Farm Economy in the Pumao Area, 1823-34

----A Case Study of Agricultural Labor Productivity of Late Imperial China

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I. Issues

Agricultural labor productivity is central to any judgment on levels of development in the pre-industrial world, since the agriculture sector was the economy virtually in its entirety and output per worker in agriculture was a key determinant of the size of the non-agricultural economy and of the standard of living of the population.

As one of the largest countries of the pre-modern world, China's situation is critically important to our understanding of agricultural labor productivity of pre-industrial Eurasia. For any compassion of China and other countries of Eurasia, there is a big problem, however. That is the problem of size and diversity. China was (and is) a large and diverse country. Its territory was

approximately equal with that of Europe as a whole (excluding Russia), while its population dwarfed the total of Europe and India together in 1820. It also boasted the size of its economy, which accounted for one third of the world economy (Maddison 1998: 20, 40). The regional differences within China in the level of economic growth were (and are) tremendous and unparalleled in the world[1]. The better way of studying China's economic history, in my opinion, is to carve out a narrower segment of Chinese agriculture in terms of area, time and subject matter covered before we start our study of Chinese farm labor productivity as a whole. For this reason, we take agriculture of the Pumao area in 1823-34 as the object of our study in this paper.

In my previous works on farm labor productivity in late imperial China (Li Bozhong 1999A, 1998: ch 8 and 2000), I have focused on Jiangnan (or the Yangzi Delta) and the period of the mid-sixteenth through mid-nineteenth century. But even these spatial and temporal extents seem too big. Moreover, it is demonstrated in my previous studies that farm labor productivity increased in the Yangzi Delta during the three centuries. But it is worthy to note that in the end of the period China's economy experienced a great change which was both the cause and effect of changes of farm labor productivity. This change took place in the early nineteenth century. From then, China's economy shifted from a long-term prosperity to a one and half century long decline[2]. Because the turning point was about 1820 and the year was the beginning year of the Daoguang Reign (1820-50) of the Qing Dynasty, the change is called "the Daoguang Depression".

Because the Daoguang Depression mainly was a business decrease (Wu Chengming 2001: 241), the major victim was the Yangzi Delta, the most commercialized region of China and the center of China's national market of the day. Logically, such seems to be the case in the Pumao area which was located in the delta and had a highly "externalized" economy. Was the business decrease, however, really the chief culprit for the decline of economy of the Pumao area? If not, what should it be and how would it inference farm labor productivity?

[1] By the nineteenth century, three macro-economic belts, the developed, the developing and the undeveloped, had been formed in China (Wang Yejian 1978). The difference between the belts, especially between the developed and the undeveloped, was so great that one cannot image all of them existed side by side within a country.

[2] According to Angus Maddison (1998: 40,41), China's share in the world GDP rose from 23.1% to 32.4% in 1700-1820. The growth rate per annum was 0.85%. In contrast, the share of Europe as a whole (excluded Russia and Turkey) was increased from 23.3% to 26.6% and the annual growth rate was 0.21%. After 1820, however, China witnessed a century-long economic decline and was the only economy with falling GDP per capita, while all the other five major economies of the world (India, Japan, Europe, United States and USSR/Russia) saw a growth in the term of GDP per capita.

As is seen below, the period of 1823-34 was a period of deteriorated climate. What happened in farm economy and in turn in farm labor productivity during the period? This is an interesting issue on the relationship between agriculture and environment in the pre-industrial world. First of all, however, we should know what farm labor productivity really was in the 1823-34 period.

II. Main sources

The major reason why I focus on the Pumao area and the 1823-34 period is quite simple: I have at hand a valuable source of information crucial for the study. This is the book of *Pumao nongzi*.

Pumao nongzi (A Report on Agriculture in the Huangpu River and Mao Lake Area) is one of "agricultural handbooks" which appeared during the late imperial times. This book was written and published first in 1834. The author was Jiang Gao, a well-known local literati in Songjiang Prefecture. He was keen on local economy, in particular rural economy, and worried about the depression he saw in the Pumao area. In the preface of the book, he said: "I have nether farms nor the responsibility for them. But I love agronomy and think that among all the people of the empire only peasants never fail to live up to what the country expects of them. Since 1822 and 1823, however, I have seen that peasants are getting withered. I sympathize them and have inquired of them carefully about why". In the inquiry, he accepted only what "every peasant told with one voice, say, expensive labor, prostrate soil power, unstable climate, and so on". He "wrote a record of what I have heard, hoping to let those who concern about agriculture know". The record is the book of *Pumao nongzi*.

Quite different from many voluminous agricultural handbooks compiled by the government or scholar/officials, this book is not big[3]. It contains 40 paragraphs, each of which deals with a specific topic[4]. Though short, the book carries very rich information of farming. In this book, Jiang Gao did not only record very detailedly all jobs, methods, techniques and other major aspects of farming of the day, but also itemized quantitatively costs and incomes, inputs and outputs, in farming, both in kinds and in money. Surprisingly, most of the data is consistent with the results from modern field investigation[5]. In addition, he also told specific methods of how to calculation area of cultivated land and yield per acre. In all senses, the book is a verity of farming in the area of the day, as was

[3] The text of the book has only 14 double pages in traditional Chinese way of bookbinding, or 27 pages in modern way.

[4] In this paper, the serial numbers, not page numbers, are used when this book is cited.

[5] For example, the workdays needed for each job of rice cultivation in the book is almost the same with those in SJXZ (p. 949).

emphasized by all local scholars in the prefaces that they contributed to this book.

The data provided in this book is not complete for our study, however, because some important matters, such as tenancy and farm size, were not recorded. Jiang Gao did not bother himself to deal with them, probably because they were too common to him and it would be cliché to talk about such matters to which local people had been accustomed for centuries. But these matters are indispensable for our study. To make a more complete picture of farm economy of the day, we have to find information necessary from other sources. Of these materials *Songjiang xianzhi* (the 1993 edition) is more important, because it contains much information from modern surveys, censuses and field investigations, which is helpful in judging whether the information is right or not in *Pumao nongzi.*

Though *Pumao nongzi* focused on the Pumao area, most of what the book told was general in the Yangzi Delta. A contemporary scholar, Wulin tuishou, made it clear in his postscript to the book: "This book details the suitability of soils, benefits of farming, diligence of workers. All these are true not only to our home prefecture of Songjiang, but also to the neighboring prefectures of Suzhou and Jiaxing". Since the three prefectures constitute the core of the Yangzi Delta, in this sense, the book is one of the most important sources in the study of agriculture in the Delta in the early nineteenth century.

III. Area and Period

The area and period under study is the Pumao area and 1823-1834. What are the characteristic features of the area and period?

1. The area

The area is called the Pu-Mao because of its location along the lower Huangpu River and Mao Lake (the lake has been silted up and does not exist today). Roughly, its geographic extent corresponds with the present Songjiang County. In the Qing, this area was divided into two counties of Huangting and Low under the jurisdiction of Songjiang Prefecture. In 1912 (the first year of the Republic of China), the administrative unit of prefecture was abolished and the county of Low was incorporated into the country of Huangting. In 1914 the new Huangting Country was renamed as Songjiang County and was put under the jurisdiction of Metropolitan Shanghai City in 1959. The area of Songjiang County is 605 square kilometers in 1988.

Geographically, the Pumao area is located in the eastern part of the Yangzi Delta. The locality of the center of the area (Songjiang Town) is longitude 121°14′east and latitude 31°north, 40 kilometers away from the center of Shanghai City.

Topographically, the area is at the bottom of the dishing Taihu Basin, low and flat. Within the area, the land scopes from the north to south and east to west. In the east, it borders the Gangshen belts with 3.5-4.5 meters above sea level, while along the Huangpu River and in the southern part of the area, the height is around 3.2 meters above sea level, with some places lying about 2.4 meters. The northern and western parts of the area are even as low as 2.2-3.2 meters, with some places being lower than the high-tide mark. In general, low land with the height of under 3.2 meters takes two thirds of all cultivated land of the Pumao area (SJXZ: 108, 109).

Geologically, soil in the area is mainly wrap soil from rivers and lakes. Soil texture is light and even, while one third of the soil is coarse sandy loam. According to a 1982 investigation, anthropic paddy soil accounts for 98 per cent of the cultivate land of the area, with a cultivated layer of 14.7 centimeters tick (SJXZ: 110, 111).

Meteorologically, in the present-day Pumao area, annual average temperature is 15.4□, with the highest of 38.2□ and lowest of 10.5□. Days free from frost are as many as 230, while rainy days are 137 with annual amount of precipitation of 1103 millimeters. June and July are the season of mould rains and typhoons come in summer with a frequency of 1.5 times a year (SJXZ: gaishu 1).

The geographic location of the Pumao area has an important inference on agriculture. The area sits at the mouth of the Huangpu River, the principal drainage channel of the Taihu water system. Three branches of the Huangpu converge in the southern part of the area and go east to the East China Sea. Because the area lies low and the higher Gangshen belt stands east of it, the Pumao area is prone to inundation if excessive water comes from the upper course of the Huangpu or rainfalls are heavy in summer. In addition, the area is subject to high tides[6].

[6] In his postscript to *Pumao nongzi*, Wulin tuishou said: "Our country of Songjiang Prefecture is located in the lowest reach [of the Huangpu River]. Silt is brought along from the sea outfall into the river by high tides. All bottomland, swamps and marshes were enclosed, drained and became fields. But if you make fields by capturing ground from water, water can recapture what it lost, too. Moreover, because of being close to the seashores, this area often suffers from typhoons, which come in the sixth and seventh lunar months and harm early rice. …. Only late rice fits. But if it rains after flowing, the farmer will be in trouble".

2. The period

Since agricultural output results from a combination of human exertions and the natural environment, we cannot exclude changes in environment when we study economic (especially agricultural) change. For this reason, climate, the most changeable of environmental factors, will be taken into our consideration in our study. The period under study is a period of climatic revulsion in Chinese history.

L. G. Thompson and others have found that air temperature dropped rapidly from around 1816 in the Northern Hemisphere. When the drop reached its bottom of, the temperature was 0.6□ lower than average temperature between 1880-1975 and has been the lowest since the seventeenth century. This violent change ushered an unstable climatic period of 15 years. Only after 1830 did climate become more stable, though still cold and wet[7].

It has been documented that this climatic change also happened in China. In Middle-East of China where the Pumao area is located, the half century of 1740-1790 was a warm period, in which the mean annual temperature was 0.6□ higher than today. In contrast, the next half century of 1791-1850 was a cold period, in which the mean annual temperature was 0.8□ lower than today. The lowest temperature appeared in around 1816, which was 2□ lower than today and was the lowest from the mini-glacial period (Zhang Peiyuan 1996: 435; Zhang De'er & Zhu Shulan 1981).

This change can also be seen in variation of dryness and wetness. A study of climatic history of the Yangzi Delta has suggested that the 1776-1820 period was a dry-bias period, while the 1821-1890 period was a wet-bias period. There was no transition period between the two periods (Zhang Peiyuan 1996:332). In other words, climate was transformed rapidly from a dry period to a wet period in the Yangzi Delta around 1820-21.

In sum, the decade of 1823-34 was a period in which climate changed violently and became very instable in the Yangzi Delta.

The same story can be found in the Pumao area. In this area, the temperature dropped after 1800 and reached the bottom in 1831 and it did not become stable until around 1840 (Zhang De'er & Zhu Shulan 1981). During the process of climatic change, violate fluctuation can be seen, including the

[7] Thompson, L. G. et at.1990. "Glacial stage ice core records from subtropical Dunde Ice Cap". Originally in China Annals of Glaciology. 14. Cited in Zhang Peiyuan 1996: 386.

extremely cold winter of 1809 and the persistent drought in 1814 (SJXZ: 142; Zheng Zhaojing 1987: 246). But the chief landmark of the change is the 1823 flood. Downpours began in the second lunar month of the year and continued to the ninth month, only with the interrupts in the sixth and eighth month (SJXZ: 141). It brought very bad flooding, which resulted in the thorough harvest failure. But the story does not stop here. In the flood, farmland was immersed for months. The long-time dunking proved devastating because it defertilized soil very badly. The fertility of soil had never recovered until 1834 when Jiang Gao wrote the book.

The post-1821 cold weather had a negative inference on agriculture in the area. Zhang Jiacheng (1988: 123-125) has suggested that a difference of 1□ implies a change of about 10 percent in agricultural output in present-day China. If his model holds truth, there would be a change of 20 percent in the case of the Pumao area in the periods before and after 1820 when temperature changed by two degrees. In the Yangzi Delta, growing seasons for paddy rice will be shorten by 1-2 weeks if the mean annual temperature goes down by 1□. Short growing seasons make it difficult for major secondary crops, not just reduce rice yields (Li Bozhong 1994).

The consequences caused by climatic deterioration from 1823 were felt very much by local people. Jiang Gao complained in *Pumao nongzi*: “The soil fertility has become too poor to be recovered, even if climate is good”; “Droughts and floods do not occur every year. What I really worry about is that soil power cannot be recovered. …After the 1823 flood, soil fertility became very lean. …The leanness of soil makes farmers needy and in turn makes harvest thin. For this reason, every year can in fact be called a famine year since then” (PMNZ: 9).

IV. Agrarian Economy in Puamo

Well before the 1823 climatic catastrophe, a highly advanced agrarian economy had been appeared in the Pumao area. The catastrophe did not change basic agrarian systems of the economy. It is necessary to make a brief review of main characteristic features of the economy before we go further.

1. Tenancy and transfer of land usufruct

Pumao nongzi does not talk clearly about tenancy in the area. But we can find that the two terms of “farmers (or peasants)” and “tenants” are a synonym in this book. There was no difference between the two terms, because the overpowering majority of peasants had become tenants long

before the nineteenth century[8]. Under the tenant system prevailing in the Yangzi Delta, "landlords never interfere with farming, all of which is managed by tenants" (Tao Xi 1927:19). The only right of the landlord was to collect rents from the tenant according to the lease signed by both the landlord and the tenant. The tenant was not obligated to pay taxes to the state. In other words, the tenant had complete usufruct of the farmland he was using, and the farm management was not interfered by either the landlord or the state.

"For the fields, there is the right of *Tianmian* (field surface), which is the price paid by another tenant to the former tenant when the fields are transferred. The price is decided according to the locations, sizes, fertility degrees of the transferred fields" (PMNZ: 4). In general, the price of *Tianmian* for a plot of fields was about one third of the value of the field before 1804 and went down with the devaluation of land after then[9].

The prevailing exchange of the right of *Tianmian* represents the further separation of ownership and usufruct of farmland. In a large degree, it settled the problems caused with the highly concentrated ownership and made it possible for the ability of the farmer to assort with the amount of land he could use.

2. Commercialization

In the Pumao area, rural economy was highly commercialized in the early nineteenth century. In Jiang Gao's words, "everything needs to be buy with money, with the only exception of rice that the farmer and his family eat" (PMNZ: 40). From *Pumao nongzi* we can see that farmers produced primarily for the market, while almost all kinds of productive goods, labor and services could be (or had to be, in many cases) obtained in the market. For this reason, all farm inputs and outputs had their market prices, which were recorded in *Pumao nongzi*.

Another aspect of this rural commercialization is that peasant economy went deep into the rural

[8] As early as in the late seventeenth century, a famous scholar, Gu Yanwu (1936: 241) suggested: "only one tenth of rural residents own cultivated land, while nine tenths are tenants" in Suzhou-Songjiang region in which the Pumao area is located.

[9] PMNZ (3): "In the past, tianmian cost more than ten thousand copper coins for a mu of the best paddy fields. The cost diminished down to one or two thousands at bottom". For land value, "thirty years ago [or before 1804], one mu of upper-grade paddy field cost 50 taels of silver with a 70 percent discount". The average ration of silver-coin conversion was 1 tael of silver to 999 copper coins (Lin Manhong 1993). By this ratio, 50 taels of silver are equal to 50,000 copper coins. With a 70% discount, the rest is 35,000 coins.

networks of finance. Pawn-broking flourished in the countryside. For the poor peasants who had only small surplus of grain but hardly sold it and got money to buy the necessaries, to get small mortgage loans from pawnbrokers was the only way to survive (PMNZ: 34). Pawnshops also practiced usury without mortgage. “When spring plowing begins, many farmers have exhausted all their grain reserves. They are very poor and can’t expect get loans on credit or mortgage”. However, "many of them could borrow grain from pawnshops and would have to pay it in fall with 20 per cent interest (PMNZ: 34). Rural finance involved peasants deeply in monetary economy.

It is worthy to note that after centuries-long commercialization, the farmer in this area knew pretty well about market prices, mortgages, deeds to land, formal contracts and interest. From *Pumao nongzi* it can be seen that cost and income were calculated carefully in every kind of productive activities, such as crop choice, labor hiring, fertilizer using, livestock breeding, and so on.

3. Wage labor and paid services

Different kinds of wage labor and paid services were widely used in agriculture in the Pumao area in the early nineteenth-century. Wage labor included long-term hired hand (*changgong* or *changnian*), seasonal labor (*manggong*) and “accompanying labor” (*bangong*, exchange labor), with seasonal labor being the most common one (PMNZ: 31). From *Pumao nongzi* it can be seen that wage labor was used in all kinds of farm jobs, while most farmers employed wage labor in some stages of rice cultivation, only except for those cultivated 3-5 mu of paddy (PMNZ: 16). Paid services prevailed, too. In land preparation, “the farmers who didn’t have any ox hired ox services from those who owned oxen, and the pay is calculated by the amounts worked by the ox” (PMNZ: 11). There were professional contractors. “They contract with the farmers who need and provide the service of pumping water into fields in summer of the next year, and charge for the service according to the amounts and heights of the fields. If it rains often, they will reap where one has not sown”. Professionals also worked in husking rice, who were called “husking partners” (*longhuo*) (PMNZ: 31).

The wide availability of wage labor and paid services made it possible for farmers to expand their management size, breaking through the limits of labor resources within a family. Moreover, quality and efficiency of farming will be improved when more professional workers are used (Li Bozhong 1996C).

V. Model Farm

A new tendency appeared in the Yangzi Delta in the seventeenth through nineteenth century. That is "middle-peasantilization" as Fang Xing (1996) called, which means that more and more peasants became "middle-peasants", and the "middle-peasants" became the majority of the peasants. In some sense, this "middle-peasantilization" can be seen a result of productive capacity of individual farmers becoming closer to each other. A representative of the appropinquity of productive capacity is that differences in size among individual farms became smaller and smaller. As a result, a kind of management of "one man farms ten mu of paddy" appeared in the late eighteenth and early nineteenth century. Not only agronomists took it as the model farm size in agricultural handbooks, but it became the standard size to which most of farms were approaching.

In the Pumao area, the model farm economy consisted of two major sections: farming and livestock breeding. We need to know what the size of a model farm, the crop structure and the crop index was. In addition, we'll also know how many animals were raised in a farm.

1. Farm size

During centuries before 1956, farming had been done virtually by individual peasant families, and a farm was actually the cultivated land a peasant family worked on. The size of a farm, therefore, was the amount of the cultivated land farmed by a peasant family, no matter whether it was owned by the family or not. *Pumao nongzi* did not mention how big the size of a common family farm was, with the only exception that he said some very poor family cultivated 3-5 mu of land. Here we'll start our analysis with man-land ratio of the day.

In the Pumao area, since all of arable land had been opened up before the nineteenth century, the total amount of cultivated land changed little in the nineteenth and twentieth centuries. The official figures of the 1902,1922,1933,1935, and 1950 are available, but they differ each other considerably (SJXZ: 298, 300). Moreover, all of them are not the result of a field survey. Here we choose the 1950 figure of 900,000 mu, which is comparatively reliable. For the population, we use the figure from the 1816 census, that is 563,052[10]. If rural population took 80 per cent of total population[11], it would

[10] SJXZ:153. The figure is one third more than the 1953 figure (425,943).

[11] Xu Xinwu (1992:211-212) estimated that in 1860 rural population took 85% of total population of Songjiang Prefecture. But it should be noticed that in 1860 the prefecture was suffering from a destructive civil war—the Taiping Rebellion. Since urban area saw more population loss than rural area did, the percentage of rural population must have be lower in pre-Taiping times, or lower than 85%. Within Songjiang Prefecture, the Pumao area was the

be 450,000. By the standard of five persons per family[12], there would be 90,000 peasant families in 1816. Calculating with the figures of cultivated land and peasant families, we arrive at a figure of 10 mu per peasant family in the Pumao area in 1810s, which is consistent with the 1950 figure[13]. Of course, this average does not represent the amount of land that the family owned because of the high concentration of land ownership as mentioned above.

Farm size is decided not only by man-land ratio, but also by farmers' productive capacity. Generally, in the Yangzi Delta, in particular in prefectures of Suzhou and Songjiang during the late eighteenth and early nineteenth century, a family farm was worked by only a man, or the farmer himself, since his wife left farming for spinning and weaving. A male adult worker could farm 10 mu of paddy fields at most. If the family owned more than 10 mu, the excess would be rented out, or farm hands would be hired if the excess was kept. The farm size, therefore, was about 10 mu of paddy (Li Bozhong 1996□, 1996B). No evidence suggests that the Pumao area was an exception.

In sum, the model farm size was about 10 mu of paddy in the Pumao area during the period under study.

2. Double cropping and crop structure

In the Yangzi Delta, double cropping had spread before the nineteenth century. Because of double cropping, the sown area usually was larger than the cultivated area a farm had. How many mu were cropped (accurately, sowed) a year rests with what cropping index was.

In the double cropping system prevailing in the Yangzi Delta, the principal crop was paddy rice and the second crops, or winter crops, were alfalfa, broad bean, rapeseed, wheat and barley. After

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most urbanized area because it had 18 big market towns, in addition to the prefecture city which was located here. The percentage of rural population of the Pumao area should certainly under the average level of the prefecture. In addition, according to the 1953 census, the percentage of rural population was 78.7% (SJXZ:153), and the 1953 urbanization level may be considerably lower than the early nineteenth-century level because of the rise of modern Shanghai which drew more and more urban population from the Pumao area.

[12] In the Yangzi Delta during the period of the sixteenth through early twentieth century, a "normal" peasant family had 5 persons, including a married couple and their underage children and aged parents. The major labor force was the farmer and his wife, while the others could take some subsidiary work. See Li Bozhong 1996A, 1998: 23, 184 note 4. In 1953, a rural family had 4.1 persons in average in 1953 (SJXZ: 153).

[13] The 1950 average is 11.4 mu of cultivated land per peasant family (SJXZ: 298,300), a bit bigger than the early nineteenth figure. But the difference is early to explain--the 1950 rural population was less, but the amount of cultivated land was almost the same.

1823, however, “my country is low, water in the fields cannot go out after rice is harvested. If it rains in winter, it will be in flood everywhere” (PMNZ: 8). “Broad bean, wheat and barley love dryness and hate wetness. If the fields are in flood in winter, you will waste labor (when you plant them)” (PMNZ: 28). “If it rains after alfalfa is sown, the seeds will go with water when you run water out of the fields. Moreover, alfalfa will perish if the fields are in flood and you will waste your investment” (PMNZ: 21), thus “alfalfa can be planted only in high and good fields” (PMNZ: 20). In lower fields, therefore, “no winter crops are farmed in successive years” (PMNZ: 30). Since winter crops were not cultivated much, we’ll neglect intentionally them in the discussion in this section, though we will deal with them in the last part of the paper.

3. Livestock

About the kinds of livestock kept by farmers in the Pumao area, *Pumao nongzi* listed just two: cattle and pigs. Oxen and water buffaloes were bred as draft animals, while hogs were fed as the main source of meat and fertilizer[14]. Since oxen and water buffaloes were not bred in most of farms, we’ll discuss only pig raising here.

Pumao nongzi does not tell how many pigs were raised in a family farm. But we can calculate the number from other records in the book. In the section on fertilizer use (PMNZ: 21), it is told that 10 piculs of pigpen manure were needed for 1 mu of paddy. Customarily, a peasant family raised one sow with its litter(s) in the Yangzi Delta. Shoats were raised for half year and then slaughtered or sold[15]. It is reported in 1960 that a pig produces 80-100 piculs of pigpen manure a year[16]. It can be seen from *Shenshi nongshu* (an earlier agricultural handbook in the Yangzi Delta) that to produce this amount of mature, a sow with a litter (6 shoats) were needed[17]. Accordingly, a peasant family had to keep one sow (with a litter of 6 shoats) if they wanted to manure their fields of 10 mu. It seems very reasonable, therefore, that the number of pigs raised by a peasant family was about 1 sow with a litter of about 6 shoats in Pumao area in the period under study.

VI. Farm Inputs and Outputs

[14] PMNZ (22) “Pig breeding is very important to farming. Is it not because fields are fertilized with pigpen manure and then produce big profits?”

[15] According to *Shenshi nongshu*. See Chen Hengli 1983: 88-90.

[16] Originated in Renmin ribao, August 26, 1960. Cited in Amano 1979: 436.

[17] According to *Shenshi nongshu*, in the late seventeenth century, a sow usually gave birth to two litters a year, six shoats a litter. The shoats were bred half year. See Chen Hengli 1983: 88-90.

In the early nineteenth-century Pumao area, farm inputs mainly included labor, fertilizer, seeds, tools and fodder, while outputs consisted of two major products—rice and pigs. Because of high commercialization, all the inputs and outputs were marketable and their prices were recorded in *Pumao nongzi*. In this section, we'll calculate these inputs and outputs both in kinds and in money according to the early 1830s prices.

1. Inputs

(1) Labor

Labor input in every job of farming was recorded accurately in *Pumao nongzi*. Based on them, Jiang Gao summed up: "About 10 workdays are needed for one mu of rice cultivation" (PMNZ: 33). Shen Jingxian, a contemporary countryman of Jiang Gao, also said: "From plowing to harvesting, one mu of rice needs about 10 workdays" [18]. It is undoubted that labor input per mu of paddy was about 10 workdays. But if labor inputs in other jobs, in particular pumping water, were added, the total would be larger, as Jiang Gao concluded, "from plowing to harvesting, one mu needs more than 10 workdays" (PMNZ: 32).

About the pay of a workday, Jiang Gao said: "For the seasonal labor, … a workday is paid 200 copper coins (including wage and all expenses in food, wine, tobacco). Since one mu of paddy needs about 10 workdays, the food (including wine and tobacco) and wage together cost 2,000 copper coins" (PMNZ: 33). It is confirmed by Shen Jingxian: "Recently, …from plowing to harvesting, one mu of rice needs about 10 workdays. If wage labor is used, one mu needs more than 2,000 copper coins". He added that pumping labor per mu costs about 500 copper coins[19].

If the cost of pumping water is not counted in (because pumping was not needed every year), therefore, labor input per mu of paddy was about 2,000 copper coins.

(2) Fertilizer

In the early nineteenth-century Pumao area, "rich farmers fertilize their fields three times. For the first time they use alfalfa", "for the second time they apply pigpen manure, 10 piculs of manure a

[18] Shen Jingxian: *Pudong caotang biji* (Jottings Written in the Cottage east of Huangpu River). Cited in Wei Jinyu 1983.

[19] Idem.

mu of paddy. For the third time, bean cakes are top dressed, 40-50 catties of bean cakes a mu". For ordinary farmers, little alfalfa was used after 1823 and alfalfa is not counted in here. This practice is quite similar with that in 1930s[20]. About the prices of pigpen mature and bean cakes, Jiang Gao told: "Pigpen manure is expensive in summer. Ten piculs cost one silver dollar", while one picul of bean cakes "costs about 2,000 copper coins generally"(PMNZ: 21). By the conversion standard between copper coin and silver in 1830-33, one picul of pigpen cost about 100 copper coins[21]. One mu of paddy needed 0.4-0.5 picul of bean cakes (here we take the mean of 0.45 picul), which cost about 900 copper coins. Together, as Jiang Gao concluded, "Fertilizer cost 2,000 copper coins [for one mu of rice]" PMNZ (33).

(3) Seeds and tools

The price of rice seeds was 300 copper coins a dou in 1834, and 1.2 dou was needed for one mu of paddy (PMNZ: 10). The expense for seeds was 360 copper coins a mu of paddy, therefore. *Pumao nongzi* listed the prices of all kinds of farm tools and implements, but the farmer did not need to buy them every year and the costs of depreciation were not big in most cases[22]. For this reason, the costs in tools and implements are omitted here.

Taking labor, fertilizer and seeds together, the total input is 43,600 copper coins for a model farm with 10 mu of paddy. This figure will be larger if the costs for tools, pumping water and other services are counted in.

(4) Fodder

As is mentioned above, a farm (or a peasant family), usually kept one sow and a litter (6 shoats here) in the Pumao area. In the early nineteenth century, pigs were fed with bean cakes and bean dregs. Calculating the figures in *Shenshi nongshu*, one sow needed 1,000 catties of bean cakes a year[23], while six shoats (raising for half year) needed 1,800 catties. Together, all the pigs ate 2,800

[20] PMNZ: 20, 21. In the 1930s, alfalfa was used as base fertilizer (but in 40% of fields, no base fertilizer was applied). Topdressing fertilizer was applied twice. The first one was applied after the festival of "Slight Heat" (usually about July 7), with 7-8 piculs of pigpen manure. The second one was after the festival of "Great Heat" (usually about July 23), with 40-50 catties of bean cakes (SJXZ: 324).

[21] I dollar weighed 0.72 tael. The silver-copper coin conversion ratio was 1: 1,370 in 1830-33 (Lin Manhong 1993). Therefore, 1 dollar was approximately converted about 986 copper coins.

[22] In addition, prices for draft animals (oxen and water buffaloes) were also listed (PMNZ: 24). We do not count draft animals in here because the majority of peasant families did not keep draft animals in this period.

[23] Ref. Chen Hengli 1983: 88-91. In the mid-twentieth century, a sow was provided 480-540 kilograms of fodder a year in Songjiang County (SJXZ: 386).

catties, or 1.8 times the fodder for a sow. In the early 1830 price, fodder for a sow cost about 20,000 copper coins[24]. Accordingly, the fodder for a sow with a litter (6 shoats) cost 56,000 copper coins.

In sum, all the expenses in rice farming and pig breeding amount to 99,000 copper coins (here taking as 100,000). This is the total input in a farm.

2. Outputs

(1) Rice

Jiang Gao said: "Recently, just two odd shi of [husked] rice is yielded in a mu of paddy worked by rich farmers and in bumper years. One shi is paid as rent and another one shi is spent for productive costs. The rest is too little to maintain everything. The situation is particularly bad after the 1823 flood because even the two-shi yield is seldom seen" (PMNZ: 33). According to him, average yield per mu of paddy should have been less than two shi in the early 1830s. If it were true, however, nobody would have been willing to cultivate, since farming could produce no surplus to keep farmers and their families. In fact, it can be seen clearly from other materials on agriculture in the Yangzi Delta during the seventeenth through nineteenth century that at least a few dou of husked rice were left after rent was paid and productive costs were deducted[25]. If only 3 dou of rice was left as a surplus, yield per mu would be 2.3 shi of rice in the early 1830s[26]. It is told in *Pumao nongzi* (23) that the total productive cost of one mu of paddy was 4,000 copper coins and it was equal to one shi of rice. From this it is certain that the price of rice per shi should be 4,000 coins in the early 1830[27].

Since one mu of paddy yielded 2.3 shi of rice and 1 shi was priced at 4,000 copper coins, the output of one mu was 9,200 copper coins. Accordingly, the total production of a farm with 10 mu was 92,000 copper coins.

[24] PMNZ (22): "What a sow eats a day costs 50-60 copper coins". Here we take the mean of 55 coins.

[25] Li Bozhong 1996D. In fact, even in the extremely recessionary period immediately after the Taiping Rebellion, there still was a surplus of 2 odd dou in neighboring Suzhou which was ravaged very badly in the rebellion.

[26] In the 1930s and 1940s, yield of rice per mu was 150-200 kilograms in Songjiang County, or 2.1-2.7 shi. Even in 1949, the ending year of decades-long wars and civil wars, yield was still 157 kilograms (about 2.1 shi) (SJXZ: 323). The figure of 2.3 shi should be closed to the reality.

[27] Jiang Gao said: "The price of rice is reckoned at 6,000 copper coins this year" (PMNZ: 35). But this is not the market price, but the round-tripping price that farmers had to pay when they borrowed grain in the transmission of spring and summer from usurers.

(2) Pigs

Jiang Gao did not refer to the income from pig breeding. According to *Shenshi nongshu*, a shoat produced about 90 catties of pork after half-year raising, and a litter (6 shoats) produced more than 500 catties (here taking 500 catties). Calculating the figures in *Pumao nongzi*, a catty of pork was priced at 80 copper coins in the early 1830s[28]. 500 catties would cost 40,000 copper coins. In addition to pork, the pigs produced about 100 piculs of manure, which was worth 10,000 copper coins in the early 1830s. Taking pork and manure together, the output of pig breeding amounts to 50,000 copper coins.

Conclusively, the total output of a farm was 142,000 copper coins (here taking 140,000 coins).

VII. On the Horn of a Dilemma

Since the total input and output was 100,000 and 140,000 copper coins respectively, the farm's account showed a favorable balance of 40,000 copper coins. This is the surplus that the farm had, which is equal to 10 shi of husked rice approximately by the 1834 price. Now, a big problem arises. After rent (10 shi of rice) was paid, nothing was left, or net production was zero. It means that farming was completely unprofitable.

In order to survive, farmers had to try their best to be off the hook. The major measures they took were two: reducing costs and increasing incomes.

Since labor and fertilizer were the two biggest items in all of farm inputs, it would be most important to cut the expenditure in these items when farmers tried to reduce productive costs. A measure commonly adopted was to replace wage labor with subordinate labor within peasant families[29]. In a best situation, the replacement could cut down on expenditure in labor by half[30]. For

[28] PMNZ (33): "In busy seasons, a hired labor is provided with diet of about two sheng of rice, half catty of pork, and vegetables, tobacco and wine. The last three items cost 30 copper coins. Daily wage is 50 copper coins. Together, the total cost is 200 copper coins a day". Because 2 sheng of rice was worth 80 coins, vegetables, tobacco and wine together cost 30 coins and wage was 50 coins, the rest was the expense of half catty of pork. One catty of pork, therefore, was worth 80 copper coins.

[29] For example, female labor. PMNZ (38): "Farmwives work extremely hard. Besides preparing food for their husbands, they have to work with the men in pumping water and weeding fields". But most of them had not worked in the field before (Li Bozhong 1996B, 1996C, 2001).

[30] PMNZ (33): "If farmers cultivate their fields only with labor from their families or from their neighbors through labor exchange, the expenditure will probably be less, but the total cost per mu of paddy is still more than

fertilizer, river mud was used as the major substitute of other kinds of fertilizer[31], and the cost could be reduced 500 copper coins at the maximum[32]. If the two methods were used, the expense in one mu of paddy would be reduced by 1,500 copper coins, or 15,000 for a farm.

For farmers, the major source to increase income was to increase double cropping, in particular because "no rent is needed to paid customarily if winter crops are planted, no matter that it is wheat, barley or rapeseed" (PMNZ: 29). Though few winter crops were sown after 1823 in the Pumao area, farmers did their best to cultivate the crops wherever conditions permitted. It is told in *Pumao nongzi* that winter crops were still planted in a limited extent. Among the crops, rapeseed seems to be planted more widely than others because it fits with the wetness better[33]. Yield per mu of rapeseed was about 1 shi in the period[34]. Bao Shichen said in 1800 that in the Yangzi Delta both the income and the expenditure (in labor and fertilizer) per mu of rapeseed was similar to those of wheat/barley[35]. In *Pumao nongz*i, both the income and the expense in labor and fertilizer per mu of wheat/barley was 1,000 copper coins in 1834[36]. But it is not the case with rapeseed. We don't really know what the price was in the early 1830s, but in the late eighteenth and early nineteenth century,

three thousand coins". In other words, the cost was reduced by 1,000 coins compared with the cost of 4,000 coins in common management.

[31] PMNZ (23): "In easy seasons of late autumn and spring, [farmers] dredge river mud. Loaded up on boats and then piled by fields, the mud is mixed with weed taken form the fields. After the mixture is rotten and dry, it is broken into pieces and spread in the fields. Its fertility is equal to half of that of alfalfa".

[32] Shen Jingxian said: "Recently, the cost of fertilizer is 15,000 copper coins a mu of paddy" (cited in Wei Jinyu 1983). This should be the minimum expense.

[33] *Nongshi youwen* (On farm works I heard in my childhood), an agricultural handbook on Huzhou in the 1830s and 1840s, said: "Land is high east of Suzhou and wheat and barley are planted more. Land is low in my country of Huzhou and rapeseed planting is more suitable" (cited in the 1863 Nanxun zhenzhi, juan 21, in ZDJ-XZZ, vol.22, p.230).

[34] According to Bao Shichen (2001:10), yield per mu of rapeseed was 2 shi in Suzhou in around 1800. You Xiulin (1962) has suggested, however, that the figure of 2 shi per mu might be too high. In Songjiang County, yield of rapeseed per mu was 36.5 kilograms (about 0.49 shi) in 1935 and 34.4kilograms (about 0.48 shi) in the 1950s (SJXZ: 328). Considering that the period of 1823-34 was a period with unfavorable climate, we follow Chen Hengli's estimate on yield in Tongxiang in the late seventeenth century (Chen Hengli 1961: 34) and take 1 shi as the average yield here.

[35] Bao Shichen (2001:10) said: "Benefit from rapeseed per mu is the same with to that of wheat and barley, and such are the case with inputs of both labor input and fertilizer. Moreover, rapeseed provides as many stalks as wheat and barley do which are used as fuel".

[36] PMNZ (29): "Wheat and barley: from plowing and seeding, then earthing and fertilizing, expenditure in labor and fertilizer amounts to 500-800 copper coins, which does not include the cost of seeds. But even in good harvest years, a mu of wheat and barley yields only one odd shi, valued at about 1,000 coins and just in balance with the expenditure".

wheat/barley price was usually 70 percent of rice price in the neighboring Suzhou (Li Bozhong 1999A), and the low wheat/barley price in 1834 was exceptional. If we take 70 percent of rice price as rapeseed price, it would be 2,800 copper coins in the early 1830s, though the estimate is probably too low[37]. Therefore, the net income per rapeseed was considerably higher than that of wheat/barley. If we assume that rapeseed was planted in two mu of fields[38], a net income of 3,600 copper coins would be achieved[39]. Jiang Gao emphasized the benefits of rapeseed planting: "Oil is pressed from rapeseed. Only part of the oil is left for the use of the family, and the rest is sold for money which will be invested in farming". Moreover, even "fallen branches and leaves of rapeseed can be used as fertilizer" (PMNZ: 28). Even broad beans and wheat and barley, which "love dryness and dislike wetness", were planted scattered. They were important in the transition between spring and summer when grain storage was exhausted (PMNZ: 28, 29). Double cropping, therefore, did become the major source of increases of income.

If income was increased by 3,600 and expenditure was reduced by 15,000 copper coins, the net income would rise by 18,600 copper coins, or 4.7 shi of rice in the 1834 price. By the standard of grain consumption in the pre-modern Yangzi Delta, it can feed about 1.6 persons[40], in addition to the farmer himself.

The measures above are not very helpful, however. First, the replacement of wage labor with subordinate labor and of bean cakes or pigpen manure with river mud means decrease of quality of labor and fertilizer, which leads to lower productivity[41]. Second, the use of these methods is limited

[37] No price records of rapeseed are available. The only information about the price I have found is in the 1638 Wucheng xianzhi (Gazetteer of Wucheng County), which said "the price of rapeseed is the same with that of rice" (cited in the 1863 Nanxun zhenzhi, juan 21, in ZDJ-XZZ, vol.22, p.227).

[38] This means that cropping index was 120, if alfalfa is not counted in. In Songjiang County, cropping index (alfalfa is not counted in) was 110 before 1949, and 150 in 1956 (SJXZ: 320, 324). Judged with these, a cropping index of 120 for the period under study seems not too high or low.

[39] The price of 1 shi of rapeseed was 2,800 copper coins, while yield was 1 shi and productive cost was 1,000 coins. In fact, however, the net input of fertilizer per mu of rapeseed was much less than that of wheat/barley, because rapeseed produces rapeseed cakes which go back into fields as fertilizer (You Xiulin 1962). Bao Shichen (2001:10) suggested that "wheat/barley exhausts soil fertility", but "rapeseed per mu produces 120 catties of rapeseed cakes with which 3 mu of paddy can be fertilized"; these rapeseed cakes "can recoup the loss of soil power caused with wheat and barley". The net income, therefore, would be higher.

[40] Bao Shichen (2001: 58) suggested that in the early nineteenth century Suzhou, "a person eats three shi of rice, if all the men and women, the old and the young, are counted in".

[41] As is shown in my previous works, in the Yangzi Delta during the period of the seventeenth through the mid-nineteenth century, in spite that wages were rising, farmers still preferred to use wage labor in busy seasons, not subsidiary labor of their wives. The major reason is that labor productivity of women was lower in the field (Li

with many factors. For example, river mud was used as the substitute of bean cakes or pigpen manure, but river mud dredging is very labor consuming[42]. Virtually, the replacement can be seen as a substitute of material resources with labor, but any increase of labor input is limited by existing labor resources. Moreover, even the supply of river mud is not infinite in a certain place (Chen Hengli 1961: 255). Third, expanding of double cropping was the major ways to increase income in a farm, but it is difficult to expand more because much of land was often inundated in winter. Therefore, by these measures farmers could not escape from the pitfall that they had fallen in.

Two things outside farming might be helpful: rural industrialization and favorable movements of price. Here we'll deal with them briefly.

First, rural industrialization is one of the most phenomena in economic history of the Yangzi Delta during the late imperial times, and cotton textile industry was the major sector of rural industry. Songjiang Prefecture, where the Pumao area was located, was the center of cotton industry of China of the day. In the eighteenth and early nineteenth centuries, almost all families spun and woven in the countryside of the prefecture[43]. Spinning and weaving were carried mainly by women and became highly specialized. The income of a woman from spinning and weaving was approximately the same with the earnings of a man from farming. Cotton spinning and weaving, therefore, was another cornerstone of peasant economy in this area[44]. This was confirmed by Jiang Gao. He suggested: "Peasant women work extremely hard. …In slack seasons, they weave cotton and make cloth. In the past, the gains from weaving were enough to support the women themselves, and could be a big help to their home economy, if they were smart. Relying on it, peasants were not poor" (PMNZ: 38).

In the 1820s and 1830s, however, cotton textile industry came to a crisis, which led the income from spinning and weaving dropped sharply (Li Bozhong 1996D, 1999). Jiang Gao said: "In the past more than ten years, the market for cotton cloth has been bad, and cloth prices has gone down. In

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Bozhong 1996C). River mud was the main substitute of "normal" fertilizer such as pigpen manure and bean cakes, but its fertility is limited and was used mainly to improve soil structure.

[42] According to Chen Hengli's investigation in Jiaxing County near Songjiang in 1956, peasants had to spend 60% of working days in fetching river mud, because they had no other sources of supply of fertilizer (Chen Hengli 1961: 255).

[43] Xu Xinwu (1992: 211, 215) estimated that in Songjiang Prefecture more than 90% of rural families spun and wove in 1860.

[44] Li Bozhong 1996B, 1996C, 2001. In addition to herself, a female worker in cotton textile industry could keep other two or three persons.

addition, cotton has failed for four years. Because raw cotton is expensive but cloth is cheap, no benefit can be achieved from spinning and weaving. Women can do nothing but still sit and eat at home. The farmers cannot survive from the crop failure this year" (PMNZ: 38). For farming, therefore, cotton textile industry could not help any more in 1823-1834.

Second, because of its high dependence on China's national market, farm economy of the Pumao area was very sensitive to market changes. It seems logical that changes which took place in the early nineteenth century would be responsible for the depression of farm economy in the Pumao area. If we make a more careful analysis of price movements of major commodities which related most closely with agriculture in the Pumao area, however, we'll find that the inference of market changes on farm economy were quite complicated, not just unfavorable. For example, the rise of rice price during the 1823-34 period was crucial to the balance of farm inputs and outputs. Jiangxi Gao made it clear, "For wage of farm worker, once the amount was set last year, it cannot be reduced afterwards", but if rice price went up faster, the employer still would be able to benefit from wage labor. Jiang Gao went on, during this period, everything had to be bought, but everything became more and more expensive, "if the price of rice was only 2,000 copper coins a picul, I am afraid that all the landlords and tenants wouldn't be able to survive" (PMNZ: 40). In this sense, the rise of rice price became the savior of farm economy of the Pumao area in 1823-34.

The fact that farm economy was highly commercialized in the Pumao area means that it was under control of the "invisible hand" of the market. Moreover, the market had broken away from local limits and integrated into China's national market before the nineteenth century (Li Bozhong 1999B). In the case of major commodities which concerned farm economy in the Pumao area (in particular rice and bean cakes), their prices were mainly decided or even completely decided by sources of supply outside the Pumao are even outside the Yangzi Delta[45]. In other words, farm economy in the Pumao area was subject to the powers it could not control, just as it was to the capricious climate. Unfortunately, we still don't know much about what role the uncontrolled market power played in farm economy in 1823-34 and how it did.

Because farmers could find no outlet, Jiang Gao bemoaned: "The people live in destitution and farming is becoming more and more difficult. In many farms, draft animals cannot be reared, farm

[45] The price was mainly decided by the import from the middle Yangzi River, while the price of bean cakes was almost completely decided by the import from North and Northeast China. In addition, cotton and cloth were two goods crucial to rural industry in this area. The price of cotton was decided by the import from the neighboring counties of Shanghai, Fengxian, Nanhui and others, while the price of cloth was decided by the export to the markets in other parts of China and foreign countries. See Li Bozhong 1998: ch. 6.

instruments are not complete, and fertilizer is not sufficient. Without enough labor, the fields are overgrown with weeds; without well-balanced weather, insect pests are destructive to rice. Farmers live at subsistence level year after year. In some cases, they have to sell their wives and children. Many unemployed farmers have starved to death. Even those who are hardworking and thrifty and have fields to farm look famished. The main reason is that soil power has become weak. Even the Heaven helps out of charity and makes climate normal, poor [land] cannot become rich, barren [soil] cannot change into fertile. Oh, it's really terrible!" (PMNZ: 39).

VIII. Conclusion

Agricultural efficiency, to which farm labor productivity is crucial, can be defined in different ways[46]. In practice all of these matters, once an economy is commercialized, and what techniques and production practices are adopted, will be influenced by various trade-offs between them. No single criterion normally dominates. Here we take the most common definition, which sees farm labor productivity as the amount of output per worker in terms of per unit of labor input (Perkins 1986: 87, Crafts 1994).

From the above analysis, we can see that the annual production of a farmer (or a farm) was about 23 shi of husked rice (approximately 1 ton) and 500 catties of pork (approximately 0.5 ton) in the Pumao area in 1823-34. In the terms of products in kinds, farm labor productivity was not low, by the standard of the mid-twentieth century Songjiang County. The production per "agricultural person" was only 427.5 kilograms in 1949[47], or the production per family (or per farm) was 1,750 kilograms in 1949, or 23 shi[48], just the same with the figure we arrived at. As for pork production, a farm produced about 500 catties of pork a year in the early 1830s, but only 250 catties in the mid-1950s[49], half of the former figure[50]. If some other criteria are taken, we still arrive at a similar

[46] In his letter of July 11, 2000 to Li Bozhong, Mark Elvin suggested that at least five possible definitions of 'efficiency' are (1) the ratio of energy put in (mainly human and animal work, but also that embodied in fertilizers and fuels) to energy produced (food and fodder); (2) the ratio of economic costs measured in money to the economic returns measured in money; (3) output of grain or other crops per unit of land farmed either per harvest or per year (which may have two or more harvests); (4) the ratio of the input of seeds to the output in seeds ('grain'), often called the 'seed-to-yield ratio'; (5) the output per hour or per day worked per worker, and so on.

[47] SJXZ: 332. It was 561.25 kilograms in the 1950s. But because of the collectivization and communization from 1956, traditional family farming ended in the late 1950s. Moreover, the quality of statistic figures of the late 1950s is very poor because of the "Great Leap" movement.

[48] A rural family had 4.1 persons in average in 1953 (SJXZ: 153).

[49] In Songjiang County, the amount of cultivated land was 11.4 mu per peasant family in 1950 and the number of pigs per mu was 0.31 in 1956 (SJXZ: 298,300, 388). Averagely, a peasant family had 3.4 pigs. In 1956, one third

conclusion. For example, in 1823-34, the seed-to-yield ratio (the ratio of the input of seeds to the output in seeds was 1:380[51], while 5.7 workdays were needed to produce a shi of rice, or one workday produced 0.2 shi of rice[52]. These are very close to those in 1930s and early 1950s.

If we look at the balance of inputs and outputs, however, we can see a different picture. After productive costs were deducted, the net production was close to zero. It means that farming was unprofitable. Even worse, nothing could help farmers to escape from the dilemma. This was a very depressing period indeed.

Jiang Gao reiterated in *Pumao nongzhi* that the pre-1823 situations had been much better and the year of 1823 was the turning point, both climatically and economically. It is clear that farm labor productivity should have been higher before 1823. Then, what was the situation before 1823? Or, what degree did farm labor productivity reach in the late eighteenth century? This is what we should study. This paper has provided a starting point for the further study of farm labor productivity in the eighteenth century. In this sense, this paper does not close the discussion, but is just the beginning of it.

Weights and Measures

1. Traditional Chinese Measure Systems

   1 catty (jin) = 16 taels (liang) = 160 qian

   1 picul (dan) = 100 catties

   1 shi = 10 dou = 100 sheng

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of the pigs was sold after one year breeding and with an average weight of 60 kilograms (SJXZ: 387, 388). Accordingly, a peasant family sold 1.1 pigs a year and the pork was about 110 catties if the meat percentage was 85%. Meanwhile, the family slaughtered 1.3 pigs for its self-consumption (it usually kept one sow). Therefore, the total pork production would be 250 catties.

[50] The difference is not difficult to explain. As Chen Hengli (1983: 90) pointed out, in pig breeding, concentrate was used less in the mid-1950s than in the late seventeenth century. Because major concentrate, or bean cakes, was expensive, peasants had to feed pigs mainly with rice bran which was of lower quality. In the early nineteenth century, however, supply of bean cakes was much more sufficient than both in the late seventeenth century and in the mid-1950s (Li Bozhong 2002: ch 8). With bean cakes as major fodder, pigs grew faster.

[51] The amount of seeds of a mu paddy was 0.12 shi of unhusked rice (equal to 0.06 shi of husked rice), while the yield was 23 shi.

[52] Yield per mu of paddy was 2.3 of husked rice, while labor input per mu of paddy was 13.

1 mu = 60 square zhang =24 bu

2. Qing Measures (approximations only. See Li Bozhong 1990: 12-13)

1 catty =1.19 market catty = 0.60 kilogram

1 picul = 1.19 market picul =59.5 kilograms

1 shi = 1.03 market shi = 103 litres = 22.66 English gallons

1 mu = 0.92 market mu = 6.14 are = 0.15 acre

3. Weight and Volume Equivalences (market measure. See Chen Hengli 1958: 25, 34)

husked rice: 1 shi = 150 catties (or 1.5 piculs).

unhusked rice (paddy): 1 shi = 130 catties (or 1.3 piculs).

wheat: 1 shi = 140 catties (or 1.4 piculs)

beans: 1 shi = 140 catties (or 1.4 piculs).

rapeseed: 1 shi = 150 catties (or 1.5 piculs).

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Abbreviations

PMNZ: Pumao nongzi (A Report on agriculture in the Huangpu River and Mao Lake area). authored by Jiang Gao. originally published in 1834. Shanghai: Shanghai shudian, 1963.

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