

The task of irrigated rice cultivation in Japan. Alan Macfarlane

Rice was grown in irrigated fields in Japan. This meant that an immensely complex system of water control had to be developed. A good deal of the water could be taken to the appropriate terrace by using gradients and an elaborate system of dams and sluices which were copied from China. Thus Morse, for instance, described how 'These walls sustain level patches of land for cultivation, the irrigation coming from a mountain stream and the water running from terrace to terrace. The sides of these otherwise barren hills resembled a garden, a city park in fact.'¹ Yet, very often the water still needed to be raised from irrigation channel to individual fields. An obvious way to do this is to use the current of the stream for power, driving a wheel to raise buckets. This was a method early invented by the Chinese, and it was used in parts of Japan. Morse described 'A curious device for irrigating the rice-fields'. 'On the banks of a swift-running river a water wheel was adjusted and was slowly turned by the current. On the sides of the wheel were fastened square wooden buckets; as they dipped into the stream they became filled with water, and as the wheel rotated the water was spilled from the buckets into a trough which conveyed it into the fields beyond.'²

While this device was 'not uncommon in the southern provinces', Morse found that it was 'rare about Tokyo and farther north.'³ In central and northern areas, instead of letting the water take the strain, a much more labour-intensive, if flexible, system was used. The principle of lifting buckets on a wheel was the same, but instead of power being provided by water, it was produced by human muscle. Morse drew a figure showing a man coming down the road with the wheel and box carried in the usual manner. In the same sketch is a man treading the wheel and raising water from the ditch in the rice-field. The box is first fitted into the embankment, the wheel drops into appropriate sockets, a long pole is driven into the mud alongside the wheel, and holding onto this the man keeps his equilibrium and turns the wheel with his feet to lift the water from the channel to the field.⁴ Often more than one person provided power. 'It was interesting to see a tread wheel in which were two strong-looking samurai treading away patiently, supplying power for a certain portion of the machinery...'⁵ Or again, 'The water-wheel device for irrigation purposes was on a large scale. There were three big wheel on the same shaft and six men

¹ Morse, Day ii, p.140

² Morse, Day ii, p.51

³ Morse, Day ii, p.284

⁴ Morse, Day i, p.47

⁵ Morse, Day ii, p.271

treading them. Large tracks of rice-fields were being irrigated in this way.⁶ A device which could have saved this effort was known and used elsewhere in the country yet people opted for this method. The reasons for this and other peculiarities will be considered later.

Once the fields were irrigated, they needed to be broken up. In fact, often these processes occur together, with a first breaking up of the hard soil left from the previous crop, and cleaning of weeds, some irrigating, and a further breaking of the soil. The soil is usually baked hard and it is extremely difficult to turn over. This is one of the prime opportunities to apply non-human power, namely oxen or, even more powerfully, horses, as plough animals. It appears that in the sixteenth and seventeenth century and perhaps before, animal power was used quite extensively for ploughing. In the early seventeenth century (XXX date?) it was noted of the Japanese that 'They plow both with Oxen and Horses as wee doe heere.'⁷ Kaempfer had noted that 'On the road hither we saw great numbers of calves, which are nurs'd up for ploughing, the country hereabouts being reckon'd the best in Japan for wheat and barley.'⁸

Thunberg described a mixture of hoeing and ploughing. 'In the beginning of April, the farmers began to turn over the ground that was intended for rice. The ground was turned up with a hoe, that was somewhat crooked, with a handle on it and was a foot in length, and of a hand's breadth. Such rice fields as lay low, and quite under the water, were ploughed with an ox or cow...'⁹

Alcock provided a picture of Japanese ploughing¹⁰ Morse describes 'a farmer going to his ovrk carrying a plough on his shoulder. It is dragged by a single bull. The point is tipped with iron and the plough is typical of the region, for there are many types of ploughs in different parts of the country.'¹¹ He adds that 'In mountain regions bulls are used to drag ploughs, and cows are used in softer ground so that boys can do the work.'¹² There are many varieties of plough. The varieties of ploughs in Japan are

⁶ Morse, Day i, p.116; for continued use into the 1950s, see Beardsley (ed), Japan, p.131

⁷Purchas, Pilgrims, 147

⁸ Kaempfer, History, 3, p.202

⁹Thunberg, Travels, iii, 137

¹⁰Alcock, Tycoon, i, 295

¹¹Morse, day ii, 139

¹²Morse, Day ii, 332

very interesting. The type is after the Chinese style, but the forms in different provinces are quite marked.¹³ It would appear, however, that humans also pulled special ploughs; 'peculiar shovel made of wood tipped with iron, The shovel part was over three feet in length and the handle seven feet long. It is used through the western part of this province (Musashi) and seems to take the place of the plough.'¹⁴

In fact, what seems to have happened, is that the Japanese moved from the plough to the hoe as the population built up in the seventeenth century. We can deduce this from the absence of plough animals by the end of the eighteenth century. Horses were not used for ploughing and were in any case very few in number, 'The small number of **horses** to be met with in this country, is chiefly for the use of their princes; some are employed as beasts of burden, and others serve travellers to ride on. Indeed I do not suppose that the sum total of all their horses amounts to the number of those made use of in one single town in Sweden.'¹⁵ As for oxen and cows, 'they seem to have a still smaller number...the sole use they make of them is sometimes for drawing carts, and for ploughing such fields as lie almost constantly under water.'¹⁶

Hayami has provided a useful overview of what happened. 'Instead of a plow drawn by livestock, a hoe or spade using human labor became the main plowing tool. This means that the labor that had been carried out earlier by horse-power now came to be done by man-power.'¹⁷ Whereas there had been considerable numbers of draft animals to the end of the seventeenth century, 'after that, their number obviously declined.'¹⁸

Before the ploughing, the banks would have to be cleared of weeds, and after the ploughing the lumps broken up. For this and other stages, and perhaps in some areas where livestock were not available, a hoe was used. Morse was both impressed by the design of this hoe and aware of the strain it put on the human back. 'The cutting edges are slightly curved inward and this insures the cutting of roots in digging,

¹³Morse, Day ii, 331

¹⁴Morse, Day ii, 326

¹⁵Thunberg, Travels, iv, 94/5

¹⁶Thunberg, Travels, iv, 95

¹⁷Hayami, Population Growth (xerox), 37

¹⁸idem

whereas in our shovel and hoe, rounding the other way, the roots are liable to slip off sideways.¹⁹ On the other hand, he thought that 'The Japanese hoe is a very clumsy-looking object. It is much lighter than it seems. The iron part is thin and the wooden part fits into it like a dovetail joint. In using it the man has to stoop a good deal, but the habits of these people in bowing low, in carrying children on the back when young, and in planting their rice all tend to develop a back of great strength.²⁰

Once the land was prepared for transplanting of seedlings, there was really no way of mechanizing the process. Alcock describes people '...nearly up to their knees in a malodorous mud field, take each their basket of young plants, and separating them into small bundles, fix them at a space of about six inches apart, into the less fluid soil below, with no other implement than their hands.²¹ Numerous further stages then occur, the constant weeding, the harvesting, and so on. As yet I do not know whether animals were used in the threshing, as they can be, to help separate the grain by trampling it. This seems unlikely, for flails were widely used, though they were different in shape from western flails.²² One invention which was said to have impoverished widows who used to do the work, is described by Smith. 'Nagatsune cited the case of one anonymous invention, the **senbakoki** (or **mugikoki**, as he called it), one of the most important farm tools developed in the Tokugawa period. It consisted of a waist-high frame fitted with bamboo or iron teeth through which stalks of rice or other cereal were pulled to strip away the heads of grain.²³

Once the grain had been brought back to the house, it has to be prepared for use. An immense amount of energy has to be used to de-husk grains and this was one of the areas where water mills became so useful in Europe and in many parts of the world. Given the numerous rushing streams and heavy rainfall of Japan, we would have expected water mills to be widely used at this stage. The principle of water-driven machinery was widely known. Mills could not only help with rice, but also with the equally tedious and time-consuming work of grinding beans and other crops. Such machines were used in parts of China, as King noted in the early twentieth century. 'At several places on the rapid streams crossed, prototypes of the modern turbine water-wheel were installed, doing duty grinding beans or grain. As with native machinery everywhere in China, these wheels were reduced to the lowest terms and the

¹⁹ Morse, Day i, p.307

²⁰ Morse, Day i, p.65

²¹ Alcock, Tycoon, 2, p.71

²² Morse, Day i, p.66

²³ Smith, Sources, p.180

principle put to work almost unclothed.¹²⁴

Strangely enough, however, I have come across little evidence of the widespread use of water (or wind) mills for grinding grain in Japan. Instead, much more labour-intensive methods were used. One was the quern where, with immense effort of arms and shoulders, grain is ground between two heavy stones. Morse describes how 'The mill for grinding grain is turned by hand, and strong arms are required to turn it.'²⁵ This would turn grain into flour, but it is no use in taking off the outer, inedible, husk. To do this the Japanese used several methods, one of these is similar to that found all over the world, for instance in Nepal, where a heavy weight is dropped repeatedly on the rice until the husk is pounded off. 'The rice is hulled by a sort of trip-hammer made of wood and weighted with stone. This is worked by a man stepping on the end of the beam, thus raising it and letting it drop. This device has endured in China for two thousand years.'²⁶ Even in the heart of cities, people were employed for hour after hour to step on and off this kind of tread-mill. 'One may see this rice-pounding going on even in the city of Tokyo. The man is naked and is concealed by a curtain consisting of strands of straw rope, a convenient device, for one may pass through this curtain without delay.'²⁷ A picture of rice pounders is provided by Regamey.²⁸

It is not a particularly difficult task to devise a mechanism to allow water to raise and drop this weight. Moeran's book on pottery describes just such a device powered by water which is used to hammer clay. (Ref. XXX) Thunberg at the end of the eighteenth century saw some water-driven machines of this kind. Writing of rice husking, he observed 'Sometimes it was beaten with blocks which had a conical hole in them. These blocks were placed in two rows, generally four on each side, and raised by water, in the same manner as the wheel of a mill. In their fall they beat the rice so that the grain separated from the chaff.'²⁹ Alongside this was the foot-driven machine. 'Sometimes, when there was no opportunity for erecting similar water-works, a machine of this kind was worked by a man's foot; who at the same time also stirred the rice with a bamboo.'³⁰ Other grains were often beaten with flails. 'Barley, Wheat and

²⁴ King, *Farmers*, p.363

²⁵ Morse, *Day i*, p.55

²⁶ Morse, *Day i*, p.55

²⁷ Morse, *Day i*, p.56

²⁸ Regamey, *Art and Industry*, p.185

²⁹Thunberg, *Travels*, iii, 149; cf iv, 85

³⁰Thunberg, *Travels*, iii, 149

Cabbage-feed are all of them threshed out at times quite in a plain and artless manner, upon straw mats, in the open air, in the villages, and not unfrequently before the doors of their houses, with flails which have three swingles.³¹ One key to the use of hand methods, as opposed to machines, may have been the desire to keep the rice stored in the husk, and only to prepare small amounts as it was needed for eating. This is implied by Thunberg's comment that 'In private families I sometimes saw rice pounded in small quantities, and for daily use, in the same manner as on board of the ships, and at other places in the East Indies; that is in a hollowed block with a wooden pestalle.'³² He notes that having loosened the grains from the stalk, the threshing 'is seldom set about before the grain is wanted to be used...'³³

³¹Thunberg, *Travels*, iv, 87/88; cf also iii, 216

³²Thunberg, *Travels*, iii, 149

³³Thunberg, *Travels*, iv, 85