Implemental and Mechanized Methods of Rice Production in Ceylon

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THE STAPLE DIET of the Ceylonese is rice. In the past, rice production in Ceylon was regarded as not worthwhile because of the low yields usually obtained and the low prices that persisted due to the availability of ample supplies of cheap rice from Burma. With the introduction of a State Guaranteed Price of Rs. 12 per bushel, the production of rice has been stimulated to a great extent. At present Ceylon imports nearly 439,000 tons of rice at a cost of about 325 million rupees. Efforts are now being made to lessen the dependence on supplies from abroad.

The present extent under rice in Ceylon is just over a million acres. The average size of a holding is about ¾ acre. In some cases, a single piece of land is owned by more than one owner. The smallest units of rice land holdings are in the Kandyan districts. On the other hand, in the Batticaloa district, holdings of ten acres or more in extent are common. The existence of small holdings which are totally uneconomic in size is due to the fragmentation of land aided by the laws of inheritance.

Climate and Soils

Climatically, Ceylon is divided into a wet zone and a dry zone. The wet zone has a satisfactory rainfall both in amount and distribution and favourable temperature and humidity conditions. It represents about one quarter of the land area of the Island, and of this, the low lying areas comprising about 250,000 acres are cultivated with rice. The dry zone extends over three-quarters of the Island and is climatically less favoured than the wet zone. The amounts, effectiveness, and distribution of rainfall in this region vary considerably according to the particular area and are very often unreliable and unpredictable.

Soils vary from light to heavy in texture and range from good to poor according to topography, locality, husbandry, &c. In the wet zone water conservation is less important than drainage for improving the physical, chemical and biological conditions. In the dry zone, however, soil and water conservation practices are of great importance. In the dry zone, large underground water supplies for irrigation purposes are not found due to the presence of a flooring of crystalline rock over the greater portion of the area. However, there are exceptions in the north-western coast and in the Jaffna Peninsula, where the nature of the underground limestone rock permits the accumulation of water. This means that in the absence of sufficient surface or underground water supplies, rice production in the dry zone calls for the provision of water.

Production and Irrigation Methods and Labour Requirements

Rice production is carried out under :—

(*a*) Human power only,
(*b*) Animal power and human power,
(*c*) Tractor power and human power,
(*d*) Tractor power, animal power and human power,
(*e*) Tractor power only (to a very small extent).

In the wet zone, the crop is grown under rainfed conditions solely, or under rainfed and irrigated conditions. Channel irrigation is commonly practised, but in a few cases lift irrigation is also operative. In the dry zone, a highland rainfed crop is grown or the crop is channel irrigated with water from local storage tanks or from major tanks linked with rivers.

Lift irrigation is not very common at present. Water lifting devices used are the single mhote, double mhote, Persian wheel, well sweep, wind mill, wooden water scoop, wooden water wheel, palmyrah leaf bucket and imported engine-driven water pumps. The source of water, where the single mhote, double mhote, Persian wheel, well sweep and wind mill are used is very often a well. For engine-driven pumps, a perennial stream often provides the source of water.

A single mhote or a double mhote is worked by a pair of bulls and two men. Either device can lift up to about 1,400 gallons per hour and irrigate about an acre in six to eight hours. A Persian wheel can also be operated by two men with a pair of bulls and lift about 2,000 gallons per hour. It can irrigate over one acre in eight hours. A well sweep can normally lift about 1,300 gallons of water per hour and irrigate about one acre in eight hours. Five men are required to operate it—one man to irrigate, one to empty the bucket of water into the channel and three to walk up and down the well sweep. The wind mill, as its name suggests, is wind-operated. The amount of water lifted varies according to the velocity of the wind and the diameter of the assembly of the rotating blades. The output would be about 360 gallons per hour during periods of weak winds. The water scoop, water wheel and the palmyrah leaf bucket are used to lift water from waterlogged rice fields prior to sowing of seed in low lying areas where the level of the field is lower than that of the drainage channel. A water scoop can bale out 600 to 800 gallons per hour and about 64 man-hours are required to lift water from an acre. A water wheel can lift about 3,000 gallons of water per hour and at an average about 9 man-hours are used to lift water from one acre. A palmyrah leaf bucket can lift about 600 gallons per hour with two men operating it. Where engine-driven water pumps are used, the volume of water lifted per hour varies from about 40,000 gallons to 100,000 gallons depending on the power and size of the unit used.

When rice production is totally done by man power, it takes about 490 man hours inclusive of irrigation, watching and weeding to cultivate an acre. When animal power and human power are used for cultivation, about 160 animal-hours and 340 man-hours are used per acre. Using men, machines and animals, about 6 machine-hours, 80 animal-hours and 340 man-hours are required for an acre crop, if no mudding is done with animals after tractor

ploughing. Using man and machines only about 310 man-hours and 14 machine-hours are necessary. However, when hand-weeding is done and threshing and winnowing operations are mechanized, it may take as much as 452 man-hours and 20 machine-hours. Irrigation, hand-weeding and hand-harvesting, and transporting to threshing floor make up about 320 man-hours.

Timeliness of Operations

The timeliness of operations varies in the different locations where rice is grown. It is absolutely necessary to keep to time in growing the crop as delay affects yields adversely and at times results in complete failure of the crop. If it is too early, generally, the harvest encounters the rains and is damaged considerably. Very often, where operations are delayed and the crop is late in the season, uneven flowering and occurrence of pests and diseases may cause such heavy damage to the crop as not to warrant its harvest. In certain areas as water is issued for irrigation according to rules laid down by the Irrigation Department, the period of issue being decided on by the cultivators at a meeting with Government officials, any delay in carrying out the operations would be detrimental to the successful growth of the crop, as water is not issued off season. Such delay in the dry zone may, in the absence of rains, result in complete failure of the crop if it is two weeks or more late in the season.

In the different locations where rice is grown, the seasons are adjusted according to the incidence of the rainfall of the area or the availability of irrigation water, and the drought period which normally coincides with harvesting time. If operations are late, the requirement of labour per acre will also increase owing to the labour required to control pests and diseases.

If tractors are used for primary tillage, delay in cultivation may make conditions in the fields too wet for the use of tractors, and if cattle or labour are not available, it may become necessary to abandon cultivation during that particular season. In some areas, for instance in the Western and Southern Provinces, where rainfed crops are grown, heavy rains which cause floods and drought periods have to be avoided for primary tillage operations.

Progress and Problems of Mechanization

Although the first tractors used in Ceylon were as far back as 1920, it was only (sometime in 1942) during the second world war that motorised power was used for the first time for primary tillage in rice cultivation. The Agricultural Engineering Division of the Department of Agriculture demonstrated the economics of the use of tractors under proper management for primary tillage operations in rice cultivation by establishing six experimental tractor units at appropriate locations in the country. Following on the success of these economic trials, the demand for tractor cultivation increased rapidly especially in areas where there was a dearth of cattle and labour. The Government encouraged the use of tractors by giving loans to Co-operative Societies to purchase tractors and by establishing tractor units at various locations where a shortage of cattle and labour existed. The areas where mechanization is mostly carried out fall within a belt ranging from a section of

the Southern Province, the Eastern, Northern and North-Central Provinces, and a portion of the Central and North-Western Provinces. There are about 1,000 agricultural tractors in use in the country today. This figure includes the gift of nearly 200 tractors given by the Australian Government under the auspices of the Colombo Plan.

The tractor units run by the Government and C. A. P. & S. Societies undertake work for private parties at more or less standardized rates. In some cases, tractor units have been run at a loss due mainly to heavy repair bills, lack of adequate supervision and the poor quality of the operators used to man the machines. Heavy repair bills have been in some cases due to the damage caused to machinery used on areas newly developed by using human power. The presence of stumps and roots in such areas have caused considerable damage to machinery. This lays stress on the necessity to use machinery for efficient land development work if tillage operations are to be mechanized thereafter. The use of tractors with trailed implements in the small rice fields is cumbersome and not common in the country. Tractors with mounted implements where the tractor and the implement work as one integrated unit are quite popular now. The agricultural tractors used in Ceylon are of various makes and types and at the moment it is not possible to say which particular make or type is the most suitable for a particular locality or job. The common implements used for primary tillage are the mouldboard plough, disc plough, tine tiller, disc tiller and the tandem disc harrow. Seeding operations have not been mechanized so far except on some State Farms where seed drills are being tried out on an experimental scale. A few private farms and some State Farms use threshing and winnowing machinery, while harvesting, threshing and winnowing machinery like combines are still being tried out on an experimental scale. Due to the small size of checks in the rice fields of Ceylon, some imported machinery had to be adapted to suit local conditions. A study of seed drilling, intercultivating following seed drilling, and the introduction of suitable harvesting, threshing and winnowing machinery appears to be necessary for the successful mechanization of rice. The breeding of rice varieties resistant to lodging and which do not shatter easily is also necessary for the successful use of combines in Ceylon.

Primary Tillage Operations

Where human power only is used, the tools used for primary tillage are the mamoty and the hand leveller. Mamoties vary in size and shape, especially in the up country districts. Their shape may be rectangular, oval-crescent or conical. The common sizes are 10 in. × 8 in. for the imported variety and 10 in. × 10 in., 14 in. × 6½ in., 12 in. × 7½ in., 18 in. × 6 in. for locally made varieties. The locally made mamoties are solely used for rice cultivation under wet and soft conditions in the fields. The number of man-hours used per acre vary from 30 to 120 depending on the size of the mamoty, the skill of the labour, and the type of soil on which it is being worked. The hand leveller used for levelling is made of wood locally. It takes 5 to 16 man-hours per acre for final levelling. With animal power, mudding the fields by using buffaloes is done in some areas. Where this is not practised, a country

wooden plough which does not turn over the soil, or a light iron mouldboard plough or an imported mouldboard plough drawn by two head of cattle, is used. The imported ploughs are used only when suitable draught animals are available, as these ploughs are normally too heavy for the local breeds of cattle. The accomplishment of animal-drawn ploughs varies from 12 to 32 hours per acre. Very often these ploughs are used under wet and muddy conditions which only permit the use of animal-drawn implements. In a very few cases elephants are used to work either a tine tiller or a disc harrow for primary tillage.

After ploughing, a wooden tooth harrow, known as a Burmese harrow, is used for breaking the clods. In some areas a spike harrow, with iron tines 6 in. to 8 in. long and spaced 4 in. apart fixed on to a wooden plank, is used after ploughing. The accomplishment of each of these harrows is about 8 man-hours per acre. For levelling a board of width varying from 4½ ft. to 6½ ft. is used. About 4 man-hours are required for an acre after using the harrow. Normally two animals are used during each of the operations of ploughing, harrowing and levelling.

Where tractors are used for primary tillage operations, the tine tiller is the most popular. The mouldboard plough was tried out originally but due to the considerable wear on the shares its use is not so popular as the disc plough. In some cases the disc tiller is also used, and is more popular than the disc plough due to its greater output per hour and cheaper cost of working per acre. Rotovators and tandem disc harrows have also been used with some success. Mounted implements have become more popular than the trailed types as the small checks of the rice fields make the latter very cumbersome.

Seeding and Transplanting

Hand broadcasting of seed is very common in Ceylon. About 2-5 bushels of seed are required per acre. The labour required is about 3 man-hours per acre. The yields are generally low compared to transplanting which takes about ¾ bushels of seed per acre. Transplanted fields are less liable to lodge than broadcast fields and give more yields. The conventional method of transplanting is at a spacing of 4 in. to 8 in., but in the recently-introduced Japanese method the spacing is 10 in. to 12 in. between rows and 6 in. to 12 in. within the row. In the conventional method the rows are uneven and the use of hand tools for controlling weeds is not possible unlike in the Japanese method where rotary hand weeders are used effectively for controlling weeds between rows of plants. The labour requirements vary, depending on factors such as the type of soil and the efficiency of the labour used. On sandy soils more labour is required than on clay soils. The labour required varies from 64-160 man-hours per acre. In the wet zone labour is not so scarce for transplanting and it is a more common practice than in the dry zone. Either hired labour is used or co-operative planting is practised, but the increased cost of cultivation is greatly offset by the higher yields obtained, especially with the Japanese method where effective control of weeds is possible. When the Japanese method of transplanting is used the labour required has been high for transplanting and subsequent operations but the yields have been very good. In some

cases over 100 per cent. increase in yields have been recorded. Transplanting economises in labour due to the obviation of the necessity to level the fields carefully which is very necessary when broadcasting is adopted. However, transplanting is difficult in areas where the soils are sandy and where labour is scarce.

When tractor-drawn seed drills are used, drilling seed in rows 12 in. apart has been found to be the optimum spacing. However the popular method is to broadcast the seed by hand and to cover them with a light disc harrow or tine tiller.

Cultivation including Pest and Weed Control

When the Japanese method of transplanting is practised, imported Japanese rotary weeders are used for the effective control of weeds between the rows of plants. In broadcast fields hand weeding is done where labour is available, or a Burmese wooden harrow is used for harrowing the standing crop to control weeds. Tractor-drawn intercultivating equipment are not in use at the moment in rice cultivation.

When hand weeding is done, about 140 man-hours or more per acre are required. When the Burmese harrow is used 16 animal-hours and 8 man-hours are required per acre. A Japanese rotary weeder requires about 48 man-hours per acre. A rotary tractor-drawn weeder has been tried out with some success at the Research Station, Maha-Illuppallama. Pests are controlled by the use of chemical sprays or dusts. Very often a 2-gallon capacity Knapsack sprayer which does an acre in one man-hour or a 5 gallon capacity rotary hand duster which also requires one man-hour per acre, is used.

Harvesting, Threshing, Winnowing and Transporting

The usual method of harvesting is by the hand sickle. The labour requirements vary from about 80 to about 120 man-hours per acre.

Combines for harvesting, threshing and winnowing rice have been tried out on a small scale, but many difficulties were experienced in their use. The smallness of the size of checks of rice fields, the unfavourable conditions in the field at the time of harvesting in most areas, the unfavourable stand of the crop when plants lodge, and the easy shattering of seeds of most rice varieties are the main obstacles hindering the use of combines in Ceylon. However, the stationary threshing and winnowing of rice with combines in the absence of separate threshing and winnowing machinery has been tried out with some success. A few threshing and winnowing machines are being used with success in certain parts of the country. Threshing by running the tractor on sheaves of paddy is fairly common in areas where cattle are scarce.

When buffaloes are used for threshing, about 60 animal-hours and 24 man-hours are required for an acre crop. When threshing is done by foot, about 80 man-hours are required for an acre crop. When tractors are used about 1½ machine-hours and 32 man-hours are required for an acre crop. When combines or threshing machinery are used for stationary threshing and winnowing, about an acre crop or a little less could be threshed and winnowed in 5 man-hours and 1 machine-hour. The use of sticks for threshing is not quite common in Ceylon. It is practised rarely in the Eastern Province in Ceylon where a

farmer or a member of his family adopts this method to get a small quantity of rice for his consumption requirement by threshing a few sheaves from his stack or shocks of rice harvested and kept near his home. A hand winnower made locally out of cane is commonly used for winnowing rice by the use of atmospheric wind. In some cases especially on State Farms, winnowing machines worked by hand are used. A hand winnower does about 40 bushels in 8 man-hours if wind is used. A winnowing machine of the Chindwin type worked by hand normally does about 40 bushels in 6 man-hours.

In certain parts, a device made locally with a fan and parts of a bicycle and worked by hand is used successfully for winnowing rice. This is popular in the Ratnapura district. It takes about 10 man-hours for winnowing 40 bushels with this device. Transport of rice from the field or threshing floor to the store is done by bullock cart, tractor-drawn trailer, lorry and men. The bullock cart is the most common form of transport at present.

Conclusion

Ceylon is said to have the lowest percentage of cultivated land in food crops in the whole of Asia. 70 per cent. of Ceylon's cultivated acreage is under non-food crops. There is a population of over 8 million in Ceylon, and this increases at the rate of 200,000 per annum, i.e., more than double the world's average. The total consumption of rice in Ceylon is about 925,000 tons per annum. At present about 439,000 tons of rice at a cost of nearly 325 million rupees are imported every year. While concentrating on improved methods of production to step up the yields, it would appear essential to bring new irrigable land under rice to compensate for the low yields obtained at present and to keep pace with the increase in population. The man-power is available in Ceylon, but the land is limited in extent and there is a shortage of cattle for cultivation work in new land development schemes. For quick results in the matter of self-sufficiency in rice, jungle land in the dry zone suitable for rice cultivation needs to be opened up by machinery and cultivation operations mechanized thereafter as far as possible. In such schemes, "postage stamp" holdings, like those existing in most parts of the country, should be avoided so that machinery could be utilized efficiently and economically. As most of the farmers in Ceylon are too poor to purchase machinery, either the State or Co-operative Societies will have to own the machinery and undertake work on a custom basis as is done in certain parts of the country at present.