

# RICE: CULTIVATION AND TREATMENT\*

## WORLD PRODUCTION

**A**MONG tropical products, there is no crop so vast as rice; the geographical incidence of this cereal is probably more widespread than that of any other vegetable product, whether cereal or otherwise. There is no other food so universally employed: rice is the staple diet of nearly half the human race.

Rice yields vary from year to year and annual records of these yields are available in most of the agricultural journals of the world. The writer of these notes sees no reason, however, to modify appreciably the approximate figures collected a few years ago for his little handbook on "Rice",—which figures are reproduced here by courtesy of Sir Isaac Pitman & Sons.

The yields of husked rice credited to the principal rice-growing countries, per annum, are as follows:

	Tons
British India ... ..	35,000,000
The Japanese Empire ... ..	10,600,000
The Netherlands East Indies ... ..	4,250,000
French Indo-China ... ..	3,500,000
Siam ... ..	2,250,000

The United States of America, the Philippine Islands, Madagascar, Egypt and Italy, each produced from 350,000 to 600,000 tons per annum, varying according to seasonal conditions.

It should be noted, however, that while the average yield of the great Eastern rice countries may keep reasonably constant, the production of the smaller rice-producing countries may vary considerably from year to year merely because rice is not their principal crop, nor is its cultivation and treatment their principal industry: in these cases the extent of its cultivation in any year is governed by other and more important considerations.

The figures for the main rice countries are, however, sufficiently impressive. When one reads of 12 million acres under rice in Burma, another 12 or 13 million in the Central Provinces of India, with perhaps 40 million acres in Bengal, Bihar and Orissa (and an area probably at least equal to the sum of all these in China), one begins to realize the vast extent to which this particular cereal is grown.

Again, comparing Oriental with Occidental production, the exportable surplus from Burma alone is equal to the total production of the United States of America, the Philippine Islands, Egypt, Spain, Italy, Brazil and Ceylon, all lumped together.

So much for the general total yield. There is, however, a notable difference in the yield per cultivated acre. While the yield of British Indian rices averages out at rather over half-a-ton per acre, yield in Japan, Spain, and Egypt, and also in British Guiana, average out three times as high.

\* By C. E. Douglas in *Tropical Agriculture*, Vol. VII, No. 7.

The writer has personally met with not specially isolated cases where the yields have been as high as three to three-and-a-half tons per acre, and that in areas not prepared, manured or irrigated in any special way with a view to high yields.

## VARIETIES

Turning now to varieties, we know that there are, literally, several thousands of these: but neither the merchant nor the housewife—who, in Europe and America at least is the ultimate criterion, is concerned with such distinctions, but only with three or four types.

In certain areas, special rices are grown which never appear in the world markets, except as curiosities: they are grown for local demands and, however valuable they may be within the limits of these localities they have no place in the world's commerce.

Take, for instance, the fine small rices of Tonkin; the red Sabaini (so called 70-day) rice of the Fayoum, in Egypt; or the small Muttusamba rice of Ceylon: these are perfectly good as food and even no doubt highly prized by the people living in their area of production. Outside that area, however, such rices are unknown and create no demand.

Roughly speaking, the world's markets demand three standardized types which may be classified as Japanese, Patna and American. Burma rice stands almost by itself, and yet, as might be expected in a country having such vast areas under cultivation, there are some definitely different types among well over 1,000 varieties cultivated there.

It is not proposed to deal at length here with the production of any specific area, but rather to give a general review of the subject as the result of observations in different countries visited by the writer.

The three main types referred to above are quite definitely distinguishable.

1. *Japanese Type*.—This is an almost round, barley type grain which has been successfully cultivated in many lands outside Japan, notably in Spain and Egypt.

As paddy, i.e., in the husk, this grain runs about 7 mm. long by  $3\frac{1}{2}$  mm. wide by  $2\frac{1}{2}$  mm. thick: shelled, or after the husk is removed, the corresponding dimensions become, say, 5 mm. by 3 mm. by 2 mm.

2. *Patna Type*.—This is a relatively long, thin, cylindrical grain as far opposed as possible to the Japanese type. Siamese rice is similar in form. The average dimensions of the paddy run to  $10\frac{1}{2}$  to 11 mm. by  $2\frac{3}{4}$  mm. by 2 mm. while the shelled rice runs about  $7\frac{1}{2}$  mm. by 2 to  $2\frac{1}{4}$  mm. wide by  $1\frac{3}{4}$  mm. thick.

3. *American Type*.—The well-known Carolina rice is chosen in this comparison because it is a recognized standard variety of distinction, commanding a high price in the world's market.

As paddy, this grain runs from 9 to 10 mm. long by 3 to  $3\frac{1}{4}$  mm. wide by  $2\frac{1}{2}$  mm. thick: the corresponding dimensions of the shelled rice are 7 mm. by  $2\frac{1}{2}$  mm. by 2 mm.

Generally speaking, genuine Carolina rice fetches the highest price, running to as much as £30 a ton, and over. Genuine Patna rice comes next, at round about £26 to £27 per ton. Spanish-Japanese type rice varies in price more than the other two, but has run from £16 to £19 during 1929. Burma rice, while of admirable quality and having a food value at least equal to that of the more expensive varieties, runs from about £12 to £15 per ton.

## RICE CULTIVATION

Apart from Western countries where wages are much higher than in the East, and where more money, and the latest agricultural machinery are alike available, there is little difference between the methods of cultivation adopted in one Oriental country compared with another.

It is remarkable how closely individual grains of recognized standard varieties conform not only to type but as regards dimensions. An interesting comparison can be instituted by setting out diagrams indicating the length, width, and thickness of the individual paddy grains. The length of the diagram is, say, six times the length of the grain, the width of the centre six times the breadth of the grain, the width at each end is six times the thickness of the grain. Even if several diagrams, based on the dimensions of similar type grains, are made and superimposed on one another, such variations as may well occur in individual grains are found to be confined within narrow limits.

Three conditions are essential for growing rice: plenty of water, an impervious subsoil to prevent that water from draining away, and an adequate temperature.

A medium loam is a suitable soil in which to grow rice, provided always that it can retain water. Water there must be, whether obtained from natural rainfall over a sufficiently extended period, as in India, Siam, French Indo-China, Japan and Java; or by irrigation only and not from rainfall, as, for example, in Egypt, and to a great extent in Italy.

The usual procedure is to plough the land thoroughly in the Spring or immediately the first rains have softened it sufficiently; it is then harrowed and levelled and probably ploughed again. A level rice field is essential otherwise it is impossible to maintain an even depth of water over the soil.

Almost universally throughout the East ploughing is done by a pair of oxen, the plough being of the simplest possible description. Deep ploughing is not necessary for rice. The use of light American ploughs operated by motor tractors is now becoming more common, although such machinery is far beyond the dreams of the great majority of Eastern cultivators.

While a pair of oxen will plough on the average three quarters of an acre per day, a light tractor plough can easily deal with six acres in the same time.

Tractors, if employed, must have amply broad wheels; in certain districts depending on the nature of the soil, tractors with caterpillar wheels are almost essential.

At this point, a word about manure is appropriate. Heavy cropping occurs, year after year, in British Guiana, without using manure of any description. In Egypt, apart from experimental plot work, the only manurial effect is obtained by sowing berseem or clover, among the rice as it comes to maturity. After the rice is harvested, cattle are turned on to the field to graze, and ultimately, the berseem roots together with the old rice stubble are ploughed in.

In some of the important rice areas in the United States of America soya bean is planted as a green manure: all such leguminous crops are of great value to rice.

Farmyard manure is excellent, but difficult to collect and distribute in countries where millions of acres are under rice; for the same reason, as well as on the score of expense, the application of chemical manures is strictly limited. In any case, the application of artificial manures should only be done in consultation with a soil chemist.

In Japan—as in China—a dressing compounded of green and farm-yard manures and village sewage, is almost universally employed, with highly satisfactory results.

### SEED SELECTION

While this obviously is of primary importance, it constitutes a very difficult problem in the great rice-growing countries of the East, where production is in millions, and seeds must, therefore, be reckoned in tens of thousands of tons. Japan, more than any other great rice country, has more or less solved the problem by most rigorous inspection in all the rice-growing prefectures. In a highly developed agricultural country like the United States of America, seed selection becomes a relatively simple matter, the more so as the total quantity grown in the Southern States and in California combined, is only a fraction of the production of British India alone.

The smaller the area under cultivation, the more easily can the difficulty be got over. It is a trivial matter to grade and specially select one ton of seed to produce 50 or 100 tons of paddy; but how to set about the selection of the quantity of seed necessary to yield several million tons of paddy is a problem of infinitely greater magnitude. It can only be dealt with by the gradual introduction, in the most favourable areas, of seed selecting stations and seed farms, and the gradual extension of the system as and when circumstances permit.

Various mechanical methods of seed selection, have been tried in different countries. Naturally, the principal object of seed selection is to get uniform grain—uniform not only as to its behaviour in the field, its time of maturity and its yield—but also as to its physical characteristic on milling, and its subsequent appearance on the market.

Paddies which grow with a long awn or beard at the end of the grain are a curse to the good miller, though the rice itself may be excellent. Rices which exhibit a red cuticle surrounding the kernel under the husk are also most annoying; they require an unnecessarily high degree of milling—often involving considerable breakage of the grain—before commercially attractive white rice can be produced.

Personally, the writer would say: “rot up and burn all awned and red rice”; there are plenty of other varieties to select from.

Selection being more or less satisfactorily effected, the seed is frequently placed in bags which are well soaked in water and then covered over with mats to start germination; immediately after which it is sown, the surface of the soil having previously been well puddled.

In America, rice is sown by drills but in the East it is broadcast—at least as regards the nursery beds. As soon as the seed has taken root, water is admitted to the field and a depth of from five to six inches is maintained, if possible, during the whole period of growth.

Rice is preferably sown in nursery beds, from which after four to six weeks, it is transplanted to the main fields, which of course must also be levelled, puddled and watered to receive the seedlings. These are planted in rows some eight or nine inches apart, two or three seedlings to each hole.

### HARVESTING

The life period of different rices varies considerably; in some cases it is as short as 80 or 90 days, as for example, in the case of Sabaini rice in Egypt; in other cases, it may require a period of 200 or 210 days, or even more, to attain maturity. From 140 to 150 days is a fair average:

generally speaking, the longer the period of growth, the better the rice. Efforts have been made to find a reliable short-dated variety suitable for conditions and countries where rainfall is deficient or irrigation supplies are difficult: but up to the present, it may be stated in general terms that even 120 days is little enough time in which to expect a sound crop.

When the grain is ripe, it is customary to run all water off the fields two or three weeks before harvesting, so as to allow the ground to dry out.

While in America reaping is done by machine, by far the bulk of the world's supply is harvested by hand, being cut with a longer or a shorter straw according to local requirements. The remaining straw is left on the land and is either trampled down by cattle or is allowed to rot and is ploughed in next season. In certain cases it is burnt.

After the grain is cut, it should be stacked or hung in the open for two or three weeks, if possible, in order to dry it out. It is dangerous to store damp grain. Thereafter, it is thrashed either by being trampled out by oxen (in which case the grain may be cut with a relatively short straw) or it is cut with a long straw, and thrashed by striking the grain over the edge of a tub, a sparred table, or even over a board set up on edge. Needless to say, all these methods are crude, slow and wasteful, but they are cheap, and they persist.

Properly designed mechanical thrashers are being increasingly employed to take the place of the older methods. These are usually most conveniently operated by crude oil, or paraffin engines. The machine may be stationary or portable, depending on local conditions: it may often be convenient to place the thrasher and engine in a barge, which can then be towed, by means of irrigation canals, to appropriate centres. Village districts may instal a machine to which the small cultivators can often conveniently enough convey their paddy in the straw. A well-designed rice thrasher will clean and dress the paddy.

Where mechanical thrashers are not employed, it is essential to clear the paddy which has been trodden out by oxen. It is impossible to prevent the grain thus thrashed becoming mixed with mud, straw and animal excreta; moreover, there is usually a certain amount of dead or immature grain; all this waste matter would be taken out in mechanical thrashers; but if these are not available, the trodden-out grain should at least be passed through suitably designed grain cleaners, to remove useless material.

## MILLING

We now come to the final treatment of the cleaned thrashed paddy. In India, in Ceylon, in British Guiana, and now to a considerable extent in Burma, the paddy is subjected to a preliminary process known as par-boiling. The process is carried out almost exclusively for the benefit of East Indian consumers, whether in their own or other countries.

The paddy is first steeped in warm water for a period varying from 20 to 30 hours, and, after draining, is then subjected for a period of 10 to 15 minutes, to the passage of low pressure steam. The sodden grain is then spread out on concrete floors and exposed for a day or two to the heat of the sun, which dries it uniformly. It is then ready for milling.

The advantages derived from this process are, that the grain is shelled with the greatest possible ease: that being greatly toughened by the process, it can be subjected to severe milling without too great loss from breakage: that it keep better; and that it is undoubtedly more nourishing than the white rice of European and Western commerce.

It is freely eaten and appreciated by Europeans living in the areas where it is prepared, while yellow or pale coffee colour when milled, it turns practically white on cooking.

Rosetta, in Egypt, has a method of rice preparation entirely its own. There the paddy is pounded in large mechanically operated mortars with an admixture of salt rock and gypsum. The resultant rice finds a ready market in the Levant but the writer has never come across a similar method of treatment outside Rosetta.

As far as the pounding is concerned, this is a more or less modern development of the crude method of milling adopted by most native races throughout the world. The mortar may be a hollow scooped out of the hard earth, or it may be a hole cut in the stump of a tree; the pestle may be a bamboo shod with an iron band and raised and lowered by hand, or it may be a ram of hard wood attached to one end of a pivoted wooden beam the other end of which is depressed and released by foot. The principle is the same; the process is slow, but the results are not too bad.

The primitive miller then scoops out the contents of his mortar and probably tosses them in the air to give the wind a chance of winnowing away the husk and light bits of broken grain. The balance is his rice of commerce.

Where the paddy has been previously toughened by par-boiling, or where its form and character is robust enough to stand the treatment, this machine does wonderfully good work. It requires, however, considerable power in relation to its output; it destroys the husk, and provides no means for the separation and recovery of the valuable bran (from the cuticle of the rice) or of the broken grain.

In small native mills treating four or five tons of paddy per day and producing par-boiled rice, or a second or third quality white rice, this machine has a definite place. Where it is a question of treating high grade white (unboiled) rice in considerable quantities, other methods are adopted.

It is perhaps difficult for the layman to appreciate that, in Burma, French Indo-China and Siam, there are probably hundreds of mills each treating several tons of paddy per day. One hundred tons of paddy will produce approximately 65 tons of rice. There are mills in Burma and in Indo-China capable of milling anywhere from 1,000 to 1,500 tons of paddy per mill per day.

In these modern mills, paddy-cleaning machines, of one design or another, are always installed because the miller can never be sure that all, or indeed any, of his incoming grain has been cleaned.

The clean paddy is then passed to the shellers, which consist of an upper fixed disc and a lower one rotating at high speed. Both discs are coated with a special mixture of emery and cement and the paddy is introduced through a central hole in the upper fixed disc. The distance between the emery faces and the discs can be adjusted—even while the machine is working—to suit the character of the grain.

The product of this machine is shelled grain mixed with a proportion of smaller still unshelled grain, and husk.

All this is passed through a winnowing or aspirating machine to remove the husk which is collected and used as fuel. All the mills in Burma, Siam and Indo-China are driven by steam engines and the only fuel used is the husk obtained from the paddy.

The shelled and unshelled rice are then passed to a special separator which divides the shelled from the unshelled grain. The latter is returned to the shellers, while the shelled grain is passed on to be whitened.

The shelled grain at this point is often termed "Loonzain", it is also shipped as "Cargo Rice", containing say from two per cent to five per cent of paddy and ten per cent of broken rice. As the husk is 20 per cent of the weight of the full paddy grains this weight is saved in shipment and the husk is retained as fuel. The brown, or Cargo rice (or 'Loonzain') is then often shipped to Europe and to America and Canada to be milled up to the required degree of finished white rice.

Whitening consists of removing the cuticle (which lies beneath the husk and surrounds the kernel) by attrition between a rapidly revolving iron cone—again covered with a mixture of emery and cement and a stationary wirecloth casing. The cuticle is rubbed off the kernel and passes through the meshes of the wirecloth as meal or bran. It is a most valuable cattle food as it contains from 16 per cent to 18 per cent of oil.

The now whitened rice may be, and often is, passed through yet another cone machine, coated perhaps with finer emery, and surrounded possibly by a lighter wirecloth. Thus the whitening process is continued; by using several cones in series, each lightly milling only a small percentage off the surface of the grain, a high degree of finish can be attained with a minimum of broken rice.

It is incorrect to speak of this rice as polished; it is only pearled or whitened, and it is not necessary to carry the process further. Modern markets, however, demand something even more attractive; when this is the case, the whitened rice is passed through polishers, consisting of wooden drums covered with sheepskin (wool exposed), the rice being rubbed by the soft skins against still finer wirecloth.

The surface of the grain is now white and smooth, but still further refinements are often adopted. The rice may be lightly steamed and oiled to give it a transparent appearance, or it may be revolved in a drum along with a previously prepared mixture of talc and glucose, which together impart an artificial glaze to the grains. This is known as glazed or coated rice, which has no merit beyond an attractive appearance. Incidentally, all the polish and glaze disappear when the rice goes into the cooking pot.

There are, of course, intermediate stages and auxiliary machinery for separating out broken rice, which, in large mills, is often carried to an accurate degree of classification. Graded broken white rice usually commands a good market; it is used for conversion into high-class laundry starch, into alcohol, for brewing, for making rice flour, and when finely crushed, for making face powder and pharmaceutical preparations.

In short, there is very little of the original grain lost in a modern mill. Husk, broken rough rice, bran or meal, whole rice and broken white rice are all recovered and bagged off for their particular use or market.

Accurate records are kept of input and outputs, and by this means it is possible to control, easily and intelligently, the most economical operation of a mill to suit varying market conditions.

This briefly, is the condensed story of the cultivation, and treatment of rice from start to finish.