34. Pao Shih-ch'en 1872:25a/3a-b; Yang Huai-shen 1983:101.

35. CNY 1984:166; Rawski 1972:32-8, 116-20; Ch'en Chih-yi 1983:77-82; T'an Tien-hsing 1986.4:33-38.

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arrangement, cultivation techniques and recurring cycles of insect damage.[36]

The traditional technology involved with double cropping of rice had to solve some particular problems. First, it had to solve the problem of seed varieties. The first crop must use any variety of early-ripening rice which had a shorter growing season and the second crop must use other variety which would be ripening after the temperature was falling gradually. Hundreds of rice varieties had been recorded in Ming-Ch'ing historical documents. For example, *Shou-shih t'ung-k'ao* 授時通考 collected records from local gazetteers of 14 provinces with a total number of 739 names of nonglutinous and 384 glutinous rice known in late Ming and early Ch'ing.[37] Although it is rather difficult to tell differences among these varieties merely by their names; these records, in fact, indicated that through trial and error, new varieties had been produced to adjust for the need of cropping systems. It is also quite remarkable that in *Fu-chun nung-ch'an k'ao-lueh,* 21 kinds of early-ripening rice, 11 kinds of late-ripening rice and 6 kinds of "second round rice" (*erh-pien-tao* 二遍稻) were recorded with details about the nature and growing season of each kind. The important fact was that late-ripening varieties were not used as the second crop in double cropping system and among those "second round" varieties, some were used as the interim crop and some as the second crop.[38]

Secondly, there was a problem of transplanting. In late Ming as stated in *T'ien-kung-k'ai-wu,* the first and second crops were both seeded around ch'ing-ming but the second crop was transplanted only after the first crop was harvested in the lunar sixth month.[39] In this case, the sprouts of of second crop would be grown for about three months before transplanting and this interval was apparently too long. In the Ch'ing period, the second crop was seeded in the lunar fifth month and thus the interval was shortened to only slightly more than one month.[40]

36. CNY 1984:166-7.

37. Amano 1962:342-343.

38. Ho Kang-te 1907:A/1a-4a; CNY 1984:167.

39. Sung Ying-hsing 1955:4.

40. CNY 1984:168.

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The third problem involved with the time required for preparing paddies for the second crop. As the first crop of rice was usually harvested in the lunar sixth month and the second crop was transplanted around ta-shu 大暑 (also in the lunar sixth month, July 23), the time left for preparing paddies was only about 15 days and it should be done in a hurry. In Hunan, some new methods had been developed to solve this problem. After the first crop was harvested, the land was not plowed but spreaded with a layer of lime and then used *pu-kun* 鋪袞 (a stick-like tool) or simply one's legs to press down roots of the first crop underneath the mud. Or, the second crop was planted right away, and after seven days a layer of lime was spreaded before weeding and roots of the first crop were pressed underneath the mud while weeding.[41]

In the lower Yangtze area, the predominant double cropping system involved one crop of rice with one crop of *ch'un-hua* 春花 (lit. spring flower), referring to winter crops which were harvested in spring.[42] This type of double cropping first appeared in mid-T'ang (around the eighth century) but became dominant in this area only during the Ming period. Some historians had pointed out that the predominance of this cropping system was related to institutional arrangement of rent payment, for tenants in this area did not have to pay rents for the winter crops.[43] The winter crops involved with this cropping system were usually wheat, barley, beans, rapeseed, and green manure plants.[44]

Since every crop had a special growing season, the adjustment for timing was very crucial for adopting double cropping system. Details about planting and harvesting seasons of various crops in the lower Yangtze area could be summarized here. The winter crops were ususlly planted in the lunar ninth to tenth months and harvested in the next fourth month (usually around hsiao-

41. CNY 1984:168.

42. For a detailed study on *ch'un-hua*, see Kawakatsu Mamoru 1989:453-494.

43. Rawski 1972:37 cited studies of Kato Shigeshi and Amano Motonosuke.

44. CNY 1984:169; note that some scholars did not think that green manure sould be counted as a crop, see Li Po-chung 1986.3:2.

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man, or May 21). Different varieties of rice had a wide range of timing; the majority was transplanted in the lunar early fifth month around mang-chung (June 6) and harvested in the eighth or ninth months; some were transplanted in the mid fifth month around hsia-chih 夏至 (June 22) and harvested in the ninth or tenth months; still some others were transplanted in the lunar fourth month and harvested in the seventh month. Although most documents classified rice varieties into three categories: early, middle and late, in this delta area the cultivation of early rice was only limited to a small number of localities along the coast, while in other places mostly middle and late varieties were planted. Thus, in many cases, middle rice was confused with early rice.[45]

For solving the problem of timing, some methods had been developed. For instance, the method of transplanting was applied to wheat by late Ming agriculturist, Mr. Shen, in such a way that wheat was seeded in the lunar eighth month and transplanted after rice was harvested.[46] From the local gazetteers, two other methods had been observed. One was to seed rice at a special seedbed for breeding sprouts; the other was to select early rice variety which had a much shorter growing season.[47] It is also notable that in the late 1820s, P'an Tseng-i 潘曾沂, a landlord in Su-chou, engaged in applying a method of *ou-chung* 區種 (pit field) to rice cultivation in expecting to change a custom of neglecting tilling in spring that had caused a reduction of rice yields. P'an noted that experiments in 1828-1829 were quite successful and the practice was imitated by some tenant and local gentry farmers, thus he reported to local officials for further extension.[48] But it is not clear whether the official effort brought about subtantial results.

In addition to these methods, a rice-producing farming household in the lower Yangtze area might arrange its farm works carefully in order to utilize labor efficiently. There were at least three ways of adjustment. The first way was to change the cropping system from double to single crop. This was prac-

45. Li Po-chung 1986.3:3-5.

46. Chang Lu-hsiang 1871:49/9a, 50/2a-b; CNY 1984:170.

47. CNY 1984:170.

48. P'an Tseng-i 1882.

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ticed around Hu-chou prefecture in Chekiang where human labor instead of oxen was used in tilling the land with iron rakers. In this area, farmers did not plant any winter crops but green manure, such as *tzu-yun-ying* 紫雲英 (Astragalus sinieus L.), which could be just mixed with soil when the land was tilled and thus, people could start to prepare paddies in the lunar third month and improved the work of land preparation. But this type of single cropping of rice was a rather exceptional case. The second way was to change the seed variety and modify the planting technique. The variety of dry rice was used and planted directly so that the labor could be saved for transplanting and irrigation. It was suggested by some agriculturists that each farming household could use part of its land to try this way of rice planting. However, this method had not been popularly adopted. The third and the most effective way was to coordinate labor and oxen among farming households. There were planty of records related to exchange of labor among farming households in the lower Yangtze area, but the most significant phenomenon was interchange of labor and oxen among households. In this way both the households with oxen (rich households) and without oxen (poor households) could increase their production capability measured in terms of units of acreage that one household could manage. It has been estimated that if a poor household did not borrow oxen, it could only manage 3.3-7.5 mou of land (approximately, 15 mou = 1 hectare), but if it borrowed, it could manage 4.9-15 mou; if a rich household did not hire labor, it could only manage 20 mou, but if it did, it could manage 35-45 mou. There were some evidences to support these estimates. In other words, the appearance of rich farming households in the lower Yangtze area during the period under study might be an indication that the production capability of farming households had been gradually improved.[49]

It should also be noted that knowledge of pesticide had been developed in the Ch'ing period based on previous accumulated experiences. That the Ch'ing knowledge about insect damage was rather realistic could be seen from

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49. Li Po-chung 1986.3:6-19.

two aspects. The one was a notion that harmful inscets, especially locusts, were not god's inscet (*shen-ch'ung* 神蟲) and should be killed. The other was a recognition of the fact that insect damage was an agent of crop failure and a reason for famine. Methods of pesticide included three major aspects. First, the damage could be prevented by catching inscets with hand or using fire. Secondly, to use poison such as, arsenic, tobacco water, wood oil, mustard, lime and so on. Thirdly, certain farming techniques were applied to prevent insects, such as planting certain crops in rotation and to clear grass roots along roadsides to prevent hiding of insects.[50]

To summarize the above discussions on technological improvements in rice cultivation within tradition, perhaps some estimates about yields should be presented for helping us to conceive the situation quantitatively. There are quite a lot of piecemeal records about rice yields that had been combed out from the local gazetteers and other documents by scholars.[51] For our purpose here, estimates for various localities are summarized in Table 1. Although estimates listed in Table 1 are rather rough, they revealed that the Lake T'ai area (including southern Kiangsu and northern Chekiang) was the location that had the highest rice yields in south China. In the Ch'ing period, however, this area gradually lost its leading position as its rice yields decreased while those in other provinces increased. The high yields in the Lake T'ai area were due not only to its superior natural conditions but also to efforts of the people in building irrigation networks, in using fertilizer, in tilling carefully and in selecting better seed varieties.[52] The fact that other provinces had their rice yields increased in the Ch'ing period indicated that the state of art of rice cultivation had gradually reaching a similar level in south China. Perhaps, it should be mentioned by passing that rice cultivation was spreaded to certain places in north China, and in T'ien-chin high yields of 653 catties per mou in Ming and 825 catties per mou in Ch'ing were even recorded.[53]

50. CNY 1984:162-2, CNK 1986:19.

51. Perkins 1969:315-329.

52. Min Tsung-tien 1984:46-50.

53. Timothy Brook 1982:659-690; Min Tsung-tien 1984:40-42.

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Table 1. RICE YIELDS IN SOUTH CHINA FROM SUNG TO CH'ING
(one crop of unhusked rice in shih catties/shih mou 市斤 / 市畝)

Location	Sung	Ming	Ch'ing
Lake Ta'i Area	450	667	550
Anhwei	300	-	270-405
Kiangsi	-	356*	391*-405
Hupei	200	225*	335*
Hunan	200	255*	445*-675
Fukien	360	-	270-540
Kwangtung	-	410*-538	532*-540
Kwangsi	-	283*-290	405*-405
Szechwan	156*	-	243*-550
National Average	269	353	405

Notes and Sources: Entries with asterisk are calculated with figures of averages from Perkins 1969:320-7; otherwise, from Min Tsung-tien 1984:37-52. Measurements of each period are converted into modern shih 市 system with the following standards:
1 Sung shih 石 = 0.6641 shih shih, 1 Sung mou = 0.896 shih mou;
1 Ming shih 石 = 1.0737 shih shih, 1 Ming mou = 0.911 shih mou;
1 Ch'ing shih 石 = 1.0355 shih shih, 1 Ch'ing mou = 0.921 shih mou;
1 shih shih 市石 = 120 catties; 1 catty = 0.6 kilogram; 15 mou = 1 hectare.

It is still debatable whether rice yields of the Lake T'ai area was actually lower in Ch'ing than in Ming times. One study suggested that it was not.[54] My understanding of this controversy is that the opinion of Wu and Hsu is only by rough impression and not by converting available records into standard units for comparison. With this understanding, we may still inquire whether traditional cultivation technology had reached a limitation as rice yields of the Lake T'ai area decreased after reaching a peak.

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54. Wu Ch'eng-ming and Hsu Ti-hsin 1987:252.

This puzzle may be tackled with a consideration of double cropping. In the Lake T'ai area during the Ch'ing period, two consecutive crops of rice could produce 810 catties per mou in regular years and 914 catties in bumper years, while the rice-wheat double cropping could produce 702 catties (550 catties of rice and 152 catties of wheat) in regular years and 1042 catties (825 catties of rice and 217 catties of wheat) in bumper years.[55] Since consecutive two crops of rice required more labor and fertilizer than the rice-wheat cropping system, the prevalence of latter in this area had, in fact, made a compensation for the decrease in rice yields. In this sense, the traditional cultivation technology seemed to be quite adjustable.

ADJUSTMENT AND CONFLICT BETWEEN RICE AND CASH CROPS

With the introduction of cotton culture from Fukien and Kwangtung area into the lower Yangtze area in Sung times and the encouragement by the Yuan and Ming governments, cotton became an important cash crop and cotton textile became a prevalent rural handicraft in the Ch'ing period.[56] Many local gazetteers recorded the cultivation of cotton, and in districts along the coast in Kiangsu, records in Ch'ing times often stated that cotton had occupied a large portion of land.[57] In other words, there was a phenomenon of competition for fertile land between rice and cotton in the lower Yangtze area.

In late Ming, a pattern of rotation between rice and cotton was develoed in the lower Yangtze area. It was stated in *Nung-cheng-ch'uan-shu* 農政全書 that at the upland which was suitable for both rice and cotton, a method of rotation could be practiced by planting cotton for two years and then rice for one year; in this way roots of straws could be putrefied, fertility of soil could be enriched, and locusts and caterpillars would not grow. The cotton should not be planted continuously for more than three years, otherwise, insects

55. Min Tsung-tien 1984:50-52.

56. Chao Kang and Ch'en Chung-i 1977:35-79.

57. Liu Ts'ui-jung 1978:3-4.

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would grow.[58] This method of rotation was also mentioned in a treatise on cotton written by a native of Shanghai in the eighteenth century.[59] This rotation between rice and cotton not only assured that the land could be better utilized but also that the crops could have high yields, the the fertility of land was adjusted and improved, while inscets could be prevented.[60]

Although it is difficult to know to what extent this method of rotation was adopted, under the circumstance that the prices of rice and cotton produced from one mou of land were about the same level and moving along the same trend druing 1628-1722,[61] and the profit obtained from cotton was not always higher than that from rice in the eighteenth century,[62] this method of keeping production of both rice and cotton no doubt had its historical significance.

Another aspect of competition for land was between rice and mulberry tree. In the lower Yangtze area, at least since the twelfth century, many paddies had been converted into dry land for mulberry trees. In late Ming and early Ch'ing, in the most important sericulture center around Hang-chou, Hu-chou, and Chia-hsing prefectures in Chekiang and Su-chou prefecture in Kiangsu, there was a rapid shift of land use from paddies to mulberry land.[63] Farming households in this area usually engaged in some sort of "mixed" agriculture.[64]

As for the revenue of sericulture, there are different estimates for the Hu-chou case in late Ming due to various interpretations to the same historical documents. One estimate showed that the revenue of mulberry leaf produced from one mou of land was about 4-5 taels and this amount was more than double of the revenue from one mou of paddy rice.[65] Another estimate

58. Shih Sheng-han 1981:965.
59. Ch'u Hua, *Mu-mien-p'u*, 4b-5a.
60. CNY 1984:119.
61. Nakayama Mio 1979:50.
62. Wu and Hsu 1987:269.
63. Wu and Hsu 1987:270; Fan Chin-min 1988:15-23.
64. Fan Chin-min 1988:15-23.
65. Wu and Hsu 1987:60.

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stated that one mou of mulberry land could produced about 80 *ko* 個 (1 *ko* = 20 catties) of mulberry leaf and in normal years, the price of one *ko* was 0.1 taels, thus, the revenue of one mou of mulberry land could be 8 taels; in years when the leaf was cheap, the price of one *ko* was about 0.04-0.05 taels and thus the revenue was only about a half.[66] The third estimate showed that the revenue of one mou of mulberry leaf was 9.5 taels, including 4 taels of advance payment, 5 taels of later payment and 0.5 taels of miscellaneous payment.[67] These estimates suggested that the revenue of mulberry leaf in late Ming Hu-chou area was about 2-4 times of that of rice. In early Ch'ing, in T'ung-hsiang (Chia-hsing prefecture), the mulberry leaf produced from one mou of land could feed about 10 *k'uang* 筐 (basket) of silkworms, or at least 2-3 to 4-5 *k'uang*. When the price of silk was relatively higher than that of rice, the revenue from one *k'uang* of silkworms would be equal to that from one mou of rice paddy. When the price of silk was relatively much cheaper than that of rice, the revenue from one mou of mulberry land could still be equal to that from one mou of rice paddy.[68] In other words, unless the price of silk fell to extremely low level, the profit of sericulture was usually higher than that of rice culture; there was a wide range of difference from 2-3 to 4-5 or even 10 times.

Another study has tried to compare the inputs of labor and capital (including fertilizer, instruments, seeds and other expenses) in the production of rice, mulberry leaf and raw silk in Ming-Ch'ing times based on information provided by the agriculturist, Mr. Shen. The estimates are summarized in Table 2. Estimates in Table 2 showed that the total input of producing mulberry leaf or raw silk was 1.7 times of that of rice from the same unit of land. Since the revenue of sericulture was much higher than that of rice culture as mentioned above, it was still profitable even though its cost was higher. The significance of this comparison demonstrated that because sericulture

66. Ch'en Heng-li 1983:77.

67. Li Po-chung 1984.2:101-2.

68. Chang Lu-hsiang 1871:50/1b.

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Table 2. LABOR AND CAPITAL INPUTS IN RICE CULTURE AND SERICULTURE
(Hu-chou area in the seventeenth century)

Input	Rice (taels/mou)	Mulberry Leaf (taels/mou)	Raw Silk (taels/mou)
Labor	1.46	2.37	1.10
Capital	0.76	1.48	2.71
Total	2.22	3.85	3.81

Source: Li Po-chung 1985.1:9-10.

required more labor and capital inputs than rice culture, the development of sericulture in the lower Yangtze area in Ming-Ch'ing times could absorb more labor and commercial capital, thus it was quite helpful to economic development and social stability of this area.[69]

As a matter of fact, due to the development of commercialization in Ming-Ch'ing times, rice, cotton and mulberry leaf became three major crops in the lower Yangtze area and there gradually appeared three major cropping zones coinciding to natural ecological conditions. The three zones were: 1) the cotton-rice zone along the coast and the river, 2) the mulberry-rice zone south to the Lake T'ai, and 3) the rice zone north to the Lake T'ai. Within each zone, other crops, such as wheat, rapeseed and beans were widely planted as an interim or second crop of the major one. This kind of specialization and combination of cropping could be a very rational way of resource utilization.[70]

A similar phenomenon of adjustment was also found in the Pearl River delta. There, rice paddies were converted into fish ponds surrounding with dikes on which fruit trees and mulberry trees were planted. In the eighteenth century due to an increase of silk export from Canton, the demand for raw

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69. Li Po-chung 1985.1:11.
70. Li Po-chung 1985.2:151-4.

silk induced people to adopt more widely a combination of fish ponds with mulberry dikes and a special way of management was developed. It was said that in this way, mud dug out from paddies was used to build dikes on which mulberry trees were planted; mulberry leaves were then used to feed silkworms whose excrements were in turn used to feed fish; the profit was "ten times" of that could be obtained from cultivating rice alone.[71]

Other cash crops that competed fertile land with rice were sugar cane and tobacco. Sugar cane was mainly grown in Fukien and Kwangtung in Ming times but was also grown in Taiwan, Szechwan, Kiangsi, Chekiang and Kwangsi in Ch'ing times.[72] Tobacco was brought to Fukien and Kwangtung in late Ming and was extended to Kiangsu, Chekiang, Anhwei, Kiangsi, Hupei, Hunan and other provinces in the north.[73] Many local gazetteers recorded that sugar cane and/or tobacco had occupied fertile paddies but precise acreage could not be derived from them. It was quite certain that the profit of sugar cane was higher than that of rice; the profit of tobacco was even higher than that of sugar cane and sericulture.[74]

A direct result of supplanting cash crops with rice in the Yangtze delta and in Fukien and Kwangtung was that these areas had to import rice for supplementing local products. (A lot of studies about grain trade in China have been done but we do not have to go into details here.) This was usually the very reason for observers to suggest that certain cash crops should be prohibited from planting. For example, a late Ming author, Ch'en Mao-jen 陳懋仁, suggested that sugar cane should be prohibited in Fukien.[75] Pao shih-ch'en 包世臣 (1775-1855), a scholar-official from Nanking, pointed out that for planting one mou of tobacco, the labor and fertilizer required were both six times of those for one mou of rice. Moreover, since many people had developed smoking habit, they smoked while doing their farm works and thus their

71. Hsieh T'ien-cheng 1987:130-3.

72. Rawski 1972:48; Liu Ts'ui-jung 1978:20-1; Wu and Hsu 1987:273.

73. Liu Ts'ui-jung 1978:16-9; Wu and Hsu 1987:275.

74. Wu and Hsu 1987:275-276.

75. Liu Ts'ui-jung 1978:20 cited *Ch'uan-nan tsa-chih* 泉南雜志.

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labor efficiency could be only about 80 percent. The harmfulness of tobacco to rice was implicit but it was quite sure.[76] This was a kind of "moral" appealing toward certain harmful cash crops.[77] But it is quite understandable for the traditional value emphasized grain more than other crops.[78] Beyond that, the population pressure in China had become more acute by the mid-nineteenth century as per capita acreage of cultivated land reduced from 5.77 mou in 1685 to 2.13 mou in 1887 or from 7.92 shih-mou in 1662 to 2.70 shih-mou in 1887 according to different estimates.[79]

Modern scholars tended to regard the competition between rice and cash crops as a result of adjustment to market conditions. For example, the case of sixteenth-century Fukien was considered as that the pattern of land use had reached a "delicate balance among numerous and complex market relations".[80] The spreading of double cropping of rice in Kiangsu during the sixteenth and seventeenth centuries was also closely related to the effect of market prices.[81] Moreover, it has been pointed out that, in general, the development of cash crops was helpful in expanding agricultural base, improving economic efficiency and increasing wealth accumulation. But regional developments differed greatly and up to the end of the eighteenth century, the acreage of cash crops was perhaps no more than 10 percent of the total cultivated acreages in China, and thus the impact of cash crops on changes of economic structure was still rather limited.[82]

ATTITUDE OF WORK

Ever since intensive agriculture was first adopted in the Chan-kuo period (463-221 B.C.), the characteristic of Chinese agriculture had been crystallized in a principle of *ching-keng-hsi-tso* 精耕細作, that is, to till refinedly and to

76. Pao Shih-ch'en 1872:26/3a-4a.
77. Li Kuo-chi 1989:628.
78. Liu Ts'ui-jung 1978:23.
79. Ho Ch'ing-lien 1987:7; Kang Chao 1986:89.
80. Rawski 1972:51.
81. Ch'en Chih-i 1985:77-81.
82. Wu and Hsu 1987:279.

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farm carefully.[83] The rice culture developed in south China could be considered as representing this principle in its finest way. Emphases on timing, deep plowing, fertilizer and pesticide had become a legacy in Chinese agriculture since the Chan-kuo period.[84] All these aspects had been developed to a very delicate set of skills related to rice culture in Ming and Ch'ing periods as discussed above in this paper. The essence of attitude of work implied in this type of intensive and refined agriculture was very succinctly pointed out by Mr. Shen, a successful late Ming managerial farmer, as he advised: "First of all, one must till diligently, use a lot of fertilizer, manage a small amount of land but try to achieve high yields".[85] An important implication of this type of agriculture is that people are well accustomed to work hard with high quality of their work; this mentality of work is no doubt quite valuable when the agricultural society is changing into an industrial one.

Here a few words should be added to the way of management which made some managerial farmers in Ming-Ch'ing times so successful. Their managerial principles may be summarized in a few points. First, they arranged farm works with great care according to the best time; for example, Mr. Shen put a list of works arranged by months in the beginning of his agricultural treatise. Secondly, they emphasized that agricultural implements should be always kept in good condition and in a large enough number. Thirdly, they stressed that hired laborers should be kept in right number and in good spirit by treating them with sufficient food and wine, and the master should inspect farm works personally. Fourthly, they had developed high farming techniques involving every process of crop cultivation, sericulture, animal husbandry (especially raising hogs and sheeps), and emphasized the coordination of resources among these works. Finally, they emphasized rational calculation; for instance, they knew precisely how much farm work a laborer could manage, they regulated the farm works, and they paid attention to market information for sell-

83. CNY 1984:182.

84. Cho-yun Hsu 1980:5-7.

85. Chang Lu-hsiang 1871:49/18a.

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ing their products and for purchasing their implements and fertilizer.[86]

It is difficult to ascertain that these managerial principles were popularly followed by all farmers in Ming-Ch'ing China as managerial farmers were but a minority and they disappeared gradually in the lower Yangtze area by the end of nineteenth century.[87] However, these principles are still quite valuable for a modern industrial society as they emphasize planning, skills of work, efficiency, and rational calulation.

In short, although types of agruicultural works are quite different from those of industrial works, some attitudes of work cultivated under traditional Chinese agriculture may be still quite valuable for the people to think about when the society is changing from an agricultural one to an industrial one.

LIMITATION OF CHINESE RICE CULTURE

It seems that limitation of traditional Chinese rice culture did not lie in its technological aspect as there were always improvements going on in the past, and in modern times when scientific methods were introduced, new improvements had been brought forth.[88] In fact, the acreages and yields of rice in mainland China were increasing during 1949-1982 with a high yields of 650 catties per mou on the average in 1982.[89] If limitation does not lie in rice cultivation technology, it may be found elsewhere. Here, I will try to raise questions rather than to provide answers.

Some scholars argued that traditional Chinese agriculture had its disadvantage lying in a combination of refined cultivation methods with small family farms organized under land tenancy relations which hindered economic development.[90] In Ming-Ch'ing times, the small family farms organized under land tenancy system was, in general, more predominant in south than in north China and it had been found that tenancy was not necessarily a condition of

86. CNY 1984:144-6; Luo Lun 1989:2-8; also see Adachi Keiji 1978:40-69.

87. Huang Tsung-chih 1988:65-77.

88. Hsien Chin-shan 1988:54-63.

89. CNK 1986:26.

90. CNY 1984:182.

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poverty.[91] Moreover, there was a general trend of changing from sharecropping to fixed rent and spreading of permanent tenancy in south China; these changes reflected institutional adjustments to population pressure.[92] Thus, it seems that methods of economic organization, or production relations, accompanying rice culture were not at all inflexible and could not be entirely responsible for modern China's retarded economic development.

Then, was the small size of family farms really an obstacle? Here the case of Japan provides a clue for comparison. It has been pointed out that small holding was institutionalized in the Meiji period and it was through the development of rice cultivation that Japan was able to achieve rapid industrialization.[93] Then, why the small family farms in China did not function as well in the late nineteenth century? Did the reforms since the 1950s succeed in finding an optimal scale of production unit for China? These questions can not be answered by this short paper and require further studies.

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91. Perkins 1969:87-108.

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