AGRICULTURE AND FOOD SUPPLY WITH SPECIAL REFERENCE TO WEST BENGAL

By Dr. J. N. MUKHERJEE

Members of the Agricultural Society, Ladies and Gentlemen,

Before I take up the subject of my address at this annual meeting of our Society, I must express my grateful appreciation of the kindness shown to me by the Members of the Society in electing me its President for a second year. I feel guilty that I did not write out the address I gave last year but I shall make amends this year for this lapse on my part.

Today we are very fortunate indeed to have in our midst as a Guest of Honour Sri Prafulla Chandra Sen, the Chief Minister of West Bengal, who also holds the portfolio of Food, Supplies and Agriculture. I may be permitted to say that I have known him for many years and to begin with as an earnest worker in rural areas inspired by the highest ideals of partiotism and selflessness. These qualities coupled with his mature experience and judgment as a political worker and leader, and his basic attachment to the grass roots of our civilisation, give us the assurance that West Bengal will forge ahead in all spheres of national activity under his guidance.

From a press report it appears that he has laid great emphasis on efficiency and team work in any approach to solve the problems confronting West Bengal. There cannot be a surer basis for united effort and the creation of a stable machinery for ensuring sound and expeditious progress of this State. Ladies and gentlemen, I would request you to join me in wishing him godspeed in his endeavour to accelerate the forward march of West Bengal, in continuation of the great achievements of Dr. B. C. Roy who laid down his life working to the very last moment.

Agriculture and Food Supply with special Reference to West Bengal

The present position regarding the availability of food grains is comparatively speaking much easier than two years ago. The progress made during the First and Second Plans in increasing Food Production has considerably contributed to this. We are however still very much dependent on a continuation of the liberal supply of food grains that we have been receiving from the United States and the imports from countries like Burma. Agriculture and food production

has been given prominence side by side with industry in the Third Plan. The target of production in 1965-66 has been set at 100 million tons annually to meet the requirement of an estimated population of 490 milions. The Agriculture Production Team sponsored by the Ford Foundation in its report on India's food crisis and steps to meet it published in April, 1959, gave on page 12 their "estimated requirements for cereals and pulses in 1965-66 for a population of 480 million persons on the basis of daily net consumption of 15 ozs. of cereals and 3 ozs. of pulses or a total of 18 ozs.", as follows :

"Consumption requirements for cereals and pulses ...	88.0	million tons
Seed, feed and wastage (12½% of total production)	12.6	million tons
Stock requirements and safety margin	9.4	million tons
Total needs ...	110.0	million tons

It is stated in the report that "in order to produce 110 million tons of food grains annually by the end of the Third Plan, the rate of production increase must average 8.2 per cent per year for the next 7 years. This rate of increase compares with an annual average of 2.3 per cent from 1949-50 to 1958-59, and an average of 3.2 per cent from 1952-53 to 1958-59. The task is overwhelming. The urgency of an all-out effort is obvious".

Nutritional Requirements

The nutritional requirements of the people provides the main basis for the determination of the target of production. This aspect deserves attention from specialists and also from the public, because of its fundamental importance for the well-being of the community.

The Nutrition Advisory Committee of the Indian Council of Medical Research recommended, in 1944, for an adult a daily allowance of 14 ozs. of cereals ; 3 ozs. of pulses ; 2 ozs. of ghee and oils ; 10 ozs. of milk and its products ; 4 ozs. of meat, fish and eggs ; 3 ozs. of fruits and nuts ; 2 ozs. of sugar and jaggery and 10 ozs. of vegetables ; that is 14 ozs. of cereals and 34 ozs. of non-cereal foods. Surveys revealed the intake of food-stuffs to have been as follows:

There seems to have been some deterioration in the intake of non-cereal foods in 1955-58 as compared to 1935-48.

1935-48 (*a*) cereals, 16.62 ozs. ; (*b*) pulses, 2.26 ozs. ; and (*c*) other non-cereal foods 11.37 ozs. ; and in 1955-58 (*a*) 16.59, (*b*) 2.39 and (*c*) 8.63 ozs. respectively.

The caloric allowances recommended by the Nutrition Advisory Committee in 1944 as also the revised recommendations made in 1958 are shown in

Appendix 1. Diet serveys conducted under the auspices of the Indian Council of Medical Research have revealed that there is a wide variation even in the same State of the caloric value of the food consumed. From the figures available, it varied in West Bengal from 2457 to 2827; in Rajasthan from 2337 to 3645; in U.P. from 2963 to 4125; in Bihar from 1892 to 3087 and in Madras from 1584 to 2640. It is apparent that the intake depends to a large extent on the capacity of a person to purchase food-stuff. These surveys show however that the consumption of cereals by an adult in addition to such quantities of non-cereals he consumes, goes upto 37 ozs. and pulses upto 10 ozs. a day and it is obvious that one cannot expect that persons accustomed to a high level of intake of food grains will take less unless poverty forces them to do so. The revised recommendations which are on a modest scale, made by the Nutrition Advisory Committee in 1958 could however be taken as a working basis for calculation of the daily requirements of cereals and pulses of an adult. Assuming that the proportion of adults engaged in sedentary, moderate and heavy work is 1: 1: 1 and that women form 50% of the total in each group, one arrives at a figure of 2750 as the overall average caloric requirement of an adult which cannot be called extravagant. These calories* could be obtained from 28 ozs. of cereals and pulses excluding fat and other non-cereals; the consumption of fat is very low for by far a great majority of the population.

In order to calculate the overall average requirements for the whole population, it is necessary to decide upon the value of the unit of population (or *adult unit*). A publication of the I.C.M.R. has put it at 0.83. Some European authorities take it to be 0.8. Unemployment and diseases are still widespread. The "virtual" adult unit must therefore be lower than what it would be otherwise. In fact these two factors have so far materially helped the country to cope with the situation caused by the availability of the food supply having been chronically much less than the actual nutritional requirements of the population. An eminent political leader who is also an economist expressed the opinion sometime ago that there is luxury consumption in India because of an expanding economy. This may be true of a very small section but the general picture for an over-whelming majority of the population is undoubtedly that of undernutrition, as also of malnutrition caused by a serious deficiency of proteins, fats, fruits and milk and whatever quantities of cereals are available have to make up for protein and some other requirements. *The figure of 0.8 will be taken instead of 0.83 although it means that the estimates of requirements will be about 4% less.*

* Actually the unit of heat used here is the kilocalorie used in thermochemistry. The caloric value of pulses, rice and wheatflour (dry ata) is about 3.5 kilocalories per gram and in some cases even less. Rice, ata and 'dal' contain moisture which may be put roughly at about 10%.

In his address as President of the Section of Agriculture of the 1960 session of the British Association for the Advancement of Science, Dr. N. C. Wright, Deputy Director General, F.A.O., mentioned that during the last war persons in U.K., whose caloric intake fell below 2700, lost weight and he therefore considered a daily intake of 2800 calories as the minimum for maintenance of health. Some occupations require a very high intake of calories *e.g.*, a wood-cutter in Europe requires 5400 calories a day. Labour engaged in agricultural operations such as irrigation by "dunies", ploughing, harvesting, thrashing, trans-plantation require high intake of calories. So also do mill-workers and mine-workers. Together they form a substantial proportion of the population. With the progress of the plans more and more men are being employed in operations requiring heavy mannual labour ; also heavy machinery is also being increasingly installed.

In my home village and its surroundings in the Burdwan district an adult engaged in agricultural work consumes one seer (32 ozs.) of clean rice a day, in the form of one meal of 'muri', parched rice ; and two meals of boiled rice. This is the standard figure of consumption of rice by agricultural labour in most parts of West Bengal. Consumption of pulses is however quite low about 2 ozs. on an average and of fat still lower. Quite a number of them get some supple-ments of animal protein and seasonally some milk but these do not materially bring average consumption of protein to any satisfactory level. It was gathered from a former Director of Agricultural of Cambodia, a Frenchman well-known amongst agricultural scientists of India, that the standard figure of consumption of clean rice by an agricultural worker of that country was 2½ lbs.

For heavy workers 32 ozs. of cereals and 3 ozs. of pulses giving about 3200 calories could be taken as a valid figure of consumption ; 20 ozs. of cereals and 3 ozs. of pulses giving about 2100 calories for moderate workers and 14 ozs. of cereals and 3 ozs. of pulses giving about 1550 calories for sedentary persons ; all under present conditions. Assuming that each group represents one-third of the total population and that women form 50% of each group and require on an average 10% less calories than men, we get 20.7 ozs. of cereals and 3 ozs. of pulses, as the overall daily requirement of an adult. Taking 0.8 as the value of the adult unit the daily requirements of cereals comes out to be a little over 16.5 ozs. per capita for the whole population. The requirement of pulses will have to be maintained at 3 ozs. The overall daily net consumption of 15 ozs. of cereals and 3 ozs. of pulses assumed by the Team is by no means high, rather it is on the low side even under the present conditions of unemployment and diseases.

The figure of 110 million tons has been calculated by the Team for a population of 480 million in 1955-56. It now appears that the population will

be 490 millions. The target should consequently be raised to 112 millions. 100 million tons fixed as the target of production by the Planning Commission definitely cuts into the provision for "Stock Requirement and Safety Margin". The Government however have planned to import 16 million tons of wheat and one million tons of rice but so far only 850000 tons of wheat and 400000 tons of rice have been imported. Steps have been taken to accelerate the import of the balance. This is as it should be as it is obvious that we are still very much dependent on imports from abroad.

To provide a safety margin against an unusual succession of unfavourable seasons two measures could be adopted, namely, storage of grain in quantities which are based on valid estimates and the other is to increase the planned target over the desired production by a margin based on the lower production in unfavourable seasons. In a five year period the higher production of food in favourable seasons may or may not match the deficit due to unfavourable seasons.

There are some important aspects which should be taken into consideration in fixing targets of production, and for estimating the resources required for the additional production and maintaining the previous level of production which is taken as the base line in a plan period. It will take us too far out of our present purposes to discuss these in detail. It will however be useful to discuss briefly the figures of production from 1949-50 to the 1961-62 and the target for 1962-63 in relation to the target for 1965-66. Table 2 taken from page 14 of the Report of the Team gives the figures upto 1957-58. The figures for 1958-59 and the subsequent two years, have been taken from the "Report in Area and Production of the Principal Crops of India". ("Prewar average to 1960-61" (Sept. 1961) through the courtesy of Sri S. Mukherjee, Statistical Officer, Department of Agriculture, West Bengal).

Table 2

(Adjusted on the basis of 1956-57 final estimates)

(million tons)

Year	Rice	Wheat	Other cereals	Total cereals	Total pulses	Total Food grains
1949-50	23.8	6·6	18.0	48 4	9.5	57.9
1950-51	21.0	6·6	16.1	43 7	8.7	52.4
1951-52	21.5	6 2	16.6	44 3	8 6	52 9
1952-53	23.1	7.4	19.0	49.5	9.3	58.8
195 -54	28 3	7 9	22 1	58 3	10.6	68 9
1954-55	25.1	8 8	22.2	56.1	11.0	67.1
1955-56	26.9	8.6	19 0	54.5	10.8	65.3
1956-57	28.1	9.1	20.1	57.3	11.4	68.7
1957-58	24.8	7.7	20.3	52.8	9.2	62.0
1958-59	30 4	9 81				75 5
	(81 4)	(31.1)				(279 9)
1959-60	31.0	10.1				74 7
	(82 -)	(32.5)				(281 6)
1960-61	33 7	10 6				7 .3)
	(83.3)	(31.8)				
1961-62						81 59**
196 -63						84 (target)

(The figures within brackets are those of area under these crops in million acres)

** From press reports.

The production in 1951-52, the first year of Plan I was almost the same as that for the preceding year, but lower by 5.5 million tons, *i.e.*, above 10% less than that for 1949-50. 1950-51 and 1951-52 seem to have been unfavourable seasons. The level of production of 1949-50 was reached in 1952-53. A sharp rise of ten million tons took place in 1953-54. A time-lag seems to be evident in mobilising the additional resources and in their utilisation. During the five years 1953-54 to 1957-58 the production remained for no obvious reason more or less static, excepting perhaps seasonal fluctuations and a sharp drop of about 7 million tons in 1957-58 compared to that of 1953-54. A sharp rise of 6.6 million tons is again observed in 1958-59 over that of 1953-54. The production showed a slight fall in 1959-60 but rose substantially in 1960-61 and still further in 1961-62 though by a smaller amount. Perhaps the time-lag in the mobilisation and utilisation of resources planned to be made available is on the way to its elimination.

During the period of the First Plan the average production was 62.6 million tons and it rose to 72 million tons during the Second Plan. A critical comparison of the increase in production with those estimated from the resources actually utilised, would form the basis for re-evaluation of the increase in production to be expected from each type of additional resource planned to be utilised in future as also from their combined use as it happens in practice. Such re-evaluation will obviously lead to a better approximation to the actual increase in production to be expected during the Third Plan and will also reveal whether a resource is not making its full contribution.

This process of re-evaluation has to be continuous in order that the accuracy of estimates of production is continually improved.

Estimates of actual Production of Food Grains

Sri Srimat Narayan, a Member of the Planning Commission, commented sometime ago on the very wide difference between the estimates of production of 75 million tons of food grains for 1960-61 made by the Central Statistical Organisation and 96 million tons by the National Sample Survey. Reference may be made to a difference of opinion between Prof. P. C. Mahalanobis and Dr. Sukhatme, the then Statistical Adviser, Indian Council of Agricultural Research, which became prominent many years ago, as to what should be the plot size for crop cutting experiments. The estimates of production per acre seem to depend on the plot size. There is also the human factor which interferes with the reliability of the record and observations, reference to which was made by Prof. P. C. Mahalanobis in one of his earlier investigations on jute. The impression the speaker gathered from conversation with eminent statisticians abroad is that house to house enumeration seems to be the only way out. Checks, counter-checks, verification and supervision are required at all stages as also a reliable organisation. It has been possible to carry out successfully the gigantic task of Census enumeration. There is therefore every reason to expect that a reliable organisation could also be built up for estimates of production based on house to house enumeration supplemented by sample surveys where necessary. Initial deficiencies will be eliminated in course of time. Panchayets and village level workers will be of great service.

An increase in production of food grains in thirteen years by about twenty four million tons, or about 41% over that of 1949-50 is no mean achievement specially considering that the organization for such colossal effort and for the mobilisation and utilisation of the resources required had to be created anew. However the production has to be increased further by more than 18

million tons to 100 million tons in the remaining four years of the Third Plan and one has to agree with the Agricultural Production Team that "the urgency of an all-out effort is obvious". The available resources for vital items fall short of those estimated to be necessary as it has been stated that only 70% of the estimated quantities of nitrogenous fertilizers would be available and the target of additional area to be brought under irrigation has to be reduced as Rs. 170 crores has been provided in the plan instead of Rs. 200 crores estimated to be required. The available resources have obviously to be utilised to the best advantage and as this is intimately linked with the broader subject of argicultural improvement, of which in fact it is a part and parcel, every effort has also to be made simultaneously to effect such improvement.

In the succeding paragraphs the position regarding the improvement of production and efficient use of two important resources namely fertilizers and irrigation will be discussed.

Possibilities of Improving Fertility and Productivity of Soils.

In the ultimate analysis the improvement of the fertility and productivity of soils must occupy the central theme of all our projects of improvement of agriculture, if for nothing else, because of the meagre area per capita available actually or potentially for crop production and an increasing population. Also the conservation of soil, water and vegetable (forest) resources and a continuous effort to minimise encroachment on potentially or actually productive soils should also be given the highest importance. These two items together with a scientific policy for the use of water for irrigation and some others form the major elements of a Scientific Policy of Agricultural Improvement.

It has been realised for a fairly long time that the productivity of soils is capable of great improvements. In 1820 the overall yield per acre of wheat in the U. K. was of the order of ten bushels, after the introduction of the Norfolk rotation it increased to about 15 bushels. It has since risen as a result of improvements in agricultural practices effected by science and technology to about 50 bushels. Such increases have taken place in most of the developed countries. Prof. V. Kovda, Director of Unesco Department of Natural Sciences and Professor of General Soil Science at Moscow University, in his address to the Seventh International Congress of the International Society of Soil Science held in 1960 in Madison, U.S.A. summarised some of the main conclusions from its deliberations as follows: "it was unanimously shown and proved that fertility and productivity of soil have no limitation and can be permanently increased in order to obtain more and more food and raw material for Industry". . . . "The pessimistic estimation of the perspective of mankind as inter-related to population,

standard of living and fertility of soils is wrong. The full utilization and realisation of recent discoveries in the field of pedology, chemistry, physics, biology and industry can increase very much the productivity of the soil. Difficulties are not in a limited fertility of soils, but in the problems of rationalization of agriculture and rationalization of the distribution of global food production". "The second very important general conclusion . . . is the concept of the peculiarity of local soil types and units as correlated with the specific nature of local means of tillage, use of fertilizers and any soil requirement aiming at keeping and increasing their fertility. There do not exist universal and standard prescriptions for keeping and increasing soil fertility. Each soil unit needs its own programme of action raising the level of its productivity and the efficiency of man's work" (Bulletin 17 of 1960 of the International Society of Soil Science, pp. 10-11).

An increase in the content of organic carbon, a satisfactory carbon to nitrogen ratio, a suitable crop rotation and maintenance of a desirable soil structure are also recognised to be very important elements in the improvement of soil fertility and productivity. All practices and treatments which are prejudical to such improvement and tend to exhaust the soil and its productivity must be eschewed. The object must thus be to build up a system of "permanent agriculture".

FERTILIZERS

Fertilizers if made available and applied in time could increase the yield per acre of the ensuing harvest. Delay and inadequacy of its supply means loss of production. The consumption of fertilizers in India has increased by leaps and bounds and in 1960 the following quantities of fertilizers expressed in tons were consumed: (Rice News'Teller, 1961, 9(3), p 2), N, 299, 500 ; P_2O_5, 64,800 ; K_2O, 51,650. It is estimated that by the end of Plan III their consumption will be as follows: N, one million ; P_2O_5, 500,000 and K_2O, 200,000. It is stated that "the F.A.O. calculates" "in order to produce 2000 kg of cereals per hectare the fertilizer dressing should be increased on an average to 60 kg per hectare and this would mean a total requirement of ten million tons for India".

The population of the U. S. A. as also the U. S. S. R. is rising fast and the position has been put aptly in an editorial of World Crops, "Who will stop them ?" It will not be a sane policy to count on the import from the U. S. A. for many years more. Besides any emergency which upsets transport or supply or both will land us in serious difficulties. Every endeavour must be made to produce in time adequate quantities of fertilizers and in particular of nitrogenous fertilizers.

It is incomperhensible that the import of fertilizers in large quantities did

not form a major item in the plan of agricultural production in the First Plan. It is encouraging however that effort is being made to import fertilizers in large quantities to supplement the indigenous production. Money spent on the import of food-grains is total loss to the country, except that it provides us with food. Money spent on the purchase of fertilizers gives employment to the people in the production, processing and marketing of grain. It also provides straw which is fodder for cattle and serves other purposes and what is of no less importance it adds organic matter to the soil through the stubble left after harvest and the compost formed by the straw in farm yard manure. Lastly it purchases food-grains at less than half the value which has to be paid for their direct purchase.

Nitrogen

Tropical soils, because of the high temperature characteristic of the climate, are poor in nitrogen and carbon and added organic matter becomes rapidly oxidized. Consequently their response to nitrogen is almost universal. A conference of agricultural scientists arranged by the Ministry of Food and Agriculture in 1948 estimated that two million tons of nitrogen which would be equivalent to ten million tons of ammonium sulphate if it was the only source, would be utilized if the whole area which could be put under one or other crop was properly fertilized. They recommended an immediate purchase of 400,000 tons of Ammonium Sulphate.

West Bengal is very favourably situated for building up chemical industries based on coal, water, air, salt, clay, and power. The production of ammonia, nitric acid and urea will create basic chemical industries, and if we do not lack in scientific and technological talent, and industrial efficiency based on hard labour and skill, there is every prospect of rapid industrial progress as also of export industries. They are also the basic chemicals of the nitrogenous fertilizer industry. At a conference with the late lamented Dr. B. C. Roy during the preparation of the Third Plan of West Bengal this suggestion was strongly and unanimously pressed by the scientists invited by him for consultation. It is interesting to know that the production of these chemicals have been decided upon at Trombay.

It is hoped that West Bengal with its own coalfields will take a broad view and with vision plan for manufacture of these basic chemicals and fully develop in time coal based chemical and other industries, in addition to those which have been established.

The different forms* of nitrogenous fertilizers such as AMMONIA, AMMONIUM SULPHATE, AMMONIUM NITRATE, AMMONIUM SULPHATE

* A new-comer which deserves to be watched is oxamide. It could be produced in West Bengal.

NITRATE, AMMONIUM CHLORIDE, UREA, CALCIUM CYANAMIDE, AMMONIUM PHOSPHATE all have their fields of use. The last two are compound fertilisers. CALCIUM CYANAMIDE is rich in lime and ammonium phosphate contains both nitrogen and phosphoric acid. These two are also alkaline and specially the former, whereas the others deplete the metallic elements from the soil complex. It is therefore the practice to use calcium carbonate in the form of limestone, dolomitic limestone and quick-lime in quantities which are known to neutralise their acidifying effect. Experiments in India have shown that nitrogen from ammonium sulphate is better utilized by paddy than that from urea and to a lesser extent better than ammonium sulphate nitrate.

Lime, Phosphate and Potash

Calcium is an essential plant nutrient but limestone and quick-lime or slaked lime are used very widely on acid soils. Liming also improves soil structure and make phosphate fertilizers, such as super-phosphate, and also molybdenum present in the soil more effective. Lime and phosphate are essential for the healthy growth of legumes used as pasture and for production of pulses. Liming is coming more into the picture only recently. Japan has been, following Daikuhara, liming paddy soils for a few decades. Studies on the lime requirements of acid soils and their response to phosphate alone or in combination with nitrogen, after liming with the required quantities, as judged by their effect on crop yields, should be done extensively in West Bengal. There is a difference of opinion as to the effect of phosphate on the yield of paddy in West Bengal. Experiments at Chinsura have shown the value of phosphates. Experiment conducted by Dr. A. W. Klemme and Dr. M. N. Basak have shown on the other hand that many soils do not respond to phosphatic fertilizers as judged by the yeild of paddy. On the other hand, farmers who get high yields of paddy in the irrigated area of the Burdwan District use two and a half maunds of bonemeal per acre.

It is not easy to make reliable forecasts of the quantities of phosphate and potash fertilizers which could be used profitably during the Third Plan. On general considerations a certain amount of phosphate and potash about 20 lbs. each per acre should be used along with nitrogenous fertilizers as the higher yields of crop of paddy will deplete these essential plant nutrients from the soil. It seems, however that the actual need for phosphate is not less than the target of production and procurement, but its rational use has yet to be developed. It is easier to make estimates of the quantities needed where response to phosphate fertilizer has already been shown by experiments. But such experiments are not many and sometimes have not been designed properly.

There is now a considerable body of knowledge regarding the use of fertilizers under Indian conditions and currently conducted experiments are adding to it and the Departments of Agriculture are making a good job of their advisory work under present circumstances. Also the facilities for such experiments have in recent years been considerably expanded but they are still far from being adequate. Comprehensive experiments carried out on a large scale and continually for about five to seven years should form the basis of advice to farmers. A Department of Agriculture conscious of its responsibilities for giving reliable advice must have adequate experimental data. At present many Departments of Agriculture in India are recommending one or two mixtures of fertilizers for a crop for the whole area of a State which is obviously not very satisfactory. A commercial firm in Europe which prepare fertilizer mixitures has found it necessary to make offers of about 20 mixtures of different compositions. The remarks of Prof. Kovda quoted earlier puts the position with clearness. Much more has to be done in the way of pot culture experiments, plant analyses and in particular field experiments and correlation between the contents of plant nutrients in the soil and their availability on the one hand and the response to fertilizers in field experiments on each major soil type on the other. Experiments done with one kind of soil are not applicable to those soils which are significantly dissimilar from it. Besides, as Dr. A. B. Stewart pointed out in his report to the I.C.A.R., the soils of Government farms having been treated with fertilizers for a long time are richer in plant nutrients and the results of experiments conducted on them are not applicable to soils even of the neighbourhood. Experiments with fertilizers have not inferquently been conducted in India without taking care to record the relevant soil data and to determine the soil type. The soil types of the farmers to whom it is intended to give advice are generally not determined. The soils of many Government farms have not been properly mapped. A proportion of the soils of the farm area of the Indian Agricultural Research Institute has been "made-up" by filling depressions and by removing top soils for levelling. Land is often acquired for an experimental farm without proper examination as to whether the soils are non-descript or not and suitable for experiments.

Irrigation

Extension of the facilities for irrigation has been a major policy of the Planning Commission. Irrigation with adequate use of manures and fertilizers has increased crop yields from about 10-15 maunds to about 35 maunds of paddy on fertile soils in the Burdwan district. There are still greater possibilities of increasing the yields, but it is not easy of accomplishment. At the same time with concerted effort the average yields can certainly be increased by improvements in methods of irrigation alone. Uncontrolled irrigation *i.e.*, being practised

in many parts of India and in particular in West Bengal has some serious disadvantages. It is often claimed that the fertilising silt which flood irrigation brings to the soil enriches it. On the other hand, it often leaves a heavy deposit of sand damaging the productivity, makes the field uneven, washes away large quantities of plant nutrients, leads to water logging especially when there are heavy showers and new channels several miles long are sometimes created washing away hundreds of acres of fertile soils. Although the importance of lining canals and providing adequate drainage in irrigation projects is now better realised it is not being done or at least remains to be done in many many projects. Flood irrigation also stands in the way of getting maximum possible yields of crops, in West Bengal paddy, and also makes it impossible to have another crop in place of paddy in rotation during the kharif season. It is known from experiments and practice in all paddy growing countries including Japan that suitable rotations increase the yield of paddy per acre. Controlled irrigation is the practice also in most of the advanced countries. Water has to be applied on the field in regulated quantities and at intervals to meet the needs of the crop according to its stages of growth under the prevailing conditions. Excess water from rainfall, if any, which would interfere with such regulation has to be drained out and the timing and dosage of irrigation adjusted. There is no reason why controlled irrigation cannot be introducted even during the period of the Third Plan in some selected areas.

The major and minor irrigation projects which are extensively being carried out have the object to utilize as much as possible of the available water supply from surface waters as also ground waters, the latter through tube-well irrigation. Inspite of this there is great scope for making available within the period of Plan III much more water for more effective irrigation. The source of surface water is excess rainfall resulting in run-off which is stored in reservoirs of various sizes ranging from extensive *beels* and waterways and tanks to small ponds. West Bengal and in fact former Bengal is studded with innumerable tanks and ponds of various sizes. Attempts have been made to improve them but the progress has not been very satisfactory. These tanks are sources of fish, water for cattle, and irrigation. The *pahars* or mounds surrounding them, sometimes their sizes are enormous, seem to have been designed from empirical experience to conserve water and minimize its loss from evaporation. They were the main source of irrigation all the year round although limited in scope as to the area they could command. Great efforts are being made in Australia and U. S. A. to prevent loss of water by evaporation from ponds in view of the importance of conserving water. It seems that the mounds are quite effective for this purpose. Besides they serve as pastures, orchards and woodlots for supplying timber, fuel and other things needed by the rural population. The increase in storage capacity by desiltation of tanks, excava-

tion of *beels*, desiltation and excavation of discarded river-beds and shallow channels will not only increase the storage capacity if carried out on an extensive scale but also provide water for irrigation and improve fish production. It seems that there is every reason to justify the establishment in all States, where mitigation of droughts and floods, prevention of water logging, irrigation, improvement of fish yields and provision for adequate drainage are crying needs, of a fully organised establishment for undertaking on a vast scale such work of reclamation, desiltation, excavation, and building up mounds or bunds with adequate equipment, machines and machinery. At present such work is perhaps being done in not a fully organised manner. Much of this work could be done independent of the foreign exchange problem. As it is labour intensive it will give employment to thousands and make an appreciable contribution to the national economy and improve the productivity of land and water.

A subject which could immediately increase the yield per acre and stabilize agriculture in the kharif season is "supplementary irrigation" in May or early in June and preferably in early April. The preparation of seed-beds as also the earlier tillage operations are dependent on rainfall, as water from canals except those fed by water from melting snow, are available much later after the storage reservoirs have got their quota of rainwater. In West Bengal water from canals is available at a time when transplantation should be made. Also if rainfall is not sufficient the preparation of seed-beds has to be delayed till rainfall has been sufficient or irrigation water is available. Two measures would be very helpful. If the soil is broken up by machine in May, the firist shower of rains will break the clods and permit the use of country ploughs. Thus tillage operations could be undertaken at the earliest possible moment. The other important measure is to provide "supplementary irrigation" to bridge the period at least from early June till the rain sets in or canal water is available. Tanks provided with bunds properly designed and having vegetation on them would be a source of the smaller quantities of water required for this purpose and serve a considerable area round them. So also would all other types of storage reservoirs provided they are deep enough and have been able to retain water against evaporation. A source of water for supplementary irrigation during this period is undoubtedly bore holes sunk in tanks and other storage reservoirs which could be utilised to fill them periodically by movable pumps and the water in both cases will be taken by farmers as usual from tanks and possibly from some others without any expenditure on channels for leading the water to the fields. In the case of larger water areas it will even be profitable to supply water by pumping. This proposal envisages that there will be sets of pumps which will be moved from place to place to renew the water of the reservoirs as required. Deep tube-wells of large diameters 30" could be sunk not only to meet the needs of municipalities but also provide supplementary irrigation where the underground source is adequate. The

system of reservoirs with bore holes and large diamater tube-wells could also be utilised for supplementary irrigation during the rabi season.

Attainable Yields of Paddy per Acre

Full benefits from irrigation is also not being obtained because of the uneven surface of the fields and lack of proper attention to the bunds surrounding them. Even poor farmers know the importance of both but they have not the resource to carry out the required measures. Those who are better-off and can provide sufficient labour themselves can attend to them better than others. But the only way to carry out these items of work satisfactorily is to use machines. If a project is undertaken to level the field properly, repair and erect the bunds as desirable and tillage operations, seed-bed preparation and transplantation are carried out in time, the transplantation being done by the first week of August or better earlier and the fields fertilised adequately, the average yield of paddy would be raised in the irrigated area to 40 maunds per acre within the period of the Third Plan. Of course we should also gradually improve the seeds that are available at present and adopt better cultural and manural practices and proper measures of crop protection and it should not be impossible to raise the average yield of paddy to 50 maunds per acre, as the productivity of soil increases. This should be possible for *indica* varieties and hybrids with *japonica* if evolved to suit our conditions would probably yield more. Laudable efforts are being continued for selection and hybridization including crosses with *japonica*. Perhaps attention could also be given to the introduction of commercial varieties on a wide scale from other countries for trials. In Australia Caloro I* and its improved version Caloro II have been grown successfully in areas of 10,000 acres of irrigated land. The average yield per acre has been 2 tons; and yields upto 5 tons obtained in some cases. This shows the possibilities of direct introduction.

Wild Rice

One fairly widespread cause of loss yield of paddy is that many fields are infested with seeds of wild shattering rice (*jhora*), which shatters seeds and is said to be the original cultivated rice in India. Where seed-beds are infested with its seeds they naturally produce a mixture of its seedlings with those of quality seedlings actually intended to be cultivated. It also contaminates the crop raised in the fields. It can be eradicated when they grow large enough as they look somewhat different and also as they ripen somewhat earlier than late *amɔn*. But because of the labour involved as also of its being edible very few farmers do so. Supplementary irrigation in May will enable the seedlings coming out from

* A cross evolved in California, U.S.A. between *Patnai* from W. Bengal and a *japonica*.

their seeds in the field to be destroyed by tillage operations. The uprooted plants should however not be left in the field. Other methods of eradication are to raise seedlings from wet seed-beds and transplant them later than usual for one year. By the time of this late transplantation, seedlings of wild rice will have grown large enough to be weeded out. A third method, difficult to put into practice but effective, is to raise paddy for one year from a variety which matures much earlier than wild rice so that it is harvested before producing any seeds.

Intensity of Cropping

The intensity of cropping must be increased through the introduction of suitable crop rotations or crop sequences which will improve and maintain soil productivity at the highest feasible levels. Land now under *aman* paddy could grow almost invariably some other crops after it has been harvested as is sometimes now done when water for irrigation is available. If early *aman* varieties some of which are heavy yielding and of good quality such as KI 36 of the W. B. Department of Agriculture are grown, gram could be grown extensively as it gives reasonable yields without irrigation. Also wheat and some other crops could be grown after early *aman* paddy if moderate quantities of water are available for supplementary irrigation. The sequence of paddy-wheat seems to have caught on in my home village and its neighbourhood. Further with controlled irrigation crops other than paddy could be grown in rotation with it during the kharif season. The higher yields of paddy which will follow controlled irrigation, adequate manuring and their efficient use and the improvement of productivity from suitable rotations will enable paddy to be grown in rotation in the kharif season and at the same time increasing the total production of paddy in the State. Cereals like wheat, oilseeds, pulses, potatoes, jute, sugarcane and many others could all be fitted in one or other rotation or crop sequence. There should also be provision for a green manure crop in the rotations or crop sequences.

The possibilities of retiring from paddy milllions of acres of land on which it is now being grown, as paddy yields per acre attain high levels and of using land thus retired for afforestation, pastures and other crops, have been mooted. Taken literally such proposals do not perhaps seem very sensible from the practical and certainly from the scientific point of view. What is certainly desirable and feasible is to retire from arable cultivation all lands which according to their land use capability are not suitable for such cultivation and use them for pasture, afforestation, orchards, plantations *e.g.*, of bamboo and wild life and fisheries according to their use capability. There are large acreages at present under arable cultivation which sould be retired without much delay and put to more profitable use by their owners. This possibility perhaps requires early attention.

West Bengal will ever remain poor as regards its agricultural economy so long as its intensity of cropping remains one of the lowest in India, because only one crop namely *aman* paddy is raised from 85% of its area under cultivation.

It is most important to develop as mentioned above crop rotations or crop sequences which will improve soil productivity, increase the intensity of cropping and maximize the production of food, fodder, fruits, vegetables and raw materials for industries.

Deficits in the Production of edible crops in West Bengal

For West Bengal agricultural improvement has to be effected on a wide front. Appendices II* and III* give the quantities and money values of agricultural produce imported in West Bengal in 1960-61. Leaving out agricultural crops and commodities which are wholly or even partly required for industries; such as jute, tobacco, mustard, oil-seeds, oil cakes, vegetable oil as also fruits, the value of cereals, pulses, sugar, spices and potatoes and other vegetables which were imported in 1960-61 amount to more than 80 crores of rupees. Development of suitable crop rotations or crop sequences, extension of the area under perennial, seasonal and/or supplementary irrigation, efficient use of adequate quantities of manures and fertilizers and of irrigation water, large scale adoption of plant protection measures, further evolution of better quality seeds and efficient cultural practices carried out at the appropriate times together with efficient measures of soil and water conservation and improvement of fisheries, tanks and other water areas, could change the agricultural economy of West Bengal from one of constant anxiety to one of faith in herself.

It should be possible to meet most of the present demands of these plant products satisfactorily as also demands likely to develop in the near furture, provided science and technology are properly utilised. It is a matter for our leaders in politics and administrators to lay down appropriate policies and provide necessary facilities so that science and technology can have full scope to make their contributions towards the development of agriculture.

* Obtained through the courtesy of the Directorate of Agriculture, West Bengal.

APPENDIX—I.

"Comparison of the 1944 NAC recommendations for caloric allowances with the revised scales.

Particulars	NAC recommendation 1944	Particulars	Revised Scales 1958
Man (55 kg)			
Sedentary work	2400		2400
Moderate work	3000		2800
Heavy work	3600		3900
Women (45 kg)			
Sedentary work	2100		2000
Moderate work	2500		2300
Heavy work	3000		3000
Pregnancy	2100	latter half of pregnancy	2300
Lactation	2700		2700
Children under 1 year	100/kg	Under 1 yr. 0-6 months	120/kg
		7-12 „	100/kg
1 to 3 years	900		1200
3 to 5 years	1200	4 to 6 years	1500
5 to 7 years	1400	7 to 9 years	1800
7 to 9 years	1700	10 to 12 years	2100
9 to 12 years	2000	13 to 15 girls	2100
		—do— boys	2500
Adolescents			
12 to 15 years	2400	16 to 19 boys	3150
		—do— girls	2100
15 to 21 years	2400		

The scales of protein allowances as recommended by the Nutrition Advisory Committee in 1944 and as revised in 1958 are given below:

Particulars	Recommended in 1944	Revised in 1958*
Man (55 kg)	82 g.	55 g.
Woman (45 kg)	67 g.	45 g.
„ Pregnancy	101 g.	100 g. (latter half of pregnancy)
„ Lactation	112 g.	110 g.
Children		
0— 1 year	3.5 g/kg	3.5 g/kg
2— 5 years	3.5 „	3.5 „
6— 7 years	3.0 „	3.0 „
8—15 years	2.5 „	2.5 „
16—20 years	2.0 „	2.0 „

* Recommendations in this column are subject to the proviso that dietary protein is derived from more than one foodstuff".

APPENDIX—II.

Import of Agricultural Crops and Commodities into West Bengal during 1960-61 (Trade Estimate)

Sl. No.	Crop or Commodities	Import by rail, road, river, sea and air (in mds.)	Estimated value in Rs.
	Fruits (Fresh)		
1.	Mango	8,00,000	1,20,00,000
2.	Orange	6,00,000	2,10,00,000
3.	Banana	7,000	1,12,000
4.	Grapes	2,000	1,50,000
5.	Mozambique	1,02,000	1,06,08,000
	Fruits (Dry)		
6.	Coconut (Dry)	10,00,000 (nos.)	2,00,000
7.	Pesta, Almond & Raisins	1,00,000	4,00,00,000
8.	Copra	43,000	23,00,000
	Vegetables		
9.	Potato (Table & Seed)	30,00,000	3,60,00,000
10.	Cabbage	60,000	10,20,000
	Spices		
11.	Chillies	7,20,000	6,48,00,000
12.	Turmeric	2,10,000	88,20,000
13.	Ginger	40,000	12,80,000
14.	Onion	7,60,000	60,80,000
15.	Garlic	40,000	8,00,000
16.	Pepper (Black)	45,000	1,12,50,000
17.	Cloves	2,600	19,50,000
18.	Cardamom (Big)	22,000	21,56,000
19.	Cardamom (Small)	4,000	32,00,000
20.	Betel leaves	18,800	15,04,000
21.	Betel nuts	1,50,000	2,50,00,000

APPENDIX—III.

Annual Import of important agricultural crops and commodities into West Bengal with value for the year 1960--61
(Figures collected from DGGIS's Office)

COMMODITIES	IMPORT (BY RAIL & RIVER ONLY) In Mds.	APPROXIMATE VALUE In Rs.
Cereals		
Wheat	24,90,172	3,48,62,420
Wheat Products	17,232	3,70,104
Rice in husk	57,86,832	7,52,28,616
Rice not in husk	94,23,343	22,61,53,032
Maize	72,207	10,10,901
Jowar	9,728	1,55,648
Bajra	4,824	77,184
Pulses		
Gram & Gram Products	20,47,300	3,07,09,500
Pulses other than Gram	44,65,080	8,93,01,600
Oilseeds		
Castor	1,96,430	45,17,890
Groundnut	6,41,743	1,79,68,804
Linseed	10,68,207	2,56,36,968
Rape and Mustard	60,17,623	20,45,99,182
Til & Jinjilli	1,16,681	46,67,240
Oil		
Castor	17,524	10,16,392
Coconut	7,25,000	4,20,00,000
Groundnut	8,49,112	6,28,34,288
*Mustard	23,57,060	18,85,64,800
Oilcake		
Castor	4,009	32,072
Others	13,67,531	1,64,10,372
Fibre		
Raw Jute (loose)	14,80,209	5,92,08,360
Jute (Pucca Bales)	66,59,280	26,63,71,200
Hemp	2,90,631	1,01,72,085
Cotton		
Raw Cotton (Lint Indian)	1,88,889	1,41,66,675
Sugar & Gur		
Sugar (other than Khandsari)	56,59,918	23,77,16,589
Gur & Jaggery	19,64,796	4,32,25,512
Molasses	9,26,903	1,39,03,545
Tobacco		
Tobacco (raw)	3,30,484	5,45,29,893
	55,178,748	1,725,410,872

(*Figures collected from Railway Head)